# CRASH 2022 SYLLABUS

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DISCLOSURE
of Relevant Financial Relationships to Learners

CRASH
Colorado Review of Anesthesia for Hospitals and Surgicenters
February 27 – March 3, 2022
Internet Live Course

All of the planners, faculty, and individuals in control of content for this educational activity have no relevant financial relationship(s) to disclose with ineligible companies.

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Relevant financial relationships are financial relationships of any amount occurring in the past 24 months with ineligible companies if the educational content an individual can control is related to the business lines or products of the ineligible company.
Sunday, February 27th
Decision-making in Airway Management: The Difficult Airway

Basem Abdelmalak, MD, FASA, SAMBA-F
Professor of Anesthesiology
Director, Anesthesia for Bronchoscopic Surgery
Director, Center for Procedural Sedation
Anesthesiology Institute, Cleveland Clinic
Past President, Society For Ambulatory Anesthesia
Past president, Society For Head and Neck Anesthesia

Conflict Of Interest Disclosure
- No active industry grants
- Co-editor, text books on “Anesthesia for Otolaryngology” and “Clinical Airway Management: an Illustrated Case Based Approach”
- Consultant and speaker:
  - Acacia Pharma
  - Medtronic Inc.

Disclaimer
- I present to you only my own understanding of and reflections on the 2022 ASA Practice Guidelines for the Management of The Difficult Airway,
- I do not speak on behalf of the task force, or the ASA or any of the societies that co-sponsored, or endorsed these practice guidelines

Objectives
At the end of this presentation, the participant will be able to discuss:
- Updates in the ASA DA Guidelines
- Decision making in airway management
- Awake intubation
- Management steps for the un-anticipated difficult airway
- Extubation of the difficult airway

Co-Chairs
J. Apfelbaum, MD
C. Hugberg, MD
R. Conrads, PhD
M. Agarwal, MPH

Methodologists

2022 American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway

Jeffrey L. Apfelbaum, M.D., Carla A. Hugberg, M.D., Michael J. Conner, Ph.D., Gmeinwieser, Matthias, Mathis, Agarwal, M.D., Richard E. Dehmer, M.D., John R. T. Fry, M.D., Robert J. ACS, F. Alan Slack, J. M.D., David T. Wilkes, M.D., Odel Akkutlu, M.D., Robert F. McLean, M.D., William H. Eisenstadt, M.D., Mark G. M. Meltzer, M.D., Avery Tang, M.D.
Anesthesiology 2022; 136:31–47
The Task Force Members

Collaborating Societies

- The American Society of Anesthesiologists (ASA)
- All India Difficult Airway Association (AIDAA)
- European Airway Management Society (EAMS)
- European Society of Anaesthesiology and Intensive Care (ESAIC)
- Italian Society of Anaesthesiology, Analgesia, Resuscitation and Intensive Care
- Learning, Teaching and Investigation Difficult Airway Group
- Society for Airway Management (SAMB)
- Society for Ambulatory Anesthesia (SAMBA)
- Society for Head and Neck Anesthesia (SHANA)
- Society for Pediatric Anesthesia (SPA)
- Society of Critical Care Anesthesiologists (SOCCA)
- The Trauma Anesthesiology Society

ASA DA Guidelines:

- May be adopted, modified, or rejected according to clinical needs and constraints, and are not intended to replace local institutional policies
- Are not intended as standards or absolute requirements
- Cannot guarantee any specific outcome
- Are subject to revision as warranted by the evolution of medical knowledge, technology, and practice
- Provide basic recommendations that are supported by a synthesis and analysis of the current literature, expert and practitioner opinion, open forum commentary, and clinical feasibility data


What’s New in the 2022 Guidelines

- International 15 members task force
- 12 national and international societies
- More inclusive of clinicians, and settings
- Decision tool
- Emphasis on the number of attempts
- Emphasis on the passage of time: earlier invasive airway


2022 Guidelines Focus

The management of the difficult airway encountered during:
- Procedures requiring general anesthesia, deep sedation, moderate sedation or regional anesthesia
- Elective airway management without a procedure
- Procedures include diagnostic, elective, and emergency procedures and invasive airway access
- Adult and pediatric patients
- Obstetric anesthesia

Application

- Everybody who perform anesthesia care and airway management
- Inpatients and outpatients
- NORA, ASCs, OBA,
- EDs, and ICUs

What is Not Covered in the 2022 Guidelines

- Airway management during CPR
- Physiologically Difficult Airway
- Patients at High Risk of aspiration without anatomically DA
- Airway management education, training and certification
- Not all manifestations of DA, and/or all possible approaches
- Pre-hospital airway management

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Table 1. Airway Management Items for Anaesthesiology Locations

<table>
<thead>
<tr>
<th>Item</th>
<th>Category</th>
<th>RecT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-inflating resuscitation bag</td>
<td>Alternative/Rescue ventilation equipment</td>
<td></td>
</tr>
<tr>
<td>Endotracheal airway control</td>
<td>Alternative airway control equipment</td>
<td></td>
</tr>
<tr>
<td>Tracheal tube styles</td>
<td>Basic airway management</td>
<td></td>
</tr>
<tr>
<td>Tracheal tube styles for difficult airways</td>
<td>Advanced airway management</td>
<td></td>
</tr>
<tr>
<td>Oral/nasal airway equipment</td>
<td>Other equipment</td>
<td></td>
</tr>
<tr>
<td>Nasal cannula</td>
<td>Emergency airway management</td>
<td></td>
</tr>
<tr>
<td>Oral airway</td>
<td>Other equipment</td>
<td></td>
</tr>
<tr>
<td>Laryngoscope</td>
<td>Tracheal tube styles</td>
<td></td>
</tr>
<tr>
<td>Standard LMA kit</td>
<td>Other equipment</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Portable Storage Unit Items for Difficult Airway Management

<table>
<thead>
<tr>
<th>Category</th>
<th>RecT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative/Rescue ventilation equipment</td>
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<td>Emergency airway management</td>
<td></td>
</tr>
<tr>
<td>Other equipment</td>
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</table>

Human Factors in DA Management

- Teamwork and communication
- Patient safety
- Leadership and management
- Environment of care
- Patient and family circumstances
- Medication and equipment management
- Equipment and supplies
- Emergency and disaster management
- Other factors

Over the Years
History of the ASA Difficult Airway Guidelines

1993 SGA
2003 Videolaryngoscopy
2013

Have we overcome the DA challenge?

2022 Adult DA Algorithm

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2022 Adult DA Algorithm

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Management of Difficult Tracheal Intubation

A Closed Claims Analysis

Aaron M. Jeffs, M.D., Michael F. Aziz, M.D.,
Karen L. Parker, M.D., Laura V. Bogdan, M.D., FRCA,
Steven L. Morris, M.D., Karen E. Stowe, M.D., M.P.H.

Anesthesiology 2019; 121:614-29

Conclusions: Outcomes remained poor in recent malpractice claims related to difficult tracheal intubation. Inadequate airway planning and judgment errors were contributors to patient harm. Our results emphasize the need to improve both practitioner skills and systems response when difficult or failed tracheal intubation is encountered.

Success of Intubation Rescue Techniques after Failed Direct Laryngoscopy in Adults

A Retrospective Comparative Analysis from the Multicenter Perioperative Outcomes Group


Anesthesiology 2016; 125:638-46

Table 1. Airway Rescue Techniques and Comparative Success Rates of the Common Rescue Strategies

<table>
<thead>
<tr>
<th>Technique</th>
<th>Failed intubation (n=1,012)</th>
<th>Successes, n (95% CI)</th>
<th>Failed n (95% CI)</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL</td>
<td>0.00 (95% CI)</td>
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<td>0.00 (95% CI)</td>
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<tr>
<td>Endotracheal intubation (n=170)</td>
<td>0.63 (95% CI)</td>
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<td>0.63 (95% CI)</td>
<td>0.001</td>
</tr>
<tr>
<td>Lighted stylet (n=128)</td>
<td>0.15 (95% CI)</td>
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<td>SGA</td>
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SQA = supraglottic airway.

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2022 Adult DA Algorithm

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Management of Difficult Tracheal Intubation

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SQA = supraglottic airway.
2022: Pre-operative Airway Assessment

- Before the initiation of anesthetic care or airway management,
- Ensure that an airway risk assessment is performed by the person(s) responsible for airway management
- When available in the patient’s medical records, evaluate demographic information, clinical conditions, diagnostic test findings, patient/family interviews, and questionnaire responses
- Assess multiple airway features to determine a patient’s potential for a difficult airway or aspiration


1993

- Assess the likelihood and clinical impact of basic management problems:
  1. Difficult intubation
  2. Difficult ventilation
  3. Difficulty with patient cooperation or consent

2003

- Assess the likelihood and clinical impact of basic management problems:
  1. Difficult intubation
  2. Difficult ventilation
  3. Difficulty with patient cooperation or consent

2013

- Assess the likelihood and clinical impact of basic management problems:
  1. Difficult intubation
  2. Difficult ventilation
  3. Difficulty with patient cooperation or consent
  4. Difficulty with equipment
  5. Difficulty with emergency airway access

2022 ASA Guidelines: Part 1

Does VL Ever Fail?

- Reports of being able to see the larynx, but cannot intubate
  1. Poor mandibular advancement
  2. Other predictors of failure
  3. Neck radiation
  4. Masses
  5. Surgical alterations (flaps)
  6. Intubator’s experience?

What This Article Tells Us That Is New

- In a closed claims analysis of 115 cases of pulmonary aspiration, death occurred in 57% of the claims and severe permanent injury in another 14%
- Sixty-one percent of the patients in the claims had either gastrointestinal obstruction or another intraabdominal process
- Anesthetic practice was judged to be substandard in 59% of the 115 claims

CONCLUSIONS: The current study provides evidence that the median force necessary to occlude the esophageal entrance to prevent regurgitation is less in women compared with men. Applying the appropriate cricoid force in women should also decrease airway-related problems that tend to occur with the use of excessive forces. The findings of the current study may only be applicable to patients with normal body habits. (Anesth Analg 2017;120:000-00)

The case against preoperative endoscopic airway examination (PEAE) in the “ENT airway”

Boram Rodzima, MD, FAPA

PEAE is questioned, and the aspiration rate as a complication of intubation is reported to be 0.04%.[7,9] Protective reflexes against aspiration include the glottic closure reflex[7,13], which is only diminished and not abolished by topicalization,13, and the cough reflex mediated by the rapidly adapting receptors (pulmonary irritant receptors) abundantly available in extra, and mainly, intrapulmonary airways including the trachea and the main bronchi.[7,19] In the author’s experience and that of other

2022 ASA Guidelines: Part 2

RELIABILITY OF GASTRIC SUCTIONING COMPARED WITH ULTRASOUND ASSESSMENT OF RESIDUAL GASTRIC VOLUME: A PROSPECTIVE MULTICENTER COHORT STUDY


Fourth ultrasound was performed 90 min after the third. Only 9% of patients had a qualitative assessed full stomach at first ultrasound examination vs. 32.8% after gastric suctioning (P < 0.001). The calculated gastric volumes significantly decreased after gastric suctioning, without a significant decrease in the number of patients with volumes > 250 mL. Four of the nine patients with calculated gastric volume > 250 mL had vomiting within the last 24 h (P < 0.016). The antral cross-sectional area significantly decreased between the third and the fourth ultrasound examination (P < 0.016). Enteral nutrition infusion did not make a significant difference to gastric volume (P = 0.12). Our results demonstrate that gastric suctioning is not a reliable tool for monitoring residual gastric volume. Gastric ultrasound is a feasible and promising tool for gastric volume monitoring in clinical practice.
Extubation of the Difficult Airway

US Closed Claims:
- Death and severe brain damage were more often associated with extubation or the recovery period

UK NAP4:
- 39% of the events followed head & neck surgery.
- Approximately 30% of these reports were associated with obstructive lesions within the airway
- Reports indicated evidence of poor anticipation and planning for management of extubation

Extubation is an Elective Procedure!

You decide on:
- Time
- Place
- Equipment
- Assistants
- Strategy/plan

Recommendation for Confirmation of Tracheal Intubation

- Confirm tracheal intubation using capnography or end-tidal carbon dioxide monitoring.
- When uncertain about the location of the tracheal tube, determine whether to either remove it and attempt ventilation or use additional techniques to confirm positioning of the tracheal tube

2022 ASA Guidelines: Part 3


Extubation of the Difficult Airway

- Have a pre-formulated strategy for extubation and subsequent airway management.
- Assess patient readiness for extubation.
- Ensure that a skilled individual is present to assist with extubation when feasible.
- Select an appropriate time and location for extubation when possible.

2022 American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway

Extubation of the Difficult Airway

- short-term use of an airway exchange catheter? and/or SGA? That can serve as a guide for expedited reintubation.
- Evaluate the risks and benefits of elective surgical tracheostomy.
- Evaluate the risks and benefits of awake extubation versus extubation before the return to consciousness.
- When feasible, use supplemental oxygen throughout the extubation process.
- Assess the clinical factors that may produce an adverse impact on ventilation after the patient has been extubated.

2022 American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway

Continuous Airway Access for the Difficult Extubation: The Efficacy of the Airway Exchange Catheter

- Prospective. 354 patients. Mostly ICU
- Mean 4 hours. Range 5 min-72 hs
- 47/51 successful re-intubation, 21 within 2 hours
- 3 inadvertently removed during re-intubation, and 1 failure to pass the tube
- 11 and 14 F 7% discomfort, 19 F 50% discomfort

What Could Go Wrong With AECs?

- Tracheo laryngeal trauma
- Kincking/esophageal migration on re-intubation
- Aspiration
- Accidental extubation of the exchange catheter
- Barotrauma with jetting through the AEC
- Stomach rupture

Follow Up Post A DA Encounter

- Use post-extubation steroids and racemic epinephrine when appropriate.
- Inform the patient (or responsible person) of the airway difficulty
- Document the presence and nature of the airway difficulty in the medical record to guide and facilitate the delivery of future care.
- Instruct the patient to register with an emergency notification service when appropriate and feasible.
Summary

- Pre-op airway evaluation and decision making are a must
- Awake intubation is a patient safety issue
- Preparation is a key to success
- Consider situational and human factors when feasible
- Be aware of time, and number of attempts, awakening the patient. Is an option so as emergency invasive airway.
- Get acquainted with the DA algorithm now, during the emergency is not the right time to look at for the first time

Society for Head and Neck Anesthesia
WWW.SHANAHQ.COM

Thank you for your attention
Basem Abdelmalak, MD, FASA, SAMBA-F
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Cleveland Clinic
Every life deserves world class care.

Thank you for your attention
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@basemcc
COVID-19
What Have We Learned?

Jason C. Brainard, MD, FCCM
Section Chief, Critical Care Medicine
Department of Anesthesiology
University of Colorado School of Medicine

Goals and Objectives

- Discuss successes and failures associated with COVID-19 response
- Discuss applications of COVID-19 learned lessons to Anesthesiology

Disclosures

- None
- But, Open to Offers 😊

Dr. Wes Ely
Intensivist
Vanderbilt University

“As I was standing at the foot of his bed, something hit me that I’d rarely been conscious of in 25 years as an ICU physician: raw fear. I could sense an uncomfortable degree of fear in my head, heart and the pit of my stomach. Fear from general dread of a new deadly disease with so many unknowns. Fear of repeated exposures for my colleagues, who could become sick and die. And fear that the virus, which was invisibly present throughout the room, would infect my lungs, blood and brain despite my best efforts. Fear can be healthy or unhealthy. This fear was unhealthy – like a barrier keeping me from the man I was trying to help.”

Fear

- Fear of not doing enough to keep our patients alive
- Fear of exposing our colleagues and ourselves to the virus
Notes From Emergency COVID-19 Conference with ICU Leadership from Italy and China
March 11, 2020

- Invasive Ventilation – “very good response to prone ventilation, delayed weaning is best due to recurrent hypoxemia, keep deeply sedated for first 7 days”
- Non-Invasive Ventilation – “NIV questionable, patients evolve and crash quickly, if SpO2 < 95% on FiO2 60%, intubate immediately”
- Hemodynamics – “myocardial dysfunction is common”
- Co-Infection – “co-infection with other viruses like influenza or RSV is < 2%, if you have a post-test for another virus, you don’t need to test for COVID, very few concurrent bacterial infections”
- Steroids and Antivirals – “remdesivir if available, possible other antiviral cocktails (lopinavir/ritonavir), ribavirin, and chloroquine, no corticosteroids”

University of Colorado COVID-19 ICU Guidelines

1. Oxygen Delivery
   a. Heated High Flow Nasal Cannula (HHFNC): Use cautiously
      i. Data suggests caution as patients deteriorate rapidly (hours), particularly in the setting of ARDS
      ii. HHFNC should only be applied in a negative pressure room and on an ICU service
   b. NIPPV (BiPAP/CPAP): Not recommended
      i. Risk of treatment failure is high. Not recommended for COVID related hypoxia or ARDS
      ii. For ARDS in particular, data (and experience) suggests role for early intubation
      iii. Exhalation port on BiPAP/CPAP mask may increase aerosolization
      iv. Consider only for patients with diagnosis responsive to NIPPV (COPD/CHF) or pre-existing need (OSA/OHS)

University of Colorado COVID-19 ICU Guidelines

1. Intubation
   a. Intubation is extremely high risk for aerosolization
      i. Perform early with ARDS
      ii. Most experienced provider should perform this procedure.
      iii. Minimize proceduralists and bedside providers as possible – consider 1 MD and 1 assistant in room with additional MD donned in PPE outside the room
      iv. Preferentially perform all intubations in a negative pressure room
      v. Utilize RSI and paralysis in all patients (minimize BVM, coughing, maximize success)
      vi. Utilize video laryngoscope for improved 1st pass success
   b. Consult Anesthesiology if concern for difficult airway or based on provider skill and experience

NIH COVID-19 Treatment Guidelines

COVID-19 Resources

Coronavirus Disease 2019 (COVID-19) Treatment Guidelines

VIEW GUIDELINES

https://covid19treatmentguidelines.nih.gov/
Fear Driving Deviation from Best Practice

- Early Intubation
- Avoidance of HHFNC and NIV
- Deep Sedation / Paralysis
- Experimental Therapies
- Return to 1990s Critical Care

Fear Driving Worse Clinical Outcomes

- Prolonged ICU and Hospital LOS
- Post-Intensive Care Syndrome (PICS)
  - Physical Disability
  - Cognitive Disability
  - Mental Health Disorders

Post-Intensive Care Syndrome (PICS)

<table>
<thead>
<tr>
<th>Physical</th>
<th>Cognitive</th>
<th>Mental Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle strength</td>
<td>Attention</td>
<td>Anxiety</td>
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<tr>
<td>Pulmonary function</td>
<td>Memory</td>
<td>Depression</td>
</tr>
<tr>
<td>Pain</td>
<td>Executive function</td>
<td>Post-Traumatic Stress Disorder (PTSD)</td>
</tr>
<tr>
<td>Exercise capacity</td>
<td>Visuospatial</td>
<td></td>
</tr>
<tr>
<td>Gait speed</td>
<td>Mental processing speed</td>
<td></td>
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</tbody>
</table>

Dr. Elisabeth Rivielo
Intensivist
Beth Israel

“...The risk of PICS is less dramatic, and further away, so we give in to immediate fears and keep patients sedated too long.”

COVID-19
What have we learned?

- No Silver Bullet for COVID-19
- No Silver Bullet in Critical Care

Get Back to Best Practice

- No Silver Bullet for COVID-19
- No Silver Bullet in Critical Care
Get Back to Best Practice

- ICU Liberation
- A2F Bundle
- PADIS Guidelines
- ARDSNet (2000): Low vs. Traditional TV in ARDS
- FACTT (2006): Fluid Management in ARDS
- PROSEVA (2013): Prone Ventilation in ARDS
- ROSE (2019): Neuromuscular Blockade in ARDS

Lessons Learned for Anesthesiology?

“Best Practice” Must Be Driven By Data

Lessons Learned - Hip Surgery

Spinal Anesthesia or General Anesthesia for Hip Surgery in Older Adults

- Mark D. Neuman, MD
- Rui Feng, PhD
- Jeffrey L. Carson, MD
- Lakisha J. Gaskins, MHS
- Derek Dillane, MD
- Daniel I. Sessler, MD
- Frederick Sieber, MD
- Jay Magaziner, PhD, M.S.Hyg.
- Edward R. Marcantonio, MD
- Samir Mehta, MD
- Diane Menio, MS
- Sabry Ayad, MD

*for the REGAIN Investigators
Lessons Learned - Hip Surgery

- Effect of Regional vs General Anesthesia on Incidence of Postoperative Delirium in Older Patients Undergoing Hip Fracture Surgery: The RAGA Randomized Trial
- Ting Li, PhD; Jun Li, PhD; Liang Yuan, MD et al.

Lessons Learned for Anesthesiology?

- TIVA vs. Inhaled Anesthetic
- Analgesic Adjuncts (Ketamine/Dex/Lido)
- Regional Nerve Blocks
- ERAS Pathways

Lessons Learned - Hip Surgery

- Day-of-Surgery Gabapentinoids and Prolonged Opioid Use: A Retrospective Cohort Study of Medicare Patients Using Electronic Health Records
- Young, Jessica C. PhD; Dasgupta, Nabarun PhD; Chidgey, Brooke A. MD; Stürmer, Til MD, PhD; Pate, Virginia MS; Hudgens, Michael PhD; Jonsson Funk, Michele PhD
- Author Information: Anesthesia & Analgesia: November 2021 - Volume 133 - Issue 5 - p 1119-1128
doi: 10.1213/ANE.0000000000005656

Thanks!
COVID-19 WHAT HAVE WE LEARNED?
THE WELLBEING PERSPECTIVE - WHAT CAN WE DO TO RECOVER, THRIVE AND FIND JOY?

LEARNING OBJECTIVES
- Define moral injury and how it applies to our current work environment
- Describe individual vs organizational tools
- Peer to Peer Conversations as a solution

Burnout
- Burnout is defined in ICD-11 as follows:
  - "Burnout is a syndrome conceptualized as resulting from chronic workplace stress that has not been successfully managed. It is characterized by three dimensions:
    - feelings of energy depletion or exhaustion
    - increased mental distance from one’s job, or feelings of negativism or cynicism related to one's job
    - reduced professional efficacy

Moral Injury vs. Stress Injury
- "A deep sense of transgression including feelings of shame, grief, meaninglessness, and remorse from having violated core moral beliefs" (Brock and Lettini 2012)
- "A betrayal of what's right, by someone who holds legitimate authority, in a 'high-stakes situation'" (Shay 1994, 2014)
- "Any severe and persistent distress or loss of ability to function caused by damage to the brain, mind, or spirit after exposure to the overwhelming stresses of fatigue (burnout), trauma, loss, or moral injury." (Nash et al 2010)
- Stress Injury Literature comes from military research
Can we measure Moral Injury to know who is at risk?

- Researchers at Duke worked to validate a tool specific to moral injury in health care professionals (HCPs).
- Moral Injury Symptom Scale-Health Professional version
- 10 dimensions of MI assessed by this measure include betrayal, guilt, shame, moral concerns, loss of trust, loss of meaning, difficulty forgiving, self-condemnation, religious struggle, and loss of religious faith.


Consensual Factors cited for contributing to professional stress in anesthesiologists

- Time Constraints
- Work Overload
- Production measures
- Complexity of clinical tasks
- High Clinical Responsibilities
- Fear of harming a patient
- Workplace atmosphere
- Communication difficulties
- Lack of job control
- Wearing family life with professional duties
- Fatigue


What can we do?

- Some days, I just want to read to research to relax and respect


https://edhub.ama-assn.org/steps-forward/module/2779763

Thank you for clicking the link to read what I really do not do for you. I am comfortable using it, but I know you will not be. I want to take this time to thank you for the trust you have placed in me.
How do we energize in healthcare?

- Highly resilient people
  - Prevail because setbacks are interpreted as “temporary, local, changeable.”
  - Don’t sit still - make changes to make the circumstances different
- Can we use Job Crafting to reinvigorate?

**Job Crafting Definition**

- Coined by Amy Wrzesniewski and Jane Dutton in 2001 “the physical and cognitive changes individuals make in the task or relational boundaries of their work.”
- Job Crafting Theory (JCT) posits that people who engage in crafting activities increase the meaningfulness of their work and people will further engage in job crafting activities to:
  - satisfy their need for control
  - to maintain a good self-image
  - to connect with others
  - Most of us do this intuitively

**Types of Job Crafting**

- **Task Crafting**: refers to the changes employees make to either the type or amount of work they do.
  - Choosing the optimal time of day to do most complex tasks - writing, research etc
  - Choosing the task that gets completed at that moment
  - Choosing the method of completing task
- **Relational Crafting**: refers to the control employees have over the people at work they interact with
  - Deciding the amount of time spent with an overly negative colleague vs overly positive
  - Deciding energy expenditure on creating social network with colleagues
  - Deciding on degree of letting work overlap with personal life
- **Cognitive Crafting**: refers to the way an employee makes changes to their perception about their job to attach more meaning to their work
  - Changing the way one thinks about work to align with personal values
  - Choosing the boundaries of the work day - allowing variance to align with current vision of balance (finishing a presentation well into the night)

**Motivating Potential Score (MPS)**

“*The overall degree to which a job is objectively designed in a way that maximizes the possibility for internal motivation on the part of the people who perform it.*”


**Protective Domains include:**

- World view
  - Death is part of life. Acceptance doesn’t mean understanding
- Social network
  - Strong role models. Trusted Mentors
  - Cognitive Flexibility
  - Optimism, positive reframing
  - Self-care and balance
  - Physical, emotional spiritual health, rituals
Mental Health Crisis Lines

- The Real Help Line (CU healthplan specific)
  - 813-555-CHAT (2428) www.becolorado.org/program/the-real-help-hotline
- Colorado Crisis Services
  - 844-455-8295 or Text “TALK” to 38295 http://coloradocrisisresources.org
- The Phoenix Center (interpersonal violence)
  - 303-956-CALL (2256) THEPCA.ORG
- National Suicide Prevention Lifeline
  - 800-273-TALK (8255) https://suicidepreventionlifeline.org
- https://positivepsychology.com/job-crafting/
- https://edhub.ama-assn.org/steps-forward
Learning Objectives

- Review epidemiology of COVID infection and in pregnant patients
- Discuss COVID screening and testing on labor and delivery units
- Understand safety considerations for COVID positive in maternal patients
- Recommendations for treatments and vaccinations

Background

Incidence
- International: 10%, wide geographical variation
- 54% asymptomatic versus 41% in general population
- Parturients more likely to develop more severe disease (13%)
- Hypercoagulable
- Immunocompromised
- Decreased Th1/Th2 immunity
- Increased risk of developing pre-eclampsia
- Possible increased duration of symptoms, needs more data

Outcomes
- 4% require ICU admission
- Increased need for invasive ventilation
- OK to prone and LLD may be just as helpful (SMFM 10/2021)
- Increased need for ECMO
- Increased mortality
  - Compared to symptomatic non-parturients: OR 1.7
  - Compared to COVID negative parturients: OR 2.85
- Risk factors:
  - Non-white ethnicity
  - Chronic hypertension
  - Pre-existing diabetes
  - Advanced maternal age (>35)
  - Elevated body mass index

Testing

- Routine testing for all admissions
  - PCR is recommended over rapid antigen test
  - 95% versus 60-75%
- Routine testing for all surgical procedures
- Antepartum testing
  - Depends on local infection rates
  - Dependent on symptoms
  - Some centers doing this weekly
  - Does it change your management, staffing and PPE
- COVID positive test should not alone dictate mode or timing of delivery

In a global systematic review: COVID negative pregnant patients
- Increases in the stillbirths and maternal deaths
- Declines in maternal mental health
- Increased rate of ruptured ectopic pregnancies
OB Visitation/Support Person Scenarios

Preparedness on the Unit
- Negative Pressure Triage Room
  - Who does the testing
  - OB RN
  - What is the turn around time
  - Specimens
  - What to do if positive or negative
    - Location
    - Visitors
    - NICU/Peds guidelines

- Negative Pressure Operating Room
  - Who secures the room
  - Understand airflow rates and clearance
  - Identify a “Runner” for individual teams (i.e. anesthesia, OB, NICU)

Preparedness in the Operating Room
- Anesthesia Machine
  - HEPA Filters
  - Covers
- Tackle box
  - Airway
  - Drugs
  - IV kits

Obstetric Anesthesia and COVID-19: Simulation Exercises

- Drill, drill, drill
  - COVID-19 Toolkit (memberclicks.net)

Labor analgesia and COVID
- Neuromuscular
  - Recommend early epidural analgesia to reduce the need for general anesthesia for emergent cesarean delivery
  - Leave epidural cath outside of a PU/COVID - room
- COVID19 diagnosis itself is NOT considered a contraindication for neuraxial anesthesia
  - DO NOT delay for COVID test
- Reduce number of potential interventions:
  - Continuous Epidural
    - Programmed Intermittent Epidural Bolus
  - Patient Controlled Epidural Analgesia
  - Epidural Blood patch: case by case
- NPO can have significant consequences: Arnedt R et al. 2019. Anes. 20(3): E182
- Nitrigenous oxide
  - COVID negative test
  - Filter with pore size < 0.25um
To the OR....

- Avoid emergent cesarean deliveries: All about the communication
- Assign the most experienced anesthesia provider
- Wear appropriate PPE: Intubation may be needed at any time.
- Consider Double gloving
- HEPA filter at the patient side of the circuit
- Extubation is equally aerosolizing
- Minimize personnel, utilize airborne (N95/PAPR) precautions.
- Extubate in the OR or transfer and extubate in a negative pressure room

ASA and APSF Joint Statement on Elective Surgery and Anesthesia for Patients after COVID-19 Infection

For patients with confirmed COVID-19 infection who are not actively immunosuppressed and experience mild to moderate symptoms, the CCM recommends delaying scheduled or other non-emergency based procedures where:

- At least 3-20 days have passed since symptoms first appeared.
- At least 10 days have passed since symptoms first appeared and not taking any anti-retroviral medications.

The timing of elective surgery is based on recovery from COVID-19, clinical judgment, and severity based categories. Suggested timelines:

- Four weeks for asymptomatic patient recovery from any mild non-respiratory symptoms.
- No need for asymptomatic patient to undergo any respiratory tests.
- Eight to 16 weeks for asymptomatic patient who is stable, immunocompetent or hospitalized.
- Twelve weeks for asymptomatic patient who is stable, immunocompetent or hospitalized due to COVID-19 infection.

Do symptoms and timing matter?

Maternal hypoxia
- Release of potent vasoconstrictors
- Preterm birth
- Still birth (1.26% versus 0.64%)
- COVID destroys the placenta
- Schwartz et al. 02/10/2022: 64 IUFD and 4 neonatal deaths across 12 countries.
- 78% destruction of the placenta and significant fibrin deposition limiting oxygen transport to the fetus
- IUGR: recent data shows birth weights within normal range
- APGAR: recent data shows APGAR scores within normal

Vertical Transmission

- ACE2 receptors throughout the placenta but......
  - Low expression of both ACE2 and transmembrane serine protease 2 (TMPRSS2)
  - Some neonates testing positive within 1 h after birth
- Replication competent virus not found in amniotic fluid, breast milk, or cord blood
- 2/3 studies report no vertical transmission and 1/3 report it is possible
- Likely 1-4%

- Antibodies: Edlow et al. (JAMA 2022)
  - At two months of age: 98% born to vaccinated moms had detectable levels IgG
  - At six months of age: 57% born to vaccinated mothers still had detectable IgG levels, compared with 8% born to unvaccinated infected mothers
- Delayed cord clamping
  - Recommended due to known benefits
- BJOG 2021
- Breastfeeding
- Salvatore et al. (Lancet 2020)
  - 116 breast feeding COVID + mothers using hand washing and masking: No transmission
Vaccination: Do it!

- Indicated in all trimesters and if breastfeeding
- No increase rate of miscarriage
- No issues with fertility
- No adverse fetal or postnatal development
  - Although delay in some development was seen for all neonates born during the pandemic
  - All three vaccines recommended even if prior COVID infection regardless of symptoms
  - Booster recommended
  - J and J
    - Increased risk of thrombocytopenia and thrombosis seen in non-pregnant women (6 cases)
    - 12/2021: FDA recommended mRNA over J and J vaccine for everyone

Treatments

Therapeutic Management of COVID-19 in the Setting of Pregnancy

Pregnancy-specific treatments for COVID-19 should not be withheld from pregnant patients because of theoretical concerns related to the safety of using those therapeutic agents in pregnancy (WBI).

SHPM supports the NRT COVID-19 treatment guidelines and suggests that shared decision-making and multimodal approaches to the treatment of the selected drugs should be used. In consideration the antiviral treatment for pregnant patients. However, therapies that could otherwise be given should not be withheld specifically due to pregnancy or lactation. Therapies including monoclonal antibodies, nucleotide analogues, antivirals, and antibiotics can and should be provided to pregnant patients with COVID-19 who meet clinical qualifications.

The NRT guidelines also recommend that monoclonal antibody therapy be offered as a treatment for infected individuals and that post-exposure prophylaxis should be considered for indeterminate vaccinated individuals exposed to SARS-CoV-2. This should also include pregnant individuals.

Only 35% vaccinated as of 11/27/2021, up from 22% on 07/2021
Monday, February 28th
WHAT’S NEW IN OBSTETRIC ANESTHESIA FROM 2020-21?
Joy L. Hawkins, M.D.
University of Colorado SOM
Disclosure: I have no financial relationships with commercial support to disclose.

GOALS & OBJECTIVES
Discuss how literature from the past year may:
1. Change clinical practice in obstetric anesthesia via new guidelines and policies.
2. Produce best practices for analgesic and anesthetic techniques during labor and delivery.
3. Optimize and expedite management of anesthetic and obstetric complications.
4. Alter practices affecting the fetus and newborn.

GUIDELINES, POLICIES & PROCEDURES
ASA PHYSICAL STATUS FOR OBSTETRICS
The 2020 ASA Physical Status Classification System update now includes Pediatric and Obstetric examples:
• ASA II: Normal pregnancy (due to physiologic changes) + well-controlled HTN, PEC without severe features, gestational diabetes
• ASA III: PEC with severe features, DM requiring insulin, thrombophilia requiring anti-coagulation
• ASA IV: HELLP, cardiomyopathy with ↓ EF, CHD
Anesthesiology 2021; 135: 904-19

ASA STATEMENT ON PDPH MANAGEMENT
ASA Committee on Obstetric Anesthesia Statement on Post-Dural Puncture Headache Management → Key Points:
• PDPH needs to be evaluated and diagnosed within 24 hours
• Mild symptoms may be managed conservatively but if symptoms are severe, a blood patch should be offered.
• A second EBP may be offered but consider other causes. Prior to a 3rd EBP consider Neurology consult + imaging.
• Post discharge, provide telephone follow-up and send her home with education on concerning symptoms.

ASA: REDUCING PERIPARTUM DISPARITIES
Reducing Maternal Peripartum Racial and Ethnic Disparities
• Document race, ethnicity and primary spoken language.
• EMR dashboards should include race, ethnicity and language.
• Educate caregivers on bias, identify women with ↑ risk for complications, engage in multi-disciplinary planning and safety bundles, and implement ERAS for cesarean.
• Create patient education in their language at a 6th grade level.
• Engage in QI initiatives that target reducing disparities.
• Support workplace diversity within our departments.
**DISPARITIES IN ANESTHETIC MGT**
A multi-state administrative database was used to determine anesthetic management from 2007-14. Black women were more likely than white women to:
- receive general anesthesia for cesarean (aOR 1.44).
- receive no analgesia for vaginal delivery (aOR 1.45).
- experience any type of severe morbidity (aOR 1.38).

*J Clin Anesth* 2020; 65: 109821

**POSTOPERATIVE BREAST-FEEDING**
ASA Committee on Obstetric Anesthesia: Statement on Resuming Breastfeeding after Anesthesia (2019)
1. All anesthetic drugs transfer to breast milk but in low concentrations considered clinically insignificant.
2. Pain interferes with breastfeeding after surgery; women should not avoid pain medicines, but add regional and other multi-modal analgesics.
3. Resume breastfeeding as soon as she is alert and able to hold her baby safely. It is not recommended that patients “pump and dump.”

**POSTOPERATIVE BREAST FEEDING**
From the Association of Anaesthetists of Great Britain:
- Women should be encouraged to breastfeed as normal following surgery.
- There is no need to express and discard breast milk after anaesthesia. Drugs are transferred to breast milk in only very small amounts.....there is no evidence of effects on the breastfed infant.

*Anaesthesia* July 31, 2020

**SOAP CONSENSUS STATEMENT**
“Sugammadex during pregnancy and lactation”
1. Avoid completely in early pregnancy as it binds progesterone, needed to maintain the pregnancy.
2. Avoid or use with caution at or near term.
3. It is safe to use with established lactation.
4. It is safe to use in patients of reproductive age if they receive counseling to use additional non-hormonal contraception (e.g. condoms) for 7 days.

[www.soap.org](http://www.soap.org)

**OPTIMIZING IOL TO REDUCE C/S**
Vaginal delivery is more frequent after elective induction of labor at 39 weeks than after expectant management.

*Obstet Gynecol* 2020; 136: 698-705

Elective induction does not incur greater resource use.

*Am J Obstet Gynecol* 2020; 222: 369

The stillbirth rate is lower if labor is induced at 39 weeks.

*Am J Obstet Gynecol, January 2020 (Po*)

After induction of labor in low-risk women, cesarean rates ranged widely from 19-85% across CA. Clinical management??

*Obstet Gynecol* 2020; 136: 1179-89

**MATERNAL MORTALITY IN THE UNITED STATES: WHAT DO WE KNOW?**
1. Pregnancy-related mortality rates are high compared to the rest of the developed world.
2. Racial disparities are large and unchanging.
3. Well over half of maternal deaths are preventable.
4. 1/3 occur during delivery, 1/3 occur in the first week after delivery, and 1/3 occur 1 week to 1 year postpartum.

*Am J Obstet Gynecol, October 2020*
LABOR ANALGESIA

BENEFITS OF VIRTUAL REALITY
VR in early labor reduced pain scores and heart rate although later epidural use did not change (85.7% vs 89.5%, p = 0.28).

Am J Obstet Gynecol January 2020, abstract #39
VR was used during epidural placement for patients with extreme anxiety with excellent results and high satisfaction. The headset displayed an underwater environment of a reef and sea creatures + bubbles with “breathe” and “relax”.

J Clin Anesth 2020; 61: 109635

SAFETY AND UTILITY OF N₂O
Nitrous oxide is safe for mother, neonate and those who work on L&D. Conversion to epidural occurs in 40-60%. Rate of neuraxial utilization does not change if nitrous is available.

APSF newsletter, June 2020, pp 60-1
18% will use nitrous as their only pain med; 82% will transition to other modalities; 3% discontinue for side effects.

J Obstet Gynecol Neonatal Nurs 2021; PMID 33493464
50% nitrous is effective at high and low altitudes although there are fewer side effects at high altitude.

Anesth Analg September 2021 (Wood)

OPTIMIZING NEURAXIAL: PIEB
Meta-analysis of programmed intermittent epidural bolus (PIEB) showed improved pain control and ↓ breakthrough pain with a trend to ↑ satisfaction and ↓ motor block.

Br J Anesth 2020; 125: 580-79
A single-center, double-blind RCT to compare PIEB (6 ml q 45 min) vs CEI (8 ml/hr) did not find differences in PCEA consumption but did find ↓ motor block.

Anesth Analg 2020; 130: 426-35

NEURAXIAL EFFECTS ON THE PLACENTA
What is the effect of epidural analgesia in active labor on uteroplacental perfusion, compared to unmedicated labor?
• Maternal blood pressures were lower (but not hypotensive) after onset of analgesia.
• Pulsatility indices in all vessels were stable over time.
• Mean pH of umbilical artery blood was 7.29 in the epidural group vs 7.31 in the unmedicated group. Same Apgars.
• Placental hemodynamics were stable despite ↓ BP.

MATERNAL OXYGEN SUPPLEMENTATION

Does intrapartum maternal oxygen supplementation improve Category II electronic FHR patterns?
• NR-FHR → recurrent variables, late decels, tachycardia, prolonged decelerations or ↓ variability.
• Mothers randomized to room air or 10L face mask.
• Oxygen administration had no impact, i.e. it did not resolve high-risk category II fetal heart tracings or hasten the resolution of decels.
Am J Obstet Gynecol 2020; 223: e1-7

MATERNAL OXYGEN SUPPLEMENTATION

A meta-analysis of 16 RCT with 2000 patients found no association between maternal oxygen administration and improvement in umbilical artery pH or other neonatal outcomes.
JAMA Pediatr 2020; 5351
A quality improvement initiative to reduce exposure to oxygen for category II FHR tracings demonstrated adherence to the guidelines without worsened maternal or perinatal outcomes.
Obstet Gynecol 2021; 138: 627-32

ACOG STATEMENT ON PPTL

Committee Opinion #827: Many women who desire PPTL do not actually undergo the procedure. Address barriers!
• Ensure fair and equitable access regardless of insurance type.
• Designate PPTL as a non-elective procedure.
• Religiously-affiliated hospitals should inform the patient of restrictions early in prenatal care and refer them to a practitioner or hospital that can accommodate their request.
• Avoid the inclination to deny PPTL based on provider values.
Obstet Gynecol 2021; 137: e169-76

CESAREAN DELIVERY

All Those In Favor Of Faster C-sections, Raise Your Hand.

PREVENTING SSI IN OBESE WOMEN

Obese women are at risk of SSI. What is the best regimen to keep drug levels adequate in tissue?
• Plasma and interstitial fluid levels were measured in 12 women with median BMI 41.5 having cesarean at term.
• Simulations found that both 2 gm and 3 gm initial doses should be redosed at 2 hours.
• With limited blood flow to adipose tissue, a higher plasma concentration is necessary to diffuse drug into the site.
Anesth Analg 2020; 131: 196 and 199

GA: SAFETY OF THE LMA

Should supra-glottic airway devices replace endotracheal tubes for elective cesarean delivery in selected patients?
• 2nd generation SGA devices have better protection from aspiration and are recommended to rescue failed intubation.
• Several studies (~8000 women) have been studied using an SGA as the primary airway device → no aspiration events.
• Caveat: fasted, non-obese, no reflux – gastric ultrasound?
Br J Anesth 2020; 125: e7
GA: OPTIMAL PRE-OXYGENATION
What is the time interval for 90% of parturients to achieve > 90% ET oxygen using face mask vs high-flow nasal oxygen during pre-oxygenation?
- Face mask required 3.6 minutes.
- Time interval for nasal oxygen could not be calculated – only 92% had achieved target after 8 minutes – 0% at 3 minutes, 67% at 4 minutes.

Anaesthesia 2020; 75: 609-16

GA: ACCIDENTAL AWARENESS
Awareness in obstetric patients may be as high as 1:256.
- 3115 obstetric patients were interviewed after GETA; 12 had accidental awareness.
- 58% were distressed, 42% felt paralyzed, 17% had pain.
- 75% occurred during induction or emergence.
- Direct postoperative questioning should be done to elicit accidental awareness after cesarean using GETA.

Anaesthesia 2021; 15385

SPINAL: UTERINE DISPLACEMENT
75 women having elective cesarean under spinal anesthesia were randomized into 3 groups: supine, 15° tilt, or 30° tilt from spinal placement to delivery.
- There was no difference in umbilical arterial pH between groups (7.31 vs 7.30 vs 7.31).
- But, the 30 degree group required significantly less phenylephrine and ephedrine.

Anesth Analg 2021; 133: 1235-43
Eur J Anaesthesiol 2022; 39: 236-43

SPINAL: LIPOPHILIC OPIOIDS
Is fentanyl a valuable addition to spinal bupivacaine (+ morphine) for cesarean delivery? Yes it is.
- Meta analysis of 17 RCT with 1064 parturients.
- Although there was more pruritus with fentanyl (RR 5.89)....
- ↓ need for supplemental analgesia by 82%
- ↓ incidence of intraoperative nausea and vomiting by 59%
- ↑ time to first request for analgesia: 91 m difference

Anesth Analg 2020; 130: 111

SPINAL: ONDANSETRON TO PREVENT ↓BP
Ondansetron has been shown to reduce hypotension and vasopressor needs after spinal for cesarean. By how much?
- Women were randomized to 4mg ondansetron or saline control 10 min before positioning for spinal anesthesia.
- A single dose of ondansetron reduced the ED50 of prophylactic phenylephrine infusion by 26%.
- Granisetron 3mg similarly lowers pressor requirement.

Anesth Analg 2020; 131: 564-9
J Clin Anesth 2021; 110469

SPINAL: NOREPINEPHRINE TO PREVENT ↓BP
Norepinephrine may preserve cardiac output and HR better than phenylephrine after spinal for cesarean.
- What dose? An RCT found an infusion of 0.08 µg/kg/min prevented hypotension in 90% of parturients.
- Br J Anesth 2020; 124: e108
- What are the effects of NE infusion on fetal cord pH vs phenylephrine? A randomized trial found no difference in umbilical arterial pH between pressor groups.
- Br J Anesth 2020; 125: 588-95
A review of the current ERAC literature found 44 different protocols and 100 different outcomes. IJOA 2020; 43: 72

Society for Obstetric Anesthesia and Perinatology: Consensus Statement and Recommendations for Enhanced Recovery After Cesarean

DOES ERAC WORK? YES!

• Oral morphine equivalents administered postpartum were 42% lower despite more mobilization in the ERAC group. Use of oxycodone after discharge also ↓ 41%.
• Total morphine equivalents were reduced 38% despite increased activity in the ERAC group. Mean pain scores during hospitalization were similar.
  Int J Obstet Anesth 2020; 43: 38
• Next we need to know which elements are most important.
  Anesthesiology Clin 2021; 39: 743-60

RISK FACTORS FOR SEVERE PAIN

Severe post-cesarean pain is associated with poor breastfeeding, postpartum depression and ↑ length of stay.
  J Clin Anesth 2020; 62: 109697

What are the risk factors for increased pain after cesarean?

• History of chronic pain (OR 4.12), current smoker (OR 2.52), pre-existing anxiety (OR 1.93), receipt of IV ketamine or fentanyl (OR 1.56), and repeat cesarean (OR 1.54).
• Non-black race and private insurance ↓ pain (OR 0.44).

ERAC: OPTIMIZING PAIN CONTROL

There was no difference in opioid use between cesarean patients receiving either 15mg or 30mg ketorolac intraop.

Administering acetaminophen and ketorolac simultaneously instead of alternating significantly reduced opioid use.
  ASA Annual Meeting abstract #A2103, 2019

A 5% lidocaine patch placed at end of cesarean was effective in reducing pain scores for 36 hours, although no ↓ opioid use.
  J Clin Anesth 2021; 73: 110328

ERAS: PONV PREVENTION


• Parturients have multiple risk factors: female, young, non-smoker, laparotomy, opioid analgesia ↓ hx PONV → give 3-4 agents for prophylaxis.
• Use agents from different classes for rescue treatments.
  Anesth Analg 2020; 131: 411-48

NERVE BLOCKS FOR C/S PAIN

A couple great reviews on peripheral blocks for cesarean:
  Reg Anesth Pain Med 2020; 45: 52-62
  Anaesthesia 2021; 76: 136-47

Bottom line: Nerve axial morphine is best for post-cesarean analgesia, but if not available quadratus Lumborum (QL) may be slightly superior to TAP blocks. Both > control / placebo.
  Anesthesiology 2021; 134: 72-87 → IT morphine better than QL
  Anaesthesia 2021; 76: 393-403 → QL better than TAP blocks
ANESTHETIC MORBIDITY

GA: FAILED AIRWAY
Review of MPOG data on intubation during cesarean 2000-18:
• Difficult intubation was $155$; 85% were classified as difficult based on the view and 15% had $\geq 3$ attempts.
• Failed intubation was $11250$ (defined as any attempt without successful ETT placement). All 12 cases were rescued using a supraglottic airway. There were no deaths.
• Risk factors: MP 3 or 4, obesity, and maternal age $> 35$.
SOAP abstract #BCPS-05, 2020

GA: ASSOCIATION WITH DEPRESSION
Is general anesthesia for cesarean associated with ↑ odds of maternal psychiatric complications?
• New York State database with 8% rate of GA for cesarean.
• Relative to neuraxial: postpartum depression OR 1.54, suicidal ideation or self-harm OR 1.91.
• Possible reasons? More postoperative pain, delayed skin-to-skin bonding and breast-feeding, emergent nature of the delivery (often fetal concerns).
Anesth Analg 2020; 131: 1421-9

PDPH: METHODS OF PREVENTION
Prophylactic IT morphine administered after delivery does not ↓ incidence or severity of PDPH after "wet tap".
Anesthesiology 2020; 132: 1045-52
Case volume and experience inversely relate to accidental dural puncture. Faculty with high volume = 0.6%, low volume = 2.4%, OR 3.77. Trainees 3.1%, registrars 1.2%.
Anaesthesia 2021; 76: 1060-7
An IT catheter can be used for analgesia / anesthesia after "wet tap", but there is not firm evidence it reduces PDPH.
Int J Obstet Anesth 2020; 41: 71-82

PDPH: LONG-TERM CONSEQUENCES
At least 4 studies in 2021 showed that women who develop PDPH after neuraxial - whether treated or not - have ↑ incidence of chronic headache, backache, depression, and disability over women with no neuraxial or no accidental dural puncture: Eur J Anaesthesiol 2021; 38: 130-37
Anaesthesia 2021; 76: 1068-76
Br J Anaesth 2021; 127: 600-7
What should our follow-up be? Can we prevent these?

PREGNANCY TESTING & LAWSUITS
From the ASA Statement on Pregnancy Testing Prior to Anesthesia and Surgery: “...routine pregnancy testing may pose greater medicolegal risk to anesthesiologists due to failure to check the result.....prior to elective surgery.”
• Patient with abdominal pain underwent surgery for presumed ectopic because a negative test was not noticed preop.
• A positive test was disclosed to family before the patient was notified; prevented her from terminating the pregnancy.
• A D&C was performed for AUB; a prior negative pregnancy test was copied and pasted into her EMR; pregnancy lost.
**SOAP THROMBOCYTOPENIA CONSENSUS**
Multidisciplinary expert consensus on neuraxial procedures in obstetric patients with thrombocytopenia.
- Determine the etiology and take a bleeding history.
- Platelet count > 70K is extremely low risk, especially in OB.
- Re-check on admission or within 72 hours, unless HELLP.
- May proceed if < 70K if risk/benefit calculation favorable.
- There are risks to withholding neuraxial as well. Consider co-morbidities, OB risk factors, airway, patient preference.
Anesth Analg 2021; 132: 1531-44 and 1527 (editorial)

**LITIGATION: POSTPARTUM NERVE INJURY**
Review of British malpractice claims for nerve injury following central neuraxial blockade – themes:
- Inadequate consent for risks, e.g. 1:250K for paralysis.
- Nerve injuries were due to direct trauma (stop for paresthesias), chemical injury (e.g. injecting chlorhexidine), compression by hematoma (very rare - only 1 case).
- Recognition, then management of complications promptly.
- Many case studies are included; fascinating!
Anaesthesia 2020; 75: 541-8 and 913-9

**LAST REVISITED: ASRA 2020 UPDATE**
1. The 2020 checklist’s main modification was conversion of the traditional bullet-pointed design to a process-flow format similar to the ASRA LAST smartphone application.
2. An ongoing management deficit was failure to recognize that LAST resuscitation differs from ACLS-guided resuscitation (animal studies show many standard ACLS drugs worsen LAST outcomes).
3. Lipid emulsion dosing instructions simplified in response to reported difficulties calculating weight-based dosing and timing of lipid administration; a level of precision that is unnecessary.

**EPIDURAL ANALGESIA & AUTISM**
2 studies from Canada and Denmark found small increases in autism in children whose mothers received labor epidurals. Negative responses were rapid and vigorous!
- SOAP / ASA / SPA / ACOG / SMFM: “no credible evidence”.
- U.S. database study: “…do not support neuraxial labor analgesia is associated with increase risk of autism.”
  JAMA Network Open 2021; 4: e2140458
- Canadian counter results: JAMA Pediatr 2021.0376
- Danish counter results: JAMA 2021; 326: 1170-7

**GENERAL ANESTHESIA & AUTISM**
“Our findings suggest that the reported associations between CS and ASD is likely due to the exposure to GA…..resonate well with a recent FDA warning regarding use of GA among young children or pregnant women and its potential effect on brain development.”
Multiple rebuttals in the same journal: “Not very likely”, “Numerous confounders” JADD 2020; 50: 688 and 1451
EPIDURAL + FEVER = FETAL BRAIN INJURY?

Systematic review and meta-analysis of epidural-related fever and potential neonatal effects.

- Epidural analgesia is associated with intrapartum hyperthermia, OR 4.21 (although not with infection).
- Intrapartum hyperthermia of any cause is associated with neonatal brain injury, OR 2.79.
- It was not possible to quantify any association between epidural-induced hyperthermia and neonatal brain injury.

Br J Anaesth 2021; 126: 500-15

GA & FETAL NEUROTOXICITY

Recent studies and editorials on this controversial subject:

- Anesth Analg 2021; 133: 595 and editorial page 592
- Anesthesiology January 2022 (Ing)
- Br J Anaesth 2021; 126: 1128-40
- Anesthesiology 2020; 133: 1007 and editorial page 967

Bottom line: we have no phenotype for what this neurotoxicity might look like, but current clinical studies on single exposure are reassuring.

OBSTETRIC & MEDICAL COMPLICATIONS

"I'm going to give it to you straight, Mr Watson, for a 27 year old you're in pretty bad shape."

PREECLAMPSIA: UPDATED GUIDELINES

Both ACOG and the American Heart Association published updated guidelines on hypertension in pregnancy.

Obstet Gynecol 2020; 135: 1492
Hypertension 2022; 79: PAP

Common themes: 1) Ensure more aggressive treatment of HTN to reduce maternal morbidity and mortality due to cardiovascular complications and stroke. 2) Treatment of HTN, prevention of seizures, and timed delivery are the main therapeutic options for preeclampsia.

UPDATED ACOG HTN GUIDELINES

Anesthesia-related items in the updated ACOG guidelines:

- NSAIDs should continue to be used preferentially over opioid analgesics........no differences in BP, anti-hypertensive requirements or other adverse events.
- Epidural or spinal anesthesia is considered acceptable, and the risk of epidural hematoma is exceptionally low in patients with platelet counts > 70K, provided the count is stable, function is normal, she is not on any anti-coagulant therapy, and there is no other coagulopathy.

TESTING REQUIREMENTS?

What is the incidence of thrombocytopenia in women with preeclampsia, and how often should we repeat labs?

- Single center retrospective analysis of 984 patients with PEC
- Incidence: 6.5% < 100K; 2.1% < 70K; 0.5% < 50K
- Platelets did not change significantly over 72 hours; the median % change was 0.
- There were no neuraxial hematomas in 40 patients who had an epidural placed with platelets < 100K.

J Clin Anesth 2020; 62: 109741
PREECLAMPSIA: ASPIRIN REAFFIRMED

ACOG, SMFM, and the US Preventive Services Task Force recommend the use of low-dose aspirin (81 mg/day) as preventive medication for preeclampsia after 12 weeks of gestation in persons who are at high risk for preeclampsia (B recommendation).

JAMA 2021; 326: 1186

HEMORRHAGE: NEW DEVICES

Intrauterine vacuum-induced hemorrhage control may provide a new rapid and effective treatment option for postpartum hemorrhage. Control of PPH occurred in 3 minutes; 98% found it easy to use.

Obstet Gynecol 2021;136:882

HEMORRHAGE: NEW DRUGS

Is ionized calcium level associated with PPH severity?
- 436 patients had calcium levels drawn at the onset of PPH.
- Hypocalcemia at the time of diagnosis of PPH was associated with progression to severe bleeding: 51.5% with severe PPH had ↓ calcium vs 10.6% with mild PPH.
- Calcium and fibrinogen were the only variables that were independently associated with risk of severe bleeding.

Br J Anaesth 2021; 126: 1022

HEMORRHAGE: NEW LAB MANAGEMENT

What is the incidence of elevated fibrinolytic activity during postpartum hemorrhage?
- TEG results were obtained during PPH in 118 women.
- Only 15 women had elevated fibrinolytic activity (12.7%)
- And further analysis of these 15 women’s TEG profiles indicated platelet-mediated clot retraction – not fibrinolysis.
- We don’t understand the pathophysiology of PPH-associated coagulopathy. Implications for use of TXA??

Anesth Analg 2020; 131: 1373 and 1370 (editorial)
**AFE: MANAGEMENT PRINCIPLES**

Principles of early management of AFE target the evolving pathophysiology. These are caused by the maternal response to introduction of foreign antigenic material of fetal origin:

1. Begin high quality CPR for cardiac arrest.
2. Use TEE or TTE to manage pulmonary hypertension and cardiac failure with pressors, inotropes, or pulm vasodilators.
3. Manage coagulopathy with products and POC testing.
4. Consider preparing for ECMO.

Am J Obstet Gynecol 2020; 222: 48

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**MANAGEMENT OF ONGOING PPH**

- Don’t wait for labs to start blood products + call an MTP.
- Transfuse RBC: FFP: platelets close to a 1:1:1 ratio.
- Add cryoprecipitate to keep fibrinogen > 200-300.
- Avoid large volumes of crystalloids. Consider giving calcium.
- Administer TXA as early as possible; within 3 hours.
- Use rFVIIa with caution → no survival benefit, high cost, 5% risk of thrombotic complications.
- Prothrombin complex and fibrinogen complexes are promising, but little or no data in obstetric cases.

Transfusion 2020; 60: 897

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**MENTAL HEALTH: NEW ANTI-DEPRESSANT**

Anti-depressants are used to treat postpartum depression but have a slow onset and frequent failure.

- A Phase 3 trial randomized women with PPD to a 2-week course of a new oral GABAa receptor modulator or placebo.
- The treatment group → clinically meaningful improvement at day 3 that was sustained through day 45, plus ↓ anxiety and improved maternal functioning.

JAMA Psychiatry 2021.1559

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**SUBSTANCE ABUSE: CANNABIS TRENDS**

Did rates of prenatal cannabis use ↑ during the COVID-19 pandemic? Yes.

- Large health system with universal prenatal urine tox screen.
- Pre-pandemic rate of use = 6.75% of pregnancies; during the pandemic rate of use ↑ to 8.14%.
- Rates ↑ 25% during the pandemic vs the 15 months before.
- Cannabis use in pregnancy is associated with low birth weight and potential neurodevelopmental effects.

JAMA online September 27, 2021

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**BREECH: ACOG UPDATE**

ACOG Practice Bulletin (update): External Cephalic Version

- Because the risks of ECV are small, and because cesarean delivery rate is lower among women who undergo a successful ECV, all women with breech presentations near term should be offered an ECV attempt.
- Neuraxial analgesia can be considered a reasonable intervention to increase ECV success rate.
- Parenteral tocolytics should be used to improve success.

Obstet Gynecol 2020; 135: e203-12
**BREECH: ANESTHETIC MGT FOR VERSION**

Can anesthetic intervention facilitate successful ECV? Which anesthetic choice is best? A network meta-analysis found:

- Neuraxial: OR 2.6 of success, most ↓ BP, lowest pain.
- Intravenous: OR 2.1 vs control, highest patient satisfaction, least non-reassuring fetal response (OR 0.36)
- Inhalational: OR 2.3
- All provided good pain control, no difference in CS rates.

*Anesth Analg* 2020; 131: 1800-11

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**COVID: MATERNAL OUTCOMES**

What are the outcomes when giving birth having COVID-19?

- A cohort study in 500 academic medical centers with 869K women → 2.2% had COVID while pregnant, 97.8% did not.
- No difference in cesarean delivery rates.
- More preterm births with COVID: 16.4% vs 11.5%.
- Higher rates of ICU admission: 5.2% vs 0.9%, OR 5.84
- More need for intubation and ventilation, OR 14.33
- Higher mortality: 0.1% vs 0.01%, OR 15.38

*JAMA Network Open* 2021;4: e2120456 / *JAMA Pediatr* 2021;175: 817

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**COVID: MATERNAL VACCINATION**

Population-level data in Scotland 12/2020-10/2021:

- Vaccination rates were lower in pregnant women than the general female population: 32% vs 77%.
- Overall, unvaccinated women accounted for 77% of COVID infections, 91% of hospital admissions associated with COVID, and 98% of ICU admissions for COVID.
- All fetal/newborn deaths during COVID infections were in unvaccinated women.

*Nature Medicine, January 2022*

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**COVID: MATERNAL VACCINATION**

Vaccine surveillance system reviewed 36K pregnant women who received mRNA COVID-19 vaccines → no safety signals.


- 100% of infants had antibodies to the COVID spike protein at high levels when mothers were vaccinated during pregnancy.
- *AJOG MFM* 2021; 100481
- COVID+ mom → infant transmission is only about 2%.

*JAMA Pediatr* 2020;4304

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**COVID + MOTHERS & THEIR INFANTS**

2 studies found breast milk from women vaccinated with mRNA vaccines contains specific IgA and IgG antibodies, and after a second dose the breast milk antibody levels increased. These antibodies showed strong neutralizing effects, potentially protecting the infant.

*JAMA Network Open* 2021; 4: e2120575

*JAMA* 2021; online 4/12/21
OBESITY: ACOG UPDATE
ACOG Practice Bulletin #230: Obesity in Pregnancy
• Allow a longer first stage of labor before performing cesarean for labor arrest.
• Mechanical thromboprophylaxis is recommended perioperatively. Weight-based anti-coagulant dosing may be considered rather than BMI-stratified dosage strategies.
• Consultation with anesthesia service should be considered for obese pregnant women with OSA because they are at increased risk of hypoxemia, hypercapnia, and sudden death.
Obstet Gynecol 2021; 137: e128-44

BARIATRIC SURGERY CONSIDERATIONS
Bariatric surgery in reproductive-age women was associated with reduced pregnancy risks (vs those who declined).
• Included ↓ rates of DM (OR 0.6), preeclampsia (OR 0.53), cesarean (OR 0.65), macrosomia or LGA baby (OR 0.24), choorioamnionitis (OR 0.45), and NICU admission (OR 0.7).
• But associated with ↑ risk of SGA neonates (OR 2.46).
• Delay pregnancy for 12 months after bariatric surgery.
Am J Obstet Gynecol 2021; 226: 121

SPINAL CORD INJURY: ACOG UPDATE
Obstetric Management of Patients with Spinal Cord Injuries
• Treat autonomic dysreflexia immediately, this is a life-threatening complication that is most likely to arise during labor. Treatment involves stopping any stimuli.
• Anesthesiologists with expertise in OB should be involved.
• Neuraxial anesthesia should be used to reduce autonomic dysreflexia. Hypertension may be treated with agents that have a rapid onset and short duration of action.
Obstet Gynecol 2020; 135: e230-6

PERIPARTUM STRESS DOSE STEROIDS?
Should a patient on chronic steroids (e.g. rheumatoid arthritis) receive stress-dose steroids during labor?
• No evidence that adrenal insufficiency occurs peripartum, so continue on their usual course but don’t supplement for vaginal delivery or cesarean.
• Do administer stress-dose steroids for primary adrenal insufficiency, i.e. disorders of the hypothalamic-pituitary-adrenal axis. They are at increased risk of adrenal insufficiency, although it’s still very low.
Obstet Gynecol 2020; 135: S22-S

THE FETUS AND NEONATE
50-80% of women use prescription meds in pregnancy but there’s little data on safety since pregnancy is excluded from trials.
Am J Obstet Gynecol July 2021
Ondansetron: no association with adverse fetal outcomes.
JAMA Network Open April 23, 2021 / JAMA Pediatrics June 1, 2020
Acetaminophen: ACOG counters concerns with strong support.
ACOG.org, Sept 29, 2021
Fenofibrate (for allergies): not associated with adverse outcomes.
JAMA Pediatrics, June 1, 2020
FETAL MEDICATION EXPOSURES

Chemotherapy: after 12 weeks gestation, major malformations were no different than expected rates. JAMA Network Open 2021; June 9, 2021

Influenza vaccine: after 3.6 years follow-up, no increased risk of adverse early childhood outcomes. JAMA 2021; 325: 2285

Anti-depressants: the risks (if any) for birth defects is acceptable compared to risks of untreated depression. JAMA Psychiatry 2020; 77: 1215

Opioids: prescription opioid use in the 1st trimester is not associated with risk of fetal malformations. BMJ 2021; 372: n102

Benzodiazepines: treatment for anxiety or sleep did not cause significantly ↓ birth weight or gestational age at birth. JAMA Network Open June 22, 2020


PTL: STEROIDS & MAGNESIUM

Incidence of severe neurodevelopmental impairment or death for extremely preterm children (born 22-27 weeks):
- 48% if they receive neither steroids or magnesium
- 53% if they receive magnesium sulfate alone
- 44% if they receive antenatal steroids
- 36% if they receive both.
- Administration of both steroids and magnesium is best care. Obstet Gynecol 2020; 135: 1377

DELAYED CORD CLAMPING

Delaying cord clamping for 60 seconds is standard of care for term and premature babies per ACOG and AAP. A new study compared outcomes at 2 years for 1500 babies < 30 weeks GA:
- Risk of death or major disability was ↓ 30% before age 2 and 17% through early childhood in delayed cord clamping group.
- 15% fewer infants needed blood transfusions after birth.
- "Rare to find a no-cost intervention with such impact." The Lancet Child & Adolescent Health 2021 Obstet Gynecol 2020; 136: e100-6

AHA UPDATE ON NEONATAL RESUSCITATION

A focused update emphasizes ↓ initial oxygen concentration:
- Newborns ≥ 35 weeks requiring respiratory support at birth should receive 21% oxygen.
- 100% oxygen should not be used as it is associated with excess mortality.
- Newborns < 35 weeks may receive 21-30% oxygen with subsequent titration based on oxygen saturation targets. Pediatrics 2020; 145: e20191382

COMPLEX UMBILICAL CORD KNOT

**BENEFITS OF KANGAROO CARE**

Kangaroo care = skin-to-skin contact with caregivers. It reduces mortality in LBW infants after they are stabilized, but what if initiated immediately after birth?

- 3200 infants with birth weight < 2 kg were randomized to 17 vs 1.5 hours of skin-to-skin contact in the NICU.
- Neonatal death occurred in 12% vs 15.7% in the first 28 days.
- Death occurred in the first 72 hours in 4.6 vs 5.8%.
- Trial stopped early due to ↓ mortality in treatment group.


**FETAL SURGERY: MMC REPAIR UPDATE**

Follow-up of children randomized to prenatal or post-delivery repair of MMC in the MOMS trial at 5-10 years old:

- Able to walk independently – 51% prenatal repair vs 23%
- Prenatal repair less likely to have a motor function level worse than their anatomic lesion level – RR 0.44
- Prior work already showed prenatal repair > better neuro-development and composite measures of self care.

JAMA Pediatrics online February 2021 + editorial

**AND WE’LL SEE WHAT’S NEW IN 2022!**

THE END
Objectives

1. Describe the epidemiology of DM and hyperglycemia in the perioperative period
2. Justify a management plan of pre and post-operative hyperglycemia
3. Discuss appropriate glucose control target
4. Formulate a plan for intra-operative insulin dosing, route and the impact of diabetic status

Introduction

- DM affects almost 10% of Americans
- 50% of diabetics will require surgery during their lifetime
- A third to half of patients with type 2 DM do not know they are diabetic at the time of surgery

Pre-operative Hyperglycemia

The prevalence of undiagnosed diabetes in non-cardiac surgery patients: an observational study
La prévalence de diabète non diagnostiqué chez les patients subissant une chirurgie non cardiaque: une étude observationnelle

Sharon Theodore, MD - Joseph B. Akins, MD - Jesu Scott, MD - Nils Persson, MD - Faozeh Niyazi, MD - Richard Zimmerman, MD - Miguel Aragones, MD - Joseph E. Fox, MD
Prevalence of Undiagnosed Diabetes in Non-cardiac Surgery Patients


All noncardiac surgery patients

- Impaired fasting glucose
  - 3,549 (10.5%)
- Undiagnosed diabetics
  - 3,426 (10.1%)

Nondiabetics with normal glucose level

- Impaired fasting glucose
  - 199 (7.9%)
- Undiagnosed diabetics
  - 133 (5.3%)

Nondiabetics with normal glucose level

- Impaired fasting glucose
  - 2,196 (86.8%)

Impact of Early Diagnosis of Diabetes

Early diagnosis and treatment of diabetes reduce its burden and poor consequences


- Suggest BG testing in all patients on admission
- Recommend A1c and monitoring of non-diabetics with BG > 140 mg/dL for 24-48 hours
- Recommend Hb A1c testing in inpatients diabetics

Pre-operative Hyperglycemia & Outcomes

Cancelling Elective Surgery For Hyperglycemia

- Retrospective review of total joint patients
- Pulmonary embolism (PE)
  - Up to a 4-fold increased risk with preoperative levels greater than 200 mg/dL
- Increased preoperative glucose levels are associated with periperaoperative mortality in patients undergoing noncardiac, nonvascular surgery

- In the Netherlands:
  - They compared 900 who died after their non-cardiac surgery with controls
  - Blood glucose levels > 200 mg/dL → 2.1-fold increased risk in overall mortality
  - 4-fold increased cardiovascular mortality
  - Risk of mortality was directly related to glucose concentrations between 110-200 mg/dL
Cancelling Elective Surgery

- The current evidence offers no guidance on:
  - Whether an elective procedure should be cancelled in light of a given level of hyperglycemia
  - A recommended management strategy
  - Optimal waiting period for controlling hyperglycemia before rescheduling
  - Whether such an intervention would indeed result in improvement in surgical outcomes

- Cancelling elective noncardiac surgery for mild to moderate hyperglycemia may not be justified
- On the other hand, in light of the documented risks associated with hyperglycemia, surgeries still get cancelled for severe hyperglycemia
- There may be potential risks associated with proceeding with surgery for:
  - BG >350 mg/dL
  - Any BG associated with diabetic ketoacidosis and/or hyperosmolar state

- 65,000 elective non-cardiac surgery patients between 2005 and 2009
- Hypotheses:
  - Pre-op BG is related to surgical outcomes (composite in-hospital morbidity/mortality, one-year mortality)
  - These relationships are dependent on the diabetic status
Hyperglycemia and Outcomes in the ICU

- ICU admission hyperglycemia was an independent risk factor for in-hospital mortality only in ND patients.
- Increased mortality with increasing mean BG concentrations in ND ICU patients compared to D.
- In the ICU intensive insulin therapy reduced mortality in all patients except for diabetics.


Krinsley JS: Glycemic control, diabetic status, and mortality in a heterogeneous population of critically ill patients before and during the era of intensive glycemic management: six and one-half years experience at a university-affiliated community hospital. *Semin Thorac Cardiovasc Surg* 2006; 18: 317-25

GLUCO-CABG Trial

- In this RCT:
  - Postoperative glucose control to 100-140 vs. 141-180 mg/dL.
  - Reduction in postoperative complication was observed among patients without diabetes and not in those with diabetes in the intensive control group.


Chronic Vs. Acute Hyperglycemia

- In a retrospective study by Egi et al.
- A time-weighted glucose level of > 180 mg/dL (10 mmol/L) during ICU stay was associated with a lower mortality in those with a preadmission HbA1c of > 7% compared to patients whose A1c was <7%.


The Impact of Diabetic Status

- Hyperglycemic diabetic may have reset their metabolism and can not tolerate normal (lower) glucose concentrations.
- Study bias: differential management by clinicians.
  - Clinicians' belief in differential sensitivity to IV insulin.
  - Fear of hypoglycemia.
- These results highlight the complex relationship between glucose metabolism and outcomes.


Surgical Stress Induced Hyperglycemia

- The Hyperglycemic Response to Major Noncardiac Surgery and the Added Effect of Thrombolysis Administration in Patients With and Without Diabetes.

Pattern of Intra-op Hyperglycemic Surgical Stress Response in Diabetics and Non-diabetics


- Prospective randomized trial, 1548 SICU patients
- Intensive insulin therapy (80-110) decreased:
  - Inflammatory markers,
  - Overall hospital mortality by 34%,
  - Blood stream infections by 46%,
  - Acute renal failure by 41%
  - Transfusion requirements

- A single center randomized trial
- 400 cardiac surgery patients
- Tight glycemic control 80-100 mg/dL intraoperatively or usual care (treat BG > 200 mg/dL)
- No difference in outcomes between the two groups
- There was a relatively small difference in blood glucose levels between the two groups
- All patients were admitted to ICU where they all received intensive glucose control


DeLiT Trial

- Multifactorial randomized single-center study
- We tested the primary hypotheses that major perioperative morbidity is reduced by:
  - 1) low-dose dexamethasone
  - 2) intensive intraoperative glucose control
  - 3) lighter anesthesia
- Patients ≥40 years of age, ASA ≤ 4 scheduled for elective major non-cardiac surgery


BMC Anesthesiol. 2010 Jun 30;10(1):11

Hypoglycemia with Tight Glucose Control

- VDB SICU: hypoglycemia was 5.1% compared to 0.8% in conventional group
- VDB MICU: hypoglycemia was 18.7% vs. 3.1% in conventional group
- Glucotrol: Stopped for hypoglycemia incidence of 9.7 vs. 2.7%
- VISEP: stopped after 537 patients for hypoglycemia incidence of 17.0 vs. 4.1%


0% severe hypoglycemia, and yet tight control did not help
108 vs 139 mg/dL
We used the same target for both diabetic and non diabetic

Abdelmalak B; Lansang C: Revisiting Tight Glycemic Control In Perioperative and Critically Ill Patients, When One Size Might Not Fit All,
RCT 6104 patients
Target 81-100 vs 144-180 mg/dL
Separated by 29 mg/dL
More death 27.5% vs 24.9% in tight vs conventional
Hypoglycemia rates 6.8% vs 0.5%
No difference in ICU or hospital LOS


Hyperglycemia and hypoglycemia are harmful
Tight control is not beneficial in cardiac and noncardiac surgery
Moderate target has been beneficial 140-180
Tighter target 110-140 may be beneficial in certain patients and situations
Use protocols that will achieve targets without hypoglycemia

Glycemic Management Target?

Hyperglycemia and hypoglycemia are harmful
Tight control is not beneficial in cardiac and noncardiac surgery
Moderate target has been beneficial 140-180
Tighter target 110-140 may be beneficial in certain patients and situations
Use protocols that will achieve targets without hypoglycemia

Routing of Insulin Administration

Insulin Induced Glucose Lowering Effects Per Unit of R Insulin I.V.

The intraoperative glycemic response to intravenous insulin during noncardiac surgery: a subanalysis of the DelIT randomized trial

Route of Insulin Administration

Cleveland Clinic
SQ Insulin Dosing

• Measured glucose minus 100/insulin sensitivity factor.
• Insulin sensitivity factor is equal to 1,800 divided by the patient’s total daily dose (TDD) of insulin.

SQ vs. IV

- SQ may be a reasonable choice for treating mild to moderate hyperglycemia.
- Concerns:
  - Varied absorption
  - Delayed onset and long duration of action
  - Challenging titratability and variability
  - Would not allow for timely management of dangerously severe hyperglycemia and thus the risk of “stacking” doses and the resulting hypoglycemia

Initiation of Insulin Infusion

- Single center, prospective, unblinded in 236 patients
- IV infusion + bolus vs boluses to treat BG > 150
- Intraoperative and post-op 48 hours
- Outcomes: composite of all-cause mortality, MI, and CHF
- 3.5% in the intervention group compared with the control group - 12.3%
Patient Safety Issues

- Many clinicians are unfamiliar with this evolving technology
- Substantial rates of pump failures have been reported, with complete failure in 44% of cases
- FDA announced that there has been a rise in problems with insulin pumps, both in the hardware and software -- grave consequences
- Hot or cold environments may decrease pump insulin effectiveness
- DKA developed from exposure of insulin pumps to heat and sunlight
- Excessive sweating can occur during or after surgery, potentially dislodging the subcutaneous needle or catheter

### Dynamic Insulin Infusion Protocol

<table>
<thead>
<tr>
<th>Short (&lt; 1 hour)</th>
<th>Intermediate (1-3 hours)</th>
<th>Long (&gt; 3 hours)</th>
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<tr>
<td><strong>Procedure</strong></td>
<td><strong>Conclusions</strong></td>
<td><strong>Procedure</strong></td>
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<tr>
<td>1. If blood glucose is above patient's usual target, take patient's own insulin pump and with 12.5-25.0 cc of Dextrose 50% IV, re-check glucose in 5 minutes.</td>
<td>1. If blood glucose is greater than 250 mg/dL, check for external factors such as stress, wound, infection, or ketosis. 2. For all patients with new diagnosis of diabetes or insulin pump therapy, consider using oral hypoglycemic agent or insulin pump basal rate of 1 unit/hour or 0.5 unit/hour based on patient's usual insulin dose.</td>
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### Management of Patients Using Insulin Pumps

- For patients presenting for surgery using insulin pump
  - Non-emergency surgery
    - May start insulin pump ½ hour prior to discontinuation of IV insulin infusion.
    - If basal rate > 1 unit/h, start IV insulin at 2/3 of the basal rate.
    - If basal rate < 1 unit/h, start IV insulin at 0.5 unit/h.
  - Emergent surgery
    - Patient may resume self-management of insulin pump
    - IV insulin infusion should continue for the duration of surgery.

- For patients presenting for surgery using insulin pump and undergoing non-emergency surgery
  - Non-emergency surgery
    - May start insulin pump ½ hour prior to discontinuation of IV insulin infusion.
    - If basal rate > 1 unit/h, start IV insulin at 2/3 of the basal rate.
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  - Emergent surgery
    - Patient may resume self-management of insulin pump
    - IV insulin infusion should continue for the duration of surgery.
Postoperative Glycemic Management

- Postoperative hyperglycemia was associated with worse outcomes in both cardiac and non-cardiac surgery.
- Moderate targets are preferred.
- Both basal bolus, and basal plus regimens have been both more effective compared to SSI.

Umpierrez GE, et al: Randomized Study Comparing a Basal Bolus With a Basal Plus Correction Insulin Regimen for the Hospital Management of Medical and Surgical patients With Type 2 Diabetes: Basal Plus Trial. Diabetes Care 2013

Using Technology in the OR

- Real time audiovisual alerts improve the rate of glucose measurement and management
- A perioperative systems design to improve intraoperative glucose monitoring is associated with a reduction in surgical site infections in a diabetic patient


Summary

- An alarming proportion of our surgical patients are hyperglycemic and many are undiagnosed diabetics
- Hyperglycemic surgical stress response is real, and is not linear throughout surgery
- It is OK to administer steroids for PONV to patients with and without DM
- Close monitoring of blood glucose levels intraoperatively is of prime importance

Summary Contd.

- Symptoms and signs of hypo and hyper glycemia are for the most part masked by general anesthesia
- Intra-op tight glucose control is not beneficial neither in cardiac nor in non-cardiac surgery
- Consequences of untreated hypoglycemia are grave
- Current evidence supports moderate targets and IV insulin infusion + boluses for BG management intraoperatively
Polling Question #1
A 25-year-old G3P2 woman at 37 weeks gestation arrives for external cephalic version (ECV) for breech presentation and inquires about the risks and benefits of anesthetic intervention. Which of the following is MOST likely to improve the success rate of ECV?
A. IV anesthesia
B. No anesthesia
C. Neuraxial anesthesia
D. Inhaled nitrous oxide

Answer
C. Neuraxial anesthesia
- ECV: for abnormal fetal presentation between 36 and 38 wks gestation.
- No anesthesia is required but...
- Higher success with neuraxial anesthesia compared to no, inhalation, or IV anesthesia.
- All anesthetic techniques improve procedure-related pain.

Anesth Analg. 2020; 131: 1800-1811

Polling Question #2
A pregnant woman at term is in labor and requests neuraxial analgesia. She has Factor V Leiden mutation and has been treated with heparin 5,000 U subcutaneous TID for 2 weeks, with the last dose 10 hours ago. Which of the following is the MOST appropriate next step?
A. Proceed with neuraxial anesthesia
B. Wait 2 hours
C. Tell the patient that she’s not a candidate for neuraxial anesthesia
D. Obtain a platelet count

Answer
D. Obtain a platelet count
- Check a platelet count when patients receive heparin therapy for >4 days to exclude heparin-induced thrombocytopenia (HIT) before proceeding with neuraxial block.
- ASRA guidelines address the timing of neuraxial block in the setting of thromboprophylaxis with heparin.
- Low-dose subcutaneous heparin (dosing regimen of 5,000 U BID or TID): neuraxial block may occur 4-6 hours after the last dose.
- Guidelines: obtain a platelet count for patients receiving subcutaneous heparin for more than 4 days due to risk of HIT.

Anesth Analg. 2018; 126: 928-94
Polling Question #3
A 27-year-old postpartum woman receives an epidural blood patch for treatment of a postdural puncture headache. She describes complete headache relief, but her symptoms return 2 days later. Which of the following options is MOST appropriate?
A. Obtain a neurology consult  
B. Repeat the epidural blood patch  
C. Oral ibuprofen  
D. Intravenous caffeine

Answer
B. Repeat epidural blood patch (EBP)
Unintentional dural puncture: PDPH more than 50% of the time in OB patients.
• PDPH causes profound morbidity: early diagnosis
• New evidence suggests long-term morbidity and consequences.
• EBP is the gold standard for treatment. ~70% success.
• If PDPH symptoms recur after a successful EBP, a second EBP is likely to be beneficial.
• Little benefit from oral analgesics. Minimal evidence that caffeine (oral or IV) is effective in the treatment of OB PDPH.

Polling Question #4
29-year-old G1P0 woman has gestational thrombocytopenia and presents in active labor. She has no clinical history of bleeding or any signs of coagulopathy. At which of the following platelet count thresholds does the benefit of neuraxial anesthesia likely outweigh the risk of spinal epidural hematoma?
A. ≥ 50 x 10^9/L  
B. ≥ 60 x 10^9/L  
C. ≥ 70 x 10^9/L  
D. ≥ 100 x 10^9/L

Answer
C. ≥ 70 x 10^9/L
According to the 2021 Society for Obstetric Anesthesia and Perinatology consensus statement, the risk of spinal epidural hematoma associated with a platelet count of 70 x 10^9/L or greater is likely to be very low and the benefits of neuraxial anesthesia outweigh the risks.

Polling Question #5
You are considering placing an epidural in your patient whose platelet count is 76 x 10^9/L. According to a recent meta-analysis, which of the following is MOST likely true regarding the complication of spinal epidural hematoma after lumbar neuraxial procedures in thrombocytopenic patients?
A. More than 100 cases of spinal epidural hematoma were reported from 1947 to 2018.  
B. Spinal epidural hematoma was rare in OB patients.  
C. Spinal epidural hematoma was most commonly seen after a combined spinal-epidural procedure.  
D. None of the above.

Answer
B. Spinal epidural hematoma was rare in OB patients.
• Systematic review and meta-analysis: 131 articles; 7,509 lumbar neuraxial procedures performed in thrombocytopenic adults and children from 1947-2018.
• 33 total spinal epidural hematomas
• Spinal epidural hematoma event rate (0.097%) was found in patients with a platelet count of 75,000 x 10^9/L or above.
• Of 5 OB cases, platelet counts ranged from 44,000 to 91,000 x 10^9/L.
Polling Question #6

36-year-old G1P1 postpartum woman presents to the ED with complaints of non-positional headache. She had an uncomplicated epidural placement and vaginal delivery 1 week ago. Her BP is 160/100 mmHg. The ED doc is requesting a blood patch. **What is the most likely diagnosis?**

A. Meningitis  
B. Postdural puncture headache  
C. Postpartum preeclampsia  
D. Cerebral vasoconstriction syndrome

Answer

C. Postpartum preeclampsia  
- Readmission >2 day or < 6 weeks after delivery for headache (70%) and SOB (30%)  
- Risk factors similar to other preeclampsia  
- Key features of this case: hypertension, non-positional headache

Polling Question #7

**Which of the following are included in the ERAC recommendations?**

A. Minimize fasting  
B. Preoperative carbohydrate loading  
C. Use of neuraxial anesthesia  
D. Initiate multimodal analgesia based on long acting neuraxial opioids  
E. All of the above

Answer

E. All of the above

Commonly used anesthesia-related components of ERAC protocols  
- Minimize fasting; encourage clear liquids up to 2 hours before surgery  
- Suggest preoperative oral carbohydrate loading  
- Use neuraxial anesthesia  
- Administer antibiotic prophylaxis  
- Initiate multimodal analgesia based on long acting neuraxial opioid  
- Administer prophylaxis for intraoperative and postoperative nausea and vomiting  
- Maintain normothermia [e.g., warm the OR, warm IV fluids, use forced air warming]  
- Optimize IV fluid administration, aiming for euvolemia  
- Promote early skin to skin contact, mother and neonate

Polling Question #8

A 35 y/o G1P0 is at 6 cm cervical dilation and is having pain during contractions. You placed her epidural about 8 hours ago when she was 3 cm (easy placement).  

**What is your initial plan to treat her pain?**

A. Nothing – tough it out  
B. Volume! (10-15 mL 0.125% bupivacaine)  
C. Density ◦ (0.25% bupivacaine +/- opioid)  
D. Replace epidural
Maternal Risk Factors | Obstetric Risk Factors
---|---
Obesity | Nulliparity
Structural back abnormalities | Increased fetal weight
Chronic low back pain | Abnormal fetal position
Opioid tolerance | Induction/augmentation of labor
Increasing age | Epidural request at cervical dilation > 7 cm
| Prolonged/rapid labor progression

Polling Question #9

Which of the following statements is most likely true about maternal mortality in the U.S.?

A. Few deaths are preventable
B. Rates of death due to preeclampsia are increasing
C. Racial disparity is rarely a factor
D. Pregnancy-related mortality rates are high compared to the rest of the developed world

Polling Question #10

Which of the following statements is most likely true about litigation after obstetric nerve injury?

A. Childbirth by itself is a less common mechanism of nerve injury than neuraxial anesthesia.
B. Prior to neuraxial anesthesia, consent is generally adequate for addressing risks.
C. There is often delayed neurologic recovery after neuraxial blockade.
D. Anesthesia providers are often inaccurate in identification of the L3–4 interspace, increasing risk for nerve injury.
Polling Question #11
Which of the following statements is most likely true local anesthetic systemic toxicity (LAST)?

A. LAST resuscitation differs from ACLS-guided resuscitation.
B. The order (bolus or infusion) and method of lipid emulsion 20% is not critical.
C. If needed, a smaller than normal dose of epinephrine is preferred (≤ 1 mcg/kg).
D. Benzodiazepines are preferred over propofol when airway management is necessary.
E. All of the above.

Answer
E. All of the above.

• LAST resuscitation differs from ACLS-guided resuscitation. Many standard ACLS drugs worsen LAST outcomes.
• The order (bolus or infusion) and method of lipid emulsion 20% is not critical.
• Use smaller doses of epinephrine (< 1 mcg/kg), if needed.
• Benzodiazepines are preferred over propofol when airway management is necessary.

Polling Question #12
A 27-year-old obese primigravida receives an epidural for labor analgesia. A 6-mL bolus of 0.125% bupivacaine was followed by a PCEA infusion of 0.125% bupivacaine with 2 μg/mL of fentanyl at a rate of 8 mL/h. Approximately one hour after initiation of the infusion, the patient was noted to exhibit Horner syndrome. Which of the following steps would be MOST appropriate for management of this patient?

A. Request an immediate neurosurgery consult.
B. Obtain a CT or MRI of the neck.
C. Temporarily stop the epidural infusion.
D. Remove the epidural catheter.

Answer

A. Request an immediate neurosurgery consult.
Answer

C. Temporarily stop the infusion via the epidural catheter.

- Horner’s syndrome: can occur after epidural anesthesia.
- Local anesthetic migrates cephalad and produces blockade.
- Decreased capacity of the epidural space during pregnancy and in the obese predisposes to migration of LA.
- Symptoms resolve simultaneously in a few hours.

Polling Question #13
Which of the following is/are true regarding sugammadex administration in pregnancy and during breastfeeding?

A. Sugammadex should be avoided in early pregnancy
B. Avoid or use sugammadex with caution in term pregnancy
C. Sugammadex is safe to use in patients with established lactation
D. In patients of reproductive age, sugammadex is safe to use when patients are counseled
E. All of the above

Answer

E. All of the above.

- In-vitro studies suggest that sugammadex binds to progesterone.
- Avoided because progesterone is needed to maintain the pregnancy.
- Can be used in patients undergoing CD under GA but evidence is limited regarding extent of drug exposure through breast milk.
- Sugammadex is safe to use in patients with established breastfeeding.
- Patients of reproductive age should be counseled about contraceptive use if they’ve received sugammadex.

www.soap.org

Polling Question #14
A parturient with pulmonary HTN is undergoing urgent CD with spinal anesthesia due breech presentation and fetal macrosomia. She is currently taking sildenafil three times daily for the pulmonary HTN. The obstetricians are having difficulty delivering the fetus and request sublingual nitroglycerin, which you refuse. You refuse because of which of the following adverse effects?

A. Uterine hypertonicity
B. Hypotension
C. Bradycardia
D. None of the above

Thank you!
See you all next year!
Conflict Management In & Out of the OR
Change Management; C-Suite Interactions; Surgeons
Basem Abdelmalak, MD; Professor, Cleveland Clinic Lerner College of Medicine
Angela Selzer, MD; Associate Professor, CU Department of Anesthesiology
Thomas Majcher, DO; Professor of Clinical Practice, CU Department of Anesthesiology
Moderator: Beth Benish, MD; Associate Professor, CU Department of Anesthesiology

Conflict Management in and Out of the OR: C-Suite Interactions
Basem Abdelmalak, MD, FASA, SAMBA-F
Professor of Anesthesiology
Director, Anesthesia for Bronchoscopic Surgery
Director, Center for Procedural Sedation
Anesthesiology Institute, Cleveland Clinic
Past President, Society For Ambulatory Anesthesia
Past president, Society For Head and Neck Anesthesia

No Financial Disclosures

Interaction With the C Suite

Interactions With the C Suite: Where to Begin
► Excel at what you do
► Maintain professionalism
► Know your C suite members
► Speak their language

Interactions With the C Suite: How to Maintain
► Build relationships
► Be helpful
► Be present and known (in a good way 😊)
Interactions With the C Suite: How to Approach

► Explain the challenge
► Present data
► Show Value:
  Value: Product (Service/Quality)
  Cost

Conflict Resolution with the C Suite

Strategies to Resolve Conflict

► Do not fight nor flight
► Distance is not a strategy: doesn’t mitigate conflict
► Conflict in the virtual world
► Giving the benefit of the doubt and being empathetic can get you a long way in resolving conflict


Before You Start the Conflict Resolution

► Define the cause of the conflict: Make sure both parties know what the conflict is really about.
► Accept your opponent’s view: does not mean agreeing with it. It simply means you understand the difference of opinion.
► Be specific about your complaints: “My idea about the new protocol was unjustly ignored”
► Resist getting involved: if the conflict does not involve you or your responsibilities.

11 Tips For Conflict Resolution in the Workplace for Managers | HR C-Suite (hrcsuite.com) https://hrcsuite.com/conflictresolution/

During the Conflict Resolution

► Keep it private: do not be part of the gossip
► Depersonalize the conflict: C Suite vs. you to People vs. problem.
► Listen actively
► Vent. once both parties have been able to vent their issues, they generate solutions more easily
► Acknowledge anger, but refrain from letting it take over the conflict resolution process
► Look for win-win solutions
  ► Thinking outside of the box.
  ► Compromise.

11 Tips For Conflict Resolution in the Workplace for Managers | HR C-Suite (hrcsuite.com) https://hrcsuite.com/conflictresolution/
After an Agreement Has Been Made

- Document the solution and the plan of action.
- Accountability
- Follow up
- Legal considerations

Thank you for your attention!

Conflict Management while Leading Change

Angela Selzer, MD
Associate Professor of Anesthesiology
University of Colorado
Medical Director, Pre-Procedural Services

No Financial Disclosures

So, you want to initiate a change?

- Implement an ERAS protocol
- Order new equipment
- Update your staffing model
- Improve staff orientation
- Improve prep area
- Develop an anemia pathway
- Reduce unnecessary testing
- …?

Change is Necessary!

If you are not actively working on improving, you are getting worse. We need change!
Change is Great!
- We all want to get better
- Institutions want to improve
- Hospitals and health care workers all want to provide the best possible care

But...
- Institutions are designed to resist change
- People struggle with change
- Change is hard and often painful
- Any change creates conflict!

Personal Experiences with Change:
- Case #1: Becoming medical director of Pre-Procedure Services

Reality:
- The clinic had been run and managed by nurse practitioners for 20 years without physician involvement
- The clinic NPs liked being independent (for the most part)
- The NPs didn’t understand why a medical director was being hired
- In general, they did not see an “upside” to this position because they were happy with things the way they were

Case #1: Medical Director Position
- Case #1: Becoming medical director of Pre-Procedure Services
- Reality:
  - The clinic had been run and managed by nurse practitioners for 20 years without physician involvement
  - The clinic NPs liked being independent (for the most part)
  - The NPs didn’t understand why a medical director was being hired
  - In general, they did not see an “upside” to this position because they were happy with things the way they were
Why are we being asked to do this, who does this person think she is? I'm just going to keep doing things my way anyway, she'll give up eventually.

I realize now that I could do this better but I guess this means I wasn't doing well before...

I'm going to try, but when it gets hard or doesn't work right away I want to give up.

Ok, I'm going to go along with this now because it's not going away, I'll need to keep working on troubleshooting difficulties with this process.

I can't believe we ever did this any other way, I understand why we do things this way and can explain to and train others.
Lessons:
- When asked to lead in a new role, remember you are the novice (regardless of academic expertise)
- Spend as much time as you can listening and learning
- Do this first, before making any changes
- Prioritize their issues before your own objectives
- Be available for criticism
- Expect normal reactions to change
- Be patient and try to see things from their perspective
- Don’t make too many changes at once!

Case #1: Medical Director Position

Case #2: Developing a faculty group

Conflict:
Needed a faculty group to staff clinic
but
Opinion of and interest in participating in the clinic was very low

Solutions:
Recruit the most vocal critics
Tap into overlooked talents
Be grateful and supportive

Case #3: Ending the printing of patient charts

Conflict:
Unnecessary waste of staffing resources & paper
but
NPs "need" printed copies to complete their work

Solutions:
Understand the insecurities this change reveals
Provide an alternative
Make a clear new standard
Reinforce clinic values
Celebrate those who were resistant but able to adapt to the new process

Case #4: Creating guidelines for screening

Conflict:
Surgeons wanted their patients to be seen in our clinic
but
The RN screening the patient would decide a patient didn’t need to be seen by us based on her own criteria

Solution:
Look further into the process
Reinforce the mission of the clinic
Create clear guidelines
Seek feedback
Have a process for continued follow up
Ultimately, staff who are unwilling to change may need to move on

Conflict with Surgeons
Your patient is not NPO, but the surgeon wants to proceed. What do you do now?

Thomas Majcher, DO, Professor of Clinical Practice, CU Department of Anesthesiology
Story

- It’s 0945, you are seeing a 16-month-old for a one-hour elective surgery scheduled at 1000.
- The family drove in from Cheyenne this morning and our patient ate an unknown quantity of spilled Cheerios found in his car seat.
- Parents discovered this at 0600, cleaned up the Cheerios and re-started NPO.
- Hospital policy suggests 6 hours fasting prior to surgery, after a light meal.
- The surgeon has clinic starting at 1300.
- The family and surgeon are upset when you consider cancelling for today.

Why is the anesthesiologist-surgeon relationship important?

- It makes life easier.

... and sets the tone in the operating room.

A great relationship improves Operating Room productivity.
Critical Role of the Surgeon-Anesthesiologist Relationship for Patient Safety

Jeffrey D. Cooper, Ph.D.

ABSTRACT

The relationship is a high-stakes partnership vital to quality patient care. The role of the anesthesiologist is often misunderstood by surgeons, which can lead to conflict and a lack of trust. This article discusses the importance of effective communication and collaboration between surgeons and anesthesiologists to improve patient outcomes. It addresses common challenges and provides strategies for building a strong, collaborative relationship.

Dispelling Myths

- Concerned with finishing the day rather than serving patient needs
- Unreasonable eagerness to cancel procedures
- Lack of concern to maintain a schedule
- Long turnover times
- Failure to communicate vital sign changes/pressors
- Rigidity around anesthetic technique

Perceptions of Anesthesiologists

- Concerned with finishing the day rather than serving patient needs
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Perceptions of Surgeons

- Unknowledgeable about medical (anesthesia-related) issues
- Failure to perceive or acknowledge extent of blood loss
- Underestimation of surgical time
- Portraying unrealistic expectations to patients and families
- Failure to consider patient desires
- Discouraging others to speak up about safety concerns

System Fixes

- Anesthesiologists and surgeons both participating in patient simulation sessions with consideration for appropriate interactions, communication
- Huddles at beginning of day
- Debriefings after last case
- Multidisciplinary case review, M&Ms

How to develop a relationship with your surgeons

- New encounters are often a source for problems
- Introduce yourself
- Communicate, close the loop
- Anticipate issues and discuss
- Get to know your surgeons
- Have mutual respect
- Keep the patient first

Surgeon-Anesthesiologist Relationship

(J.B. Cooper)

- How well they get along
- How much they rely on each other for advice
- Do they keep each other informed on actions impacting their dyadic partner

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(J.B. Cooper)

- How well they get along
- How much they rely on each other for advice
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Conflict Management (Indeed.com)

- Take immediate action: Minimizes tension and keeps others out of the disagreement.
- Frame the discussion positively: Say "I'd like to get your opinion on this matter".
- Focus on the issue, not the person: Avoid personal attacks and focus on problem-solving.
- Practice active listening: Eye contact, open-ended questions to understand their message without interruption. Re-state your understanding of the issue: "I hear you saying..."
- Encourage consensus: Often possible without compromising patient care.

So, what about that NPO patient?

- I listened and understood the surgeon's and family's perspective
- Busy clinic starting at 1300
- Lunch from noon until then
- We delayed the case until noon (the surgeon ate lunch at 1100)
- The case went without incident.
- Everyone compromised, but not patient safety!
Tuesday, March 1st
NORA Challenges and Pitfalls

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Director, Anesthesia for Bronchoscopic Surgery
Director, Center for Procedural Sedation
Anesthesiology Institute, Cleveland Clinic
Past President, Society For Ambulatory Anesthesia
Past president, Society For Head and Neck Anesthesia

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Objectives

- Enlist sources of complexity in NORA and propose solutions
- Identify a framework for a successful efficient NORA service
- Outline safety issues related to sedation and anesthesia in NORA
- Discuss interventions to improve NORA outcomes

Conflict Of Interest Disclosure

- Consultant and Speaker – Medtronic and Acacia Pharma
- Past-president, Society for Ambulatory Anesthesia (SAMBA)

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- Patients have consented to the presented pictures
- Moreover, the identifying features have been covered to the extent possible to ensure privacy

NORA: Definition

Any anesthesia service provided in a location (procedure room, CT/MRI suite, etc.) outside the main operating room pavilion

Old term: “Remote” Anesthesia

Locations for NORA Services

- Gastroenterology Endoscopy Suite
- Interventional Radiology areas including CT
- Bronchoscopy Suite
- Cardiac Catheterization Lab
- Electrophysiology Lab
- MRI (diagnostic, and surgical)
- Nuclear Medicine
- PACU (Electroconvulsive therapy)
- Pain Management procedure rooms
Why Did NORA Exist?

- New advances in the procedures:
  - Not requiring the full capabilities of an operating room
  - Requiring complex and immobile technology
- Higher risk patients who were not previously considered candidates for any intervention, now have an option
- Economic trend for more outpatient vs. inpatient services
- Procedural sedation Vs. Anesthesia services

Sources of Complexity and Challenge In NORA

- Space
- Equipment
- Staff
- Patients
- Procedures
Modern Bronchoscopy Suite


Minimal Requirements For Anesthesia In NORA

- A reliable oxygen source along with backup
- Adequate suction
- Ability to scavenge waste gases
- A resuscitator bag
- Anesthetic meds, monitoring equipment, and supplies
- Adequate lighting and electrical outlets
- Sufficient space

ASA Guidelines for Nonoperating Room Anesthetizing Locations. Approved by the ASA HOD on October 15, 2003 and Last amended on October 16, 2013

Minimal Requirements For Anesthesia In NORA Contd.

- Unobstructed access to the patient, anesthesia equipment, and emergency supplies
- Emergency cart with a defibrillator
- Building codes and facility standards
- Adequately trained staff for immediate assistance
- A reliable two-way communication to request additional assistance
- Adequate post-anesthesia care

ASA Guidelines for Nonoperating Room Anesthetizing Locations. Approved by the ASA HOD on October 15, 2003 and Last amended on October 16, 2013

Sources of Complexity and Challenge in NORA

- Space
- Equipment
- Staff
- Patients
- Procedures

Staff Proceduralist

- Stranger in a strange land
- This can impede teamwork
- Proceduralists may have unrealistic expectations
- COMMUNICATION
- TEAM BUILDING

Anesthesia Services Staffing

- Anesthesiologist only
- Similar to other assignments
- Anesthesia Care Team
- Geographic proximity of sites
- Requirement to "remain immediately available"
- Teaching Physician
- CMS billing rules versus accreditation standards
- Supervision
- When might this be appropriate versus medical direction?
Solutions for Large Vs. Small Centers

- Large centers may have enough demand to run NORA as mini procedures suites to allow efficient staffing
- Small centers can plan for renovations/new construction aiming for multi-purpose suites and/or within the main OR pavilion for better efficiency

Adopted with permission from Dr. Alan Marco

Scheduling of Anesthesia Services

- Block time versus fitting into gaps
- If sufficient volume, block time may improve utilization
- Scheduling full days rather than partial days of coverage should improve efficiency
- For lower volume services, a long day every other week rather than shorter blocks every week
- Economic goal is to reduce overutilized time
- More expensive than underutilized time

Adopted with permission from Dr. Alan Marco

Sources of Complexity and Challenge in NORA

- Space
- Equipment
- Staff
- Patients
- Procedures

Analysis to Establish Differences in Efficiency Metrics Between Operating Room and Non-Operating Room Anesthesia Cases

- Retrospective, university MC, 2015 data
- Faster turnover 16 Vs. 37 min
- Less case cancellation .86 Vs 1.35%
- Delayed first case start time 24 Vs. 11 min

Re-do PVI in EP Lab

- 61 Y/O male: 92 Kg / 6', MP I, short TM
- Admitted to re-start Tikosyn and for treatment of CHF
- PMH:
  - HTN, CAD with large remote anterior MI, s/p PCI, remote 4v CABG, s/p ICD for VF arrest
  - Severe LV dysfunction EF 30%
  - Longstanding atrial tachyarrhythmia (s/p surgical cryoMAZE then catheter based PVI)

Severe Comorbidity and Aspiration Risk

- 65 Y/O male, severe AS, who has a PE
- Gastric outlet obstruction due to stomach CA, scheduled for EGD and BX
- Would you accept him in the endoscopy suite?
- MAC? Vs. GA
- RSI? with or without cricoid pressure? Or awake intubation?
- Invasive monitors?
EGD For LVAD Patients

- Increased need due to acquired VW
- Pulsatile Vs non pulsatile
- Monitoring oxygenation and perfusion
- Pump flow and pulse index

Routine EBUS with a Twist

- 70 Y/O F
- HTN
- Chronic hoarseness
- COPD
- Rt renal mass
- LUL 6.9cm mass associated with mild left hilar adenopathy
- Scheduled for staging EBUS/TBNA

Sources of Complexity in NORA

- Space
- Equipment
- Staff
- Patients
- Procedures

CT Guided Lung Cancer Cryoablation

- 70 year old patient scheduled for cryoablation of LU lung cancer.
- A fib takes sotalol, pradaxa
- COPD uses supplemental O₂ @ 3L
- LLE embolism resulting in a BKA
- ETOH abuse, cut back to 3 beers QD

Issues and Complications

- Procedure specific
  - Lung parenchymal hemorrhage
  - Pneumothorax
  - Hypothermia
  - Loss of airway
- Patient specific
  - Alcohol withdrawal
  - Chronic hypoxemia

NORA Service Specific issues
Anesthetic Considerations And Techniques For Advanced Diagnostic And Therapeutic Bronchoscopy

Challenges in GI NORA
- Monitoring ventilation
- Airway management
- NPO status
- LVAD patients
- CO₂ Bowel insufflation

Indications for Intubation in GI Endoscopy
- Patient related
  - Emergency
  - Significant cardiac or respiratory comorbidities
  - Sepsis
  - Intestinal obstruction (esophagus, stomach, duodenum or small or large intestines)
- Procedure related
  - Long duration of procedure
  - Complex procedure
- Anatomical problems
  - Complex anatomy
  - Short gut syndrome
  - Zenker’s diverticulum
  - Short Roux-N-Y loop
  - Large hiatus hernia
  - Morbid obesity
- Anesthesia related
  - Known difficult intubation
  - Inadequate NPO duration
  - Retained food
  - CO₂ use during the endoscopy

Other Challenges
- Hypovolemia from bowel prep
- Uncorrected anemia from GI Bleed
- Bradycardia, and/or arrhythmia from bowel distension, or scope insertion
- Other complications:
  - Bleeding
  - Perforation
  - Aspiration

Policies and Procedures: Definitions
- POLICY:
  - a mandatory, high level overall standard to establish a course of action toward organization and/or enterprise-wide accepted strategies and objectives.
- PROCEDURE:
  - provides detail on how to implement an existing policy
- GUIDELINE:
  - suggested best practice which sets out a process to follow in a particular set of circumstances to reach certain quality outcomes. Guidelines are not mandatory.
Preop NPO Guidelines

<table>
<thead>
<tr>
<th>Ingested Material</th>
<th>Minimum Fasting Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear liquids</td>
<td>2h</td>
</tr>
<tr>
<td>Breast milk</td>
<td>4h</td>
</tr>
<tr>
<td>Infant formula</td>
<td>6h</td>
</tr>
<tr>
<td>Non-human milk</td>
<td>6h</td>
</tr>
<tr>
<td>Light meal</td>
<td>6h</td>
</tr>
<tr>
<td>Regular meal</td>
<td>8h</td>
</tr>
</tbody>
</table>

Recovery and Discharge Common Questions:

- Requirement for urination before discharge?
- Requirement for drinking clear liquids?
- Responsible adult to accompany them home?
  - Adult observation overnight???
- Minimum duration of stay in recovery?

NORA and COVID-19

- Follow the same COVID-19 screening testing policy as in the main OR
- Follow the same infection control practices

Other Guidelines/Policies

- Pre-op evaluation
- Infection control
- Medication management
- Endoscope management
- Pacemaker/AICD management

ASA COVID-19 Resources Free to All
WWW.ASAHQ.ORG
Bronchoscopy Under Procedural Sedation

New Relevant Publications

Bronchoscopy challenges during the COVID-19 pandemic
Published July 31, 2020

COVID-19 and anesthetic considerations for head and neck surgeries and bronchoscopy and dental procedures

Procedural sedation in the COVID-19 era
Published May 20, 2020

https://www.ccjm.org/cc/covid-19-curbside-consults

Bronchoscopy Under Procedural Sedation

- Many patients are home oxygen dependent
- Even if not, they typically require many liters of oxygen supplementation
- Frequent coughing would increase the aerosolization of the virus during and after this already AGP,
- Use of the nasal route for bronchoscopy is common, known for high virus load
- Thus, Consider General Anesthesia

Registry and QI Process

Patient Safety in NORA

- 12 M NACOR patients from 1500 facilities
- NORA patients were older
- MAC is more common in NORA
- Most common minor complications: PONV, and pain
- Hemodynamic instability was reported in 0.1% of NORA patients
- Respiratory complications in 0.09%,
- Both significantly lower than rates reported in the OR data
Patient Safety in NORA

- Overall mortality was greater in OR patients compared to NORA patients, 0.4 vs 0.2%, respectively.
- The cardiology and radiology areas had a mortality rate significantly greater than the OR of 0.5%.
- Wrong patient/side procedures were higher in NORA.

Closed claims study

- In MAC cases, respiratory depression was responsible for 21% MAC-related claims.
- Over half of these adverse events were felt to be preventable with better monitoring. 

Wrong patient/side procedures were higher in NORA

- Compared with OR claims, those in the NORA locations are more often associated with patient death, issues with ventilation and higher payout.

Closed claims study

- In MAC cases, respiratory depression was responsible for 21% MAC-related claims.
- Over half of these adverse events were felt to be preventable with better monitoring.

Wrong patient/side procedures were higher in NORA

- Compared with OR claims, those in the NORA locations are more often associated with patient death, issues with ventilation and higher payout.

Monitors in NORA

- Electrocardiogram
- Blood pressure (manual, automatic, arterial catheter)
- Capnograph
- Oxygen analyzer
- Anesthetic agent concentration analyzer
- Temperature (when indicated)
- Gas flow/plethysmography (part of anesthesia machine)
- Airway pressure monitor (part of anesthesia machine)
- Airway disconnect alarm
- Nerve Stimulator (where non-depolarizing muscle relaxants have been used)
- Urometer (measure urine output - where appropriate)
- Depth of hypnosis monitor (optional, more so preferred for TIVA)

Summary

- NORA is growing fast, and its future is bright.
- Some complexities can be addressed by pre-planning such as the space, equipment and personnel challenges.
- We have to be familiar with, prepared for, and ready to manage patients’ comorbidities.
- Successful safe delivery of NORA would require well thought out plan and organization.
Summary Contd.

- Patient safety in NORA areas is our #1 priority and focus
- Flexibility is needed to tailor and modify old anesthetic techniques and develop new ones to meet the new needs
- Effective communications and team work are essential for successful management of these challenging cases

Thank you for your attention
Basem Abdelmalek, MD, FASA, SAMBA-F
abdelmb@ccf.org
@basemcc
Optimizing Patients from the ICU—Pearls for Practice
Breandan L. Sullivan MD
Associate Professor, University of Colorado School of Medicine
Co-Medical Director Cardiothoracic Intensive Care Unit

2020–2022

THE YEARS OF THE LUNGS!

• Ventilator Management
• Case Based Discussion

Case
• 45 y/o coming to the OR emergently cold leg
• Intubated in ED 5 days ago
• Progressive Hypoxemia
  • Covid-19 pneumonia
  • Sedated, intubated, paralyzed
• PMH: obesity BMI 35, newly diagnosed diabetic, smoker, unvaccinated
• Sound familiar?

Vent Settings
• Pressure Control
  • 15/10
• Tidal Volumes
  • 350 ml (6 ml/kg of ideal body weight)
• Minute Ventilation
  • 6 L/min
• PEEP
  • 10 cm H2O
• Plateau Pressure
  • 25
• Saturations/most recent ABG/Fio2
  • 94%
• I/O’s (fluid goals for the day)

What are we dealing with?
What do I need?
• Transport ventilator vs ambu bag
• Can My anesthesia machine match this?
• Does the surgery/anesthesia require different vent settings?
• Tidal volumes vs plateau pressure vs PEEP
• Drive Pressure?
Nuances in vent management

• Tidal Volumes
• High/Low PEEP
• Plateau Pressures
• Delta Pressure
  • Drive pressure!!!!!
  • Plateau PEEP

Outline

• Define ARDS
  • American-European Consensus Definition
  • Berlin Definition

Acute Respiratory Distress Syndrome

• Definition 1994
  • American-European Consensus Conference
  • Incidence in literature all over the place
  • How do you study a disease if nobody agrees what the disease is?

Acute Respiratory Distress Syndrome

• Acute Lung Injury
  • PaO2:Fio2
    • Less then 300
  • ARDS
    • PaO2:Fio2
    • Less then 200
  • Exclusion criteria
    • Low cardiac output syndrome
    • Pulmonary Capillary Wedge Pressure >18mmHg

Problems with the old definition

• Concurrent ARDS and ALI
• No consideration of vent settings
• Rare use of PA catheters in critically ill patients
  • Reliance on echocardiography
• Heart failure co-exist with ARDS
  • PAWP criteria removed

Confusing?

Acute Lung Injury
(lung inflammation)

Acute Lung Injury
(less severe)

ARDS
(severe)
Concerns

- Reliability
- Validity
- Here come the Germans!

Berlin Definition

- Consensus Panel
  - 2011
  - European Society of Intensive Care Medicine
  - American Thoracic Society
  - Society of Critical Care Medicine
  - 3 Mutual Exclusive Categories of hypoxemia
  - Better Predictor of Mortality

Berlin Definition

- Mild
  - $\text{PaO}_2 : \text{FiO}_2$
  - 200-300
  - PEEP>5

- Moderate

- Severe

Berlin Definition

- Mild
  - $\text{PaO}_2 : \text{FiO}_2$ 100-200
  - PEEP>5

- Moderate

- Severe

Berlin Definition

- Mild

- Moderate

- Severe
  - $\text{PaO}_2 : \text{FiO}_2 <100$
  - PEEP>10

Berlin Definition

- No PA Catheter needed

- However:
  - “as long as they have respiratory failure not fully explained by cardiac failure or fluid overload”

- Acuteness
  - Within one week of offending circumstance
Berlin Definition

- German Engineering
  - 3 mutually exclusive categories (hospital or 90-day mortality)
    - Mild (Mortality 27%)
    - Moderate (Mortality 32%)
    - Severe (Mortality 45%)

Outline

- Define ARDS
- Major iatrogenic factors

Major iatrogenic factors

- Ventilator
- Blood Products
- Fluid Administration
- Pneumonia

Major iatrogenic factors

- Ventilator
- Blood Products
- Fluid Administration
- Pneumonia

Ventilator induced lung injury

- Acute lung injury directly induced by mechanical ventilation
- Alveolar over distention
- Cyclic atelectasis
- Unclear exact mechanism
  - Mechanical stretch may
    - Induce inflammatory cytokine production
    - Injure alveolar capillary bed
VENTILATOR INDUCED LUNG INJURY (VILI)

- Clear Problem in sick lungs
- In ARDS lung protective strategy
  - Reduces the rates of multi-organ dysfunction
  - Saves lives

Sick Lungs...

- Nobody debates the fact...
- Sick Lungs need rest...

**N Eng J Med** Vol 342; 18:1301-1308

**Table 4. Main Outcomes Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group Receiving Lower Tidal Volumes</th>
<th>Group Receiving Traditional Tidal Volumes</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death before discharge home and breathing</td>
<td>31.0</td>
<td>38.8</td>
<td>0.007</td>
</tr>
<tr>
<td>without assistance (median days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breathing without assistance by day 28 (%)</td>
<td>65.7</td>
<td>55.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>No. of ventilator-free days, days 1 to 28</td>
<td>12±11</td>
<td>10±11</td>
<td>0.007</td>
</tr>
<tr>
<td>Barotrauma, days 1 to 28 (%)</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of days without failure of nonpulmonary organs</td>
<td>15±11</td>
<td>12±11</td>
<td>0.006</td>
</tr>
<tr>
<td>or systems, days 1 to 28</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nobody does that...

- This only applies in the ICU...
- I don’t take people with ARDS to the operating room...
- Nobody would ventilate
  - Without PEEP
  - With massive tidal volumes

High Risk Surgeries

- Cardiopulmonary Bypass
  - As high as 20% develop ARDS
  - Mortality of 80%
- Thoracic Surgery
  - Pneumonectomies
  - 8% develop ARDS (Berlin Definition)
  - Anaesthesia vol 105, no 2, 2006
What are the usual suspects?
Anesthesiology 2013;118: 19-29

- Retrospective analysis
- 50,367 Non-emergent
- General surgery
- Rate of post operative ARDS within 7 days
- 0.2%

What were the usual suspects?

- Higher Volume of Crystalloid
- Transfusion of blood products
- Higher Mean Airway pressures
- Higher FiO2
- Causal or not?

Multi-hit hypothesis or one big hit

- Ventilator induced lung injury
- Infection
- Immune deregulation
- Inflammation
- Hypoxia
- Hypotension

ARDS

What is the real world practice?

Intraoperative ventilation: incidence and risk factors for receiving large tidal volumes during general anesthesia
Fernandez et al. BMC Anesthesiology 2011 11:22

- What is a single “ARDSnet” center OR practice?
- Cross Section Analysis
  - Electronic Database
- Patients having major abdominal surgery
- >4hs of surgery
- All patients with complete data
  - 2007-2010
  - 429 patients

Fernandez et al
BMC Anesthesiology 2011 11:22

- Tidal volume range
  - 5.1 - 15 ml/kg ideal body weight
- >8ml/kg ideal body weight
  - 64%
“Healthy” Lungs

• Not a problem
• You can’t hurt a 25-year-old getting his knee scoped...
• Right?

Fernandez et al
BMC Anesthesiology 2011 11:22

• Tendency to give larger tidal volumes
• Especially in short obese females
• Bad habit
  • Actual vs Ideal body weight
  • Ideal Body Weight (IBW):
    Female: \((2.3 \times \text{# of inches} \times \text{height > 60}) + 45.5 = \text{Kg IBW}\)
    Male: \((2.3 \times \text{# of inches} \times \text{height > 60}) + 50 = \text{Kg IBW}\)

Fernandez et al
BMC Anesthesiology 2011 11:22

• Intraoperative Tidal volumes >10ml/kg
  • Higher incidence of post-op ventilation
  • Longer ICU and hospital stay

Retrospective, what’s first?

Another Possible Explanation

• Mechanical Ventilation
• Too high of tidal volumes
• Screw up a lot of organ systems:
  • Coagulation
  • Renal Function
  • Vascular Tone
  • Cardiac Performance

What could explain this?

1. "Lung-Vascular"
2. "New metabolic acidosis"
3. "New gastrointestinal bleeding"
4. "New renal failure"
5. "New coagulopathy"
6. "New cardiac failure"
7. "New neurological injury"
8. "New sepsis"
9. "New hypoxemia"
10. "New hypotension"
11. "New fever"
12. "New hypothermia"
13. "New chest wall pain"
14. "New rib fracture"
15. "New abdominal pain"
16. "New abdominal distention"
17. "New decreased breath sounds"
18. "New increased breath sounds"
19. "New decreased heart sounds"
20. "New increased heart sounds"
21. "New decreased pulse"
22. "New increased pulse"
23. "New decreased blood pressure"
24. "New increased blood pressure"
25. "New decreased oxygen saturation"
26. "New increased oxygen saturation"
27. "New decreased urine output"
28. "New increased urine output"
29. "New decreased hematocrit"
30. "New increased hematocrit"
31. "New decreased white blood count"
32. "New increased white blood count"
33. "New decreased platelet count"
34. "New increased platelet count"
35. "New decreased renal function"
36. "New increased renal function"
37. "New decreased liver function"
38. "New increased liver function"
39. "New decreased coagulation function"
40. "New increased coagulation function"
41. "New decreased cardiac function"
42. "New increased cardiac function"
Lungs as inflammatory mediators

- Protective ventilation in sick lungs
- Protects from MODS (ARDSnet trial)
- JAMA 2003: 289:2104-2112
- Nonprotective ventilation in sick lungs:
  - Induces pro-inflammatory cytokine production
  - Microvascular injury
  - Multi-organ dysfunction
    - Transplantation
    - Cell apoptosis
      - Small bowel
      - Kidneys

It is our training...

- Correct the numbers
  - SPO2
    - Make it normal
  - PACO2
    - Make it normal

What about “healthy” lungs

- "IMPROVE" TRIAL NEJM 2013;369;5:428-437
  - 400 Pts.
    - Elective abdominal surgery
    - At risk for postoperative pulmonary complications
  - Randomized
    - Protective Mechanical Ventilation
    - Non-protective Mechanical Ventilation

“IMPROVE” TRIAL NEJM 2013;369;5:428-437

- Primary outcomes
  - Occurring within 7 days after surgery
  - Major Pulmonary Complications
    - Pneumonia
    - Need for Ventilation (invasive or non-invasive)
  - Major Extra-pulmonary Complications
    - Sepsis, Severe Sepsis, Septic Shock
    - Death

Protective Mechanical Ventilation NEJM 2013;369;5:428-437

- 6-8 ml/kg predicted body weight
- 6-8 cm H2O PEEP
  - Recruitment breath every 30 min
    - 30 cm H2O pressure
    - 30 sec
    - No plateau pressure >30 cmH2O

Nonprotective mechanical ventilation NEJM 2013;369;5:428-437

- 10-12 ml/kg predicted body weight
- No PEEP
- Plateau pressure goal less than 30cm H2O
- No scheduled recruitment maneuvers
- If patient de-saturated (sats <92%)
  - Anesthesiologists could use:
    - PEEP
    - Recruitment maneuvers
  - Sound familiar?
Who were these patients?

NEJM 2013;369,5:428-437

Results

• Average Tidal volume
  • Non-Protective Ventilation Strategy
    • 11.1 ml/kg
  • Protective Ventilation Strategy
    • 6.4 ml/kg
• Major Pulmonary and Extra pulmonary complications
  • 10.5% Protective Ventilation Strategy
  • 27.5% Nonprotective Ventilation Strategy
  • P=0.001

Oxygenation and Ventilation

Table S5. Gas Exchange after Extubation and at Postoperative Day 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-protective Ventilation group (N = 200)</th>
<th>Lung Protective Ventilation group (N = 200)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH After extubation ¶</td>
<td>7.4 (0.05)</td>
<td>7.4 (0.05)</td>
<td>0.02</td>
</tr>
<tr>
<td>Day 1 ‡</td>
<td>7.3 (0.05)</td>
<td>7.4 (0.05)</td>
<td>0.92</td>
</tr>
<tr>
<td>PaO2 – mmHg After extubation ¶</td>
<td>99.8 (46.6)</td>
<td>103.2 (53.5)</td>
<td>0.66</td>
</tr>
<tr>
<td>Day 1 ‡</td>
<td>83.7 (27.2)</td>
<td>87.6 (28.5)</td>
<td>0.17</td>
</tr>
<tr>
<td>PaCO2 – mmHg After extubation ¶</td>
<td>40.6 (5.3)</td>
<td>41.8 (4.6)</td>
<td>0.03</td>
</tr>
<tr>
<td>Day 1 ‡</td>
<td>39.4 (5.0)</td>
<td>40.1 (4.8)</td>
<td>0.17</td>
</tr>
<tr>
<td>HCO3- – mmol/liter</td>
<td>23.0 (2.6)</td>
<td>23.2 (2.9)</td>
<td>0.35</td>
</tr>
<tr>
<td>Day 1 ‡</td>
<td>24.6 (2.7)</td>
<td>24.5 (2.5)</td>
<td>0.90</td>
</tr>
<tr>
<td>SaO2 – % After extubation ¶</td>
<td>95.3 (3.4)</td>
<td>95.4 (3.2)</td>
<td>0.96</td>
</tr>
<tr>
<td>Day 1 ‡</td>
<td>94.9 (3.3)</td>
<td>95.6 (2.8)</td>
<td>0.04</td>
</tr>
</tbody>
</table>

“There were no relevant between-group differences in gas exchange after extubation on day one after surgery.”
A Case Based Discussion: Geriatric Anesthesia

Angela Selzer, MD
Associate Professor of Anesthesiology
University of Colorado

Disclosures

I have no financial disclosures to make

Learning Objectives

1. Describe the physiologic changes in elderly patients and their impact on perioperative management.
2. Identify risk factors for adverse perioperative outcomes in the elderly and explain the components of a comprehensive preoperative assessment.
3. Review perioperative management strategies and benefits of a multidisciplinary team that may help reduce the risk of adverse outcomes commonly seen in this population.

Preoperative Assessment & Optimization

- Geriatric Assessments:
  - Overall Risk
  - Cognitive Function
  - Frailty
  - Nutrition
  - Goals of care
  - Preop COVID infections

Case Presentation

72 yo male with a history of Type 2 Diabetes Mellitus, CAD s/p stent in 2015, prior CVA without residual effect, PVD, paroxysmal afib, history of tobacco use (quit 5 years ago), and COPD requiring 2L O2 with activity, history of ODM abuse. He has received 3 total COVID vaccine doses, with a booster in October, 2021. He tested positive for COVID on 1/6/2022 with dyspnea, cough and an increased oxygen requirement. He received outpatient therapy and believes he is now fully recovered. He uses a cane for ambulation and is able to perform activities of daily living.

The patient presents for preoperative evaluation prior to revision total hip arthroplasty scheduled in 2 months.

PMH:
- DM Type 2 - c/b peripheral neuropathy
- PVD
- previous CVA
- CAD s/p stent to LAD (2015)
- paroxysmal afib
- COPD on 2L O2
- previous right total hip arthroplasty
- inguinal hernia repair

MEDS:
- Metformin
- Pregabalin
- ASA 81 mg
- Carvedilol 25 mg PO BID
- Apixaban 5 mg PO BID
- Lasix 20mg tid
- Fluticasone/Salmeterol 1 puff BID
- Albuterol PRN
- Ativan 0.5 mg PRN

PSH:
- previous right total hip arthroplasty
- atopic dermatitis
- history of tobacco use - quit 2015
- history of ODM abuse - quit 2015
- cannabis use - “gummies daily”

FMH:
- History of Alzheimer’s in father
- history of ODM use in mother
- history of ODM use in father

Preop COVID infections (1/5/2022)

History:
- Anxiety

F：
Preoperative Assessment & Optimization

- Geriatric Assessments:
  - Overall Risk
  - Cognitive Function
  - Frailty
  - Nutrition
  - Goals of care
  - Preop COVID infections

- ACS NSQIP Surgical Risk Calculator
  - Developed by American College of Surgeons
  - Data updated regularly (last in Nov, 2021)
  - Goals:
    - to better inform surgeons and patients of surgical risk
    - To facilitate the informed consent process
  - 21 variables
  - 13 Outcomes

Risk Assessment

Enhancing the American College of Surgeons NSQIP Surgical Risk Calculator to Predict Geriatric Outcomes

- The Geriatric Surgery ACS NSQIP collaborative launched the Geriatric Pilot Project
- Collected data on 60,000 patients from a subset of 33 NSQIP hospitals
- 6 additional variables reflecting: cognition, function, mobility & decision making
- 4 new geriatric specific outcomes: pressure ulcer, delirium, new mobility aid, functional decline

Table 8: Criteria for the Optimal Preoperative Assessment of the Geriatric Surgical Patient

In addition to evaluating a complete history and physical examination of the patient, the following assessments are strongly recommended:

1. Assess the patient's cognitive ability and capacity to understand medical information
2. Assess the patient for depression
3. Obtain the patient's wishes for developing prognostic outlooks
4. Assess for global and other outcomes, such as outcomes related to
   - Determined baseline blood tests:
     - Neurocognitive status and correlate preoperative medications or treatments to the patient's current medical history
   - Obtain an accurate overall medical history for the patient, focusing on potential outcomes, such as the potential for pneumonia
   - Update medication and medication history
   - Update goals and expectations in the context of the patient's current medical history
   - Document patient's family and social support system
   - Offer appropriate preoperative diagnostics not focused on

Can generate a PDF of the document
Case Presentation

- The patient says yes to all functional screening questions
- He is able to care for himself at home without help
- He also reports that he has had no falls over the last year

Preoperative Assessment & Optimization

- Geriatric Assessments:
  - Overall Risk
  - Cognitive Function
  - Frailty
  - Nutrition
  - Goals of care
  - Preop COVID infections
Cognitive Impairment

- In the US, in patients over 70 years old:
  - 22.2% have cognitive impairment
  - 13.9% have dementia
- Cognitive impairment is associated with:
  - Prolonged hospitalization
  - Increased perioperative morbidity
  - Increased incidence of delirium

Expert Opinion: Assess cognition in every geriatric patient
- Any assessment is fine, specifically mention the mini-cog
- Screen early in assessment
  - May need a family member or care provider to help with history taking, medications, etc
Cognitive Assessment

- Any cognitive tool is acceptable
  - MiniCog is easy
  - MoCA is comprehensive & sensitive
  - MoCA-Blind can be used on telehealth visits
- Choose a tool & train the staff
- Perform on every patient over 65

Case Presentation

- We perform a MoCA cognitive exam on our patient and he scores a 25/30 revealing mild cognitive impairment
Preoperative Assessment & Optimization

*Geriatric Assessments:*
- Overall Risk
- Cognitive Function
- Frailty
- Nutrition
- Goals of care
- Preop COVID infections

Frailty

- Age related state of decreased physiologic reserve that results in diminished resiliency, loss of adaptive capacity and increased vulnerability to stressors
- Predicts perioperative morbidity and mortality better than chronologic age
- Highlights opportunities to intervene

Case Presentation

- Our patient cannot walk up one flight of stairs or more than one block. He has greater than five illnesses but does not feel fatigued and has not lost weight in the past six months.
- He scores 3 on the frailty screening, identifying him as high risk
- He is referred to a geriatrician for a comprehensive assessment and tailored intervention plan

Table 1. Geriatric Assessments: Frailty

<table>
<thead>
<tr>
<th>Frailty Screening</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Weakness</td>
<td>Yes</td>
</tr>
<tr>
<td>Slowed Gait</td>
<td>Yes</td>
</tr>
<tr>
<td>Loss of weight</td>
<td>No</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Yes</td>
</tr>
<tr>
<td>Lowered activity</td>
<td>Yes</td>
</tr>
<tr>
<td>Self-care</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 2. Frailty Assessment: Geriatric Risk Factors

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>falling</td>
<td>increased risk of falls</td>
</tr>
<tr>
<td>fractures</td>
<td>increased risk of fractures</td>
</tr>
<tr>
<td>infections</td>
<td>increased risk of infections</td>
</tr>
<tr>
<td>hospital stay</td>
<td>increased risk of hospital stay</td>
</tr>
</tbody>
</table>

Table 3. Goals of Care: Frailty

<table>
<thead>
<tr>
<th>Goals of Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain management</td>
</tr>
<tr>
<td>Activity level</td>
</tr>
<tr>
<td>Nutrition</td>
</tr>
<tr>
<td>Mental health</td>
</tr>
</tbody>
</table>

Table 4. Preoperative Assessment: COVID Infections

<table>
<thead>
<tr>
<th>Preoperative Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID precautions</td>
</tr>
<tr>
<td>Hand hygiene</td>
</tr>
<tr>
<td>Face mask</td>
</tr>
<tr>
<td>Social distancing</td>
</tr>
</tbody>
</table>

Table 5. Preoperative Assessment: Goals of Care

<table>
<thead>
<tr>
<th>Goals of Care</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Activity level</td>
</tr>
<tr>
<td>Nutrition</td>
</tr>
<tr>
<td>Mental health</td>
</tr>
</tbody>
</table>

Table 6. Goals of Care: Frailty

<table>
<thead>
<tr>
<th>Goals of Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain management</td>
</tr>
<tr>
<td>Activity level</td>
</tr>
<tr>
<td>Nutrition</td>
</tr>
<tr>
<td>Mental health</td>
</tr>
</tbody>
</table>

Table 7. Preoperative Assessment: COVID Infections

<table>
<thead>
<tr>
<th>Preoperative Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID precautions</td>
</tr>
<tr>
<td>Hand hygiene</td>
</tr>
<tr>
<td>Face mask</td>
</tr>
<tr>
<td>Social distancing</td>
</tr>
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</table>

Table 8. Goals of Care: Frailty

<table>
<thead>
<tr>
<th>Goals of Care</th>
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<tbody>
<tr>
<td>Pain management</td>
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<td>Activity level</td>
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<tr>
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</table>

Table 9. Preoperative Assessment: Goals of Care

<table>
<thead>
<tr>
<th>Goals of Care</th>
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<tbody>
<tr>
<td>Pain management</td>
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<td>Nutrition</td>
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<td>Mental health</td>
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Table 10. Goals of Care: Frailty

<table>
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<tr>
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<tbody>
<tr>
<td>Pain management</td>
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</tr>
<tr>
<td>Nutrition</td>
</tr>
<tr>
<td>Mental health</td>
</tr>
</tbody>
</table>
In the elderly, malnutrition is estimated in:
- 5.8% of individuals in community
- 13.8% in nursing homes
- 38.7% in hospitals
- 50.5% in rehab centers

Poor nutritional status is associated with an increased risk of:
- Postoperative adverse events
- Infection (SSI, pneumonia, UTI)
- Wound complications (dehiscence, anastomotic leaks)
- Prolonged hospital length of stay

Nutritional Assessment

Case Presentation

- Nutrition screening revealed a normal nutritional status
- Referral to a dietician was deferred at this time

Shared Decision Making

- Patients often proceed with surgery:
  - Believing they had no other choice
  - Underestimating how difficult recovery will be
  - Without advanced directives
Shared Decision Making

- Benefits
- Risks
- Alternatives
- Nothing

Use the space below each section to write down any questions to take to your appointment.

https://www.choosingwisely.co.uk/shared-decision-making-resources/

Preoperative Assessment & Optimization

- Geriatric Assessments:
  - Overall Risk
  - Cognitive Function
  - Frailty
  - Nutrition
  - Goals of care
  - Preop COVID infections

Preoperative Assessment & Optimization

- Geriatric Assessments:
  - Overall Risk
  - Cognitive Function
  - Frailty
  - Nutrition
  - Goals of care
  - Preop COVID infections

Timing of Surgery with COVID infection

- COVID-19 Study Protocol
- Outcomes of Surgery in COVID-19 infection: international cohort study

Original Article

Timing of surgery following SARS-CoV-2 infection: an international prospective cohort study

COVID-19 Collaborative and GlobalSurg Collaborative

- 140,231 Patients from 116 countries
- Primary Outcome, 30-day mortality
Conclusions of COVIDSurg Trial:

- Asymptomatic COVID infections confer a higher mortality rate for 7 weeks after infection.
- Patients with continued symptoms after 7 weeks have an increased mortality rate.
- Data were collected until Oct, 2020:
  - Unvaccinated patients
    - Predominantly Alpha, with Beta and Delta variants
  - COVID Surg 3 trial: collecting data Feb, 2022:
    - More vaccinated patients
    - Predominantly Omicron variant

“Decisions should be tailored for each patient since the possible advantages of delaying surgery for at least 7 weeks following SARS-CoV-2 diagnosis must be balanced against the potential risks of delay”
A Case Based Discussion:
Geriatric Anesthesia

Ramu Gumidyala, MD
Assistant Professor of Anesthesiology
University of Colorado

Disclosures

- I have no financial disclosures to make

Learning Objectives

1. Identify risk factors for adverse perioperative outcomes in the elderly and explain the components of a comprehensive preoperative assessment.
2. Describe the physiologic changes in elderly patients and their impact on perioperative management.
3. Review perioperative management strategies and benefits of a multidisciplinary team that may help reduce the risk of adverse outcomes commonly seen in this population.

Preoperative Assessment & Optimization

- Geriatric Assessments:
  - Overall Risk
  - Cognitive Function
  - Frailty
  - Nutrition
  - Goals of care
  - Preop COVID infections

Intraoperative Management

- Geriatric Physiology
- Structural
- Functional
- Anesthetic Considerations
- Geriatric Pharmacology
- Anesthetic Choice

Case Presentation

72 yo male with a history of Type 2 Diabetes Mellitus, CAD s/p stent in 2015, prior CVA without residual effect, PVD, paroxysmal afib, history of tobacco use (quit 5 years ago), and COPD requiring 2 L O2 with activity, history of ETOH abuse. He has received 3 total COVID vaccine doses, with a booster in October, 2021. He tested positive for COVID on 1/6/2022 with dyspnea, cough and an increased oxygen requirement. He received outpatient therapy and believes he is now fully recovered. He uses a cane for ambulation and is able to perform activities of daily living.

The patient presents for preoperative evaluation prior to revision total hip arthroplasty scheduled in 2 months.

PMH:
DM Type 2 - c/b peripheral neuropathy
PVD
previous CVA
CAD s/p stent to LAD (2015)
paroxysmal afib
COPD on 2 L O2
Recent COVID infection (1/5/2022)
Intraoperative Management

- Geriatric Physiology
- Structural
- Functional
- Anesthetic Considerations
- Geriatric Pharmacology
- Anesthetic Choice

Neurologic Changes

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>FUNCTION</th>
<th>ANESTHETIC CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain Volume</td>
<td>Likelihood</td>
<td>Memory Decline</td>
</tr>
<tr>
<td>Dorsal, SHT, ACh, NE receptors</td>
<td>BBB permeability</td>
<td>Pod/POCD risk</td>
</tr>
<tr>
<td>Epidural space</td>
<td>Sensitivity to</td>
<td>Anesthetic agents</td>
</tr>
<tr>
<td>CSF volume</td>
<td>Sensitivity to</td>
<td>Neuronal/regional anesthetic</td>
</tr>
<tr>
<td>Number/diameter nerve root fibers</td>
<td>Distance between Schwann cells</td>
<td></td>
</tr>
</tbody>
</table>

Cardiovascular

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>FUNCTION</th>
<th>ANESTHETIC CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elastic/Connective tissue</td>
<td>Beta-adrenergic activity</td>
<td>SVR/CO</td>
</tr>
<tr>
<td>Myocyte #</td>
<td>Baroreceptor sensitivity</td>
<td>Max HR</td>
</tr>
<tr>
<td>Conduction fiber density</td>
<td>Vascular compliance</td>
<td>SVR/SP pressure</td>
</tr>
<tr>
<td>SA node #</td>
<td>Contractility</td>
<td>HD instability</td>
</tr>
<tr>
<td>UOP</td>
<td>Pulse pressure</td>
<td>Risk of CAD, arrhythmias, valvulopathy</td>
</tr>
<tr>
<td>Vascular Rigidity</td>
<td>Endothelial dysfunction</td>
<td>Autonomic dysfunction</td>
</tr>
<tr>
<td>Pulmonary arterial area</td>
<td>L V Diastolic dysfunction</td>
<td>MAP</td>
</tr>
</tbody>
</table>

Respiratory

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>FUNCTION</th>
<th>ANESTHETIC CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory muscle strength</td>
<td>Flexibility</td>
<td>Time to desaturation</td>
</tr>
<tr>
<td>Elasticity</td>
<td>Central response/lung, lung volume, stress</td>
<td>Apnea</td>
</tr>
<tr>
<td>Small airway size</td>
<td>Vital capacity</td>
<td>Hypoxic/hypercapnic</td>
</tr>
<tr>
<td>Surfactant</td>
<td>RV/FiO2</td>
<td>Sensitivity to respiratory depressants</td>
</tr>
<tr>
<td>Pulmonary vascular area</td>
<td>Hypoxic pulmonary vasoconstriction</td>
<td>Risk of bronchospasm</td>
</tr>
<tr>
<td>Chest wall rigidity</td>
<td>Lung compliance</td>
<td>Risk of aspiration</td>
</tr>
<tr>
<td>Central airway size</td>
<td>Expiratory flow limit</td>
<td>Risk of aspiration</td>
</tr>
<tr>
<td>I NV</td>
<td>Risk of infection</td>
<td></td>
</tr>
</tbody>
</table>

Prevention of Pulmonary Complications

- Risk Factors
  - Obesity
  - COPD
  - Smoking history
  - COPD
  - Age > 70
  - ASA > 4

- Prevention
  - Optimal use when appropriate
  - Minimize use of intermediate/long acting intubating agents
  - Ensure adequate reversal
  - Laparoscopic choice for bariatric surgery
  - Preoperative inspiratory muscle training
  - Protective lung strategy
  - Adequate reversal
  - Use of NIPPV
**Gastrointestinal/Hepatic**

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>FUNCTION</th>
<th>ANESTHETIC CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>small intestine area</td>
<td>Rate of drug metabolism</td>
<td>↑</td>
</tr>
<tr>
<td>liver volume</td>
<td>Acid secretion</td>
<td>↓</td>
</tr>
<tr>
<td>Hepatic/Splanchnic</td>
<td>Hepatic metabolism</td>
<td>↓</td>
</tr>
<tr>
<td></td>
<td>Synthesis of coagulation factors</td>
<td>↓</td>
</tr>
<tr>
<td></td>
<td>Gastric emptying time</td>
<td>↑</td>
</tr>
</tbody>
</table>

**Renal**

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>FUNCTION</th>
<th>ANESTHETIC CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renal mass</td>
<td>GFR/creatinine clearance</td>
<td>Drug clearance</td>
</tr>
<tr>
<td>Nephrons</td>
<td>Ability to clear Na</td>
<td>Risk of dehydration</td>
</tr>
<tr>
<td>Blood flow</td>
<td>Ability to concentrate urine</td>
<td>Electrolyte abnormalities</td>
</tr>
<tr>
<td></td>
<td>Thirst response</td>
<td>Risk of AKI</td>
</tr>
<tr>
<td></td>
<td>Na retention</td>
<td>Risk of drug toxicity</td>
</tr>
</tbody>
</table>

**Fluid Management**

**Body Composition/Pharmacology**

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>FUNCTION</th>
<th>ANESTHETIC CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeletal Muscle Mass</td>
<td>O2 consumption</td>
<td>Hypothermia</td>
</tr>
<tr>
<td>Total body water</td>
<td>Heat production</td>
<td>Serum drug concentration after bolus</td>
</tr>
<tr>
<td>Lean body mass</td>
<td>Renal/Hepatic drug clearance</td>
<td>Hypothemia for fat soluble drugs</td>
</tr>
<tr>
<td>Albumin</td>
<td>Volume of distribution of water soluble drugs</td>
<td>Risk of drug toxicity</td>
</tr>
<tr>
<td>Percentage body fat</td>
<td>Volume of distribution of lipid soluble drugs</td>
<td>Prolonged drug effect</td>
</tr>
<tr>
<td>Distance between Schwann cells</td>
<td>Target organ drug sensitivity</td>
<td>Increased sensitivity to anesthetics</td>
</tr>
</tbody>
</table>

**Patient Positioning**

- Risk factors for positioning injuries:
  - Cardiopulmonary bypass
  - ASA status
  - Case length
  - Transfusion need
  - Hypotension and need for pressor
  - Hypothermia

**Intraoperative Management**

- Geriatric Physiology
  - Structural
  - Functional
  - Anesthetic Considerations
- Geriatric Pharmacology
- Anesthetic Choice
Pharmacokinetics

<table>
<thead>
<tr>
<th>Variables</th>
<th>% Change from older to younger patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body water</td>
<td>↓15</td>
</tr>
<tr>
<td>Lean body mass</td>
<td>↓35</td>
</tr>
<tr>
<td>Body fat</td>
<td>↓15 to older (women) 100 to younger (men)</td>
</tr>
<tr>
<td>Serum albumin</td>
<td>↓20</td>
</tr>
<tr>
<td>Kidney weight</td>
<td>↓20</td>
</tr>
<tr>
<td>Hepatic blood flow</td>
<td>↓40</td>
</tr>
</tbody>
</table>

Pharmacodynamics

Drug Classes

- Cardiovascular
  - Beta-blockers
  - Ca-channel blockers
- Anti-arrhythmics
- Opioids
- Benzodiazepines
- Sedatives/Hypnotics
- Haldol
- Reversal Agents/Sugammadex

Drug Risk

- 5-HT3 antagonists
- Serotonin syndrome
- QTc prolongation
- Corticosteroids
- Delirium
- Hyperglycemia
- Scopolamine
- Delirium
- Constipation
- Phenothiazines
  - Anticholinergic effects
  - Contraindicated in Parkinson's disease
- Metoclopramide
  - Extrapyramidal effects
  - Contraindicated in Parkinson's disease

Anesthetic Choice

- Regional techniques
  - Selective procedure
  - Gross venous return
  - Minimize anesthesia

- Regional anesthesia
  - Minimize patient discomfort

PONV Prophylaxis

Drug

- 5-HT3 antagonists
- Serotonin syndrome
- QTc prolongation
- Corticosteroids
- Delirium
- Hyperglycemia
- Scopolamine
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The patient presents for preoperative evaluation prior to revision total hip arthroplasty scheduled in 2 months.

PMH:
- DM Type 2 – c/b peripheral neuropathy
- PVD
- previous CVA
- CAD s/p stent to LAD (2015)
- paroxysmal afib
- COPD on 2 L O2
- CKD creat. 1.2
- Recent COVID infection (1/5/2022)
- Anxiety

MEDS:
- Metformin
- Pregabalin
- ASA 81 mg
- Carvedilol 25 mg PO BID
- Apixaban 5 mg PO BD
- Furosemide 20 mg qday
- Fluticasone/Salmeterol 1 puff BD
- Albuterol PRN
- Furosemide 20 mg PRN
- Ativan 0.5 mg PRN

PSH:
- previous right total hip arthroplasty
- inguinal hernia repair

SH:
- History of tobacco use - quit 2015
- History of EtOH abuse - quit 2015
- Cannabis use - “gummies daily”

FMH:
- History of Alzheimer’s in father

Perioperative Anesthetic Plan

- Comprehensive geriatric assessment to include cardiopulmonary risk, falls, frailty, nutritional and pre-habilitation needs, medication review, and cognitive assessment.
- Discuss increased risk of perioperative pulmonary complications.
- Continue his aspirin and beta-blockers, furosemide, and inhalers perioperatively given his previous coronary stenting and cardiac history and pulmonary history.
- Spinal anesthesia if he held his apixaban x 72 hours with propofol sedation. Adjust intaroperative dosing of medications appropriately for this age group and avoid polypharmacy.
- Adjust PONV strategy taking into account patient comorbidities
- Take extra precautions intraoperatively to help mitigate positioning injuries and pressure ulcers.

Thank you!
Geriatric Anesthesia: Postoperative Concerns

Nathaniel J Brown, MD, PhD
Assistant Professor
CU SOM Dept of Anesthesiology
Rocky Mountain Regional VAMC
March 1, 2022

Disclosures
No financial disclosures

Learning Objectives
Discuss delirium and postoperative cognitive decline as major concerns in the postoperative care of the elderly.

Identify risk factors associated with delirium and POCD.

Identify prevention strategies for delirium and POCD.

Postoperative badness: The big players

Delirium
Post Operative Cognitive Dysfunction (POCD)

Delirium vs POCD

Delirium:
"Acute confusional state with alterations in attention and consciousness."
(the agreed upon definition)

POCD
"A decline in a variety of neuropsychological domains [including processing speed, memory, executive function, etc]." (one of many definitions)

Delirium
Delirium is diagnosed by criteria set out in the DSM.
Stated succinctly as: “a disturbance in consciousness that is accompanied by a change in cognition that cannot be better accounted for by a preexisting or evolving dementia.” (DSM)

POCD
Has 3 main “flavors” described as: hyperactive, hypoactive, and mixed.
The majority (66%) are hyperactive with a mixed presentation second most common at 31%. Isolated hyperactive delirium is rare (~1%).
CAM (confusion assessment method) is the most commonly used to score delirium.
Postoperative Delirium

A major concern in the elderly

Prevalence 10% or more
Cardiac and hip surgery carry big risk
ICU care carries the biggest risk (up to 60-80%)
Age is a big risk factor for postoperative delirium.

Unsurprisingly, the greater the number of predisposing risk factors (called “vulnerability” factors) the smaller the stress needed to induce delirium.

Prevention is key
Once delirium has begun there are few interventions that have much of a proven effect.

Clinical Interventions in Aging

Prevention of postoperative delirium in elderly patients planned for elective surgery: systematic review and meta-analysis

Conclusion: Multicomponent interventions, the use of antipsychotics, EEG-guidance, and dexmedetomidine treatment can successfully reduce the incidence of postoperative delirium in elderly patients undergoing elective, non-cardiac surgery. However, present studies are heterogeneous, and high-quality studies are scarce. Future studies should add these preventive methods to already existing multimodal and multidisciplinary interventions to tackle as many precipitating factors as possible, starting in the pre-admission period.

Postoperative Delirium

Major vulnerability factors are advanced age, visual impairment (visual acuity < 20/70), illness severity (APACHE score >16), cognitive impairment (MMSE >24), hearing impairment, dehydration, sleep deprivation, immobility, among others.

Preventing Postoperative Delirium

Antipsychotics may help.
Dexmedetomidine may also help.
Probiotics?
Intraoperative correction of metabolic derangements (electrolytes, volume status, etc.)
Intraoperative and postoperative: decrease known trigger medications such as opioids, benzodiazepines, dihydropyridines CCBs, etc.

TIVA vs volatile anesthetics?
TIVA vs volatile maintenance Delirium prevention? POCD prevention?
2018 Cochrane Review
28 RCTs and over 4500 participants.
There was heterogeneity in the data. Noted difficulty in blinding the anesthesia technique to the provider, some important variables (like intraoperative hypotension) could not be adequately controlled for. Data reporting inconsistencies also made the analysis less reliable.

Delirium prevention? POCD prevention?
2018 Cochrane Review
28 RCTs and over 4500 participants.
There was heterogeneity in the data. Noted difficulty in blinding the anesthesia technique to the provider, some important variables (like intraoperative hypotension) could not be adequately controlled for. Data reporting inconsistencies also made the analysis less reliable.

Preventing Postoperative Delirium
A wrinkle
Many advocate for use of neuraxial and regional techniques to avoid GA in the elderly.
Conflicting data
Recent study (2020) showed no benefit specifically in hip surgery, which is one of the higher risk surgeries for postoperative delirium.
114 patients, ages 65+, ASA 2-4 with hip fracture

Post-Operative Cognitive Decline (POCD)
Not a single, specific diagnosis in the DSM
Inconsistent definitions, but here’s one: “[a new] dysfunction in cognition, that is not explained by a preexisting neurocognitive disorder” (Kubala et al.)
Is gradual in onset, in contradistinction to delirium.
Requires neuropsychometric testing to track.
Usually self-limiting.
POCD and Risk

Age is thought to be the most significant risk factor. Some newer data point to possible biomarkers (neuron-specific enolase (NSE) and S100b), but as of now it's too early to know. Cardiac surgery is, again, a higher risk surgery. The label “POCD” may represent several different underlying problems. Because of the possibility that several layers of etiology are possible...

Change in Nomenclature?

Recommendations for the Nomenclature of Cognitive Change Associated with Anaesthesia and Surgery—2018


The working group recommends that “perioperative neurocognitive disorder” be used as an overarching term for cognitive impairment identified in the perioperative or postoperative period. This includes cognitive decline diagnosed before surgery (dementia or neurocognitive disorder); any form of acute event (perioperative delirium and cognitive decline diagnosed up to 30 days after the procedure [delayed neurocognitive recovery]) and up to 12 months (postoperative neurocognitive disorder).

Promise for the future

Clinical Interventions in Aging

Postoperative cognitive dysfunction – current preventive strategies

Exhibit undesired side effects. Interventions to reduce oxidative stress and neuroinflammation could prove beneficial. Preventive strategies, early recognition, and management of perioperative risk factors seem to be, by far, the best modality to deal with POCD till further progress in therapeutic intervention evolve.

Is It the Anesthesia? (we don’t know)

Clinical Interventions in Aging

General anesthetic and the risk of dementia in elderly patients: current insights

“Neither the route of anesthesia nor the type of anesthetic appears to be significantly associated with the development of postoperative delirium or postoperative cognitive dysfunction.”

Is all POCD really POCD?

Is it possible that sometimes an acute event can cause greater scrutiny or reflection by a patient or family members? Humans are excellent pattern finders, so we sometimes pin changes that have been happening over months or years to a specific event thought to be sentinel. Not all POCD research depends on clinical assessments of cognitive function. Not every patient complaint of being “mentally different” after surgery is POCD or one of its kin. Nevertheless, POCD remains common, and a problem of significant concern.

Anesthesiology and cognitive impairment: a narrative review of current clinical literature

Jillian C. Belkin and Ruudge R. Noppom

Abstract

Background: The impact of general anesthesia on cognitive impairment is controversial and complex. A large body of evidence supports the association between exposure to surgery under general anesthesia and development of delayed neurocognitive recovery in a subset of patients. Existing literature continues to debate whether these short-term effects on cognition can be attributed to anesthetic agents themselves or whether other variables are causal of the observed changes in cognition. Furthermore, there is conflicting data on the relationship between anesthesia exposure and the development of long-term neurocognitive disorders, or development of incident dementia in the patient population...
A great deal of research is needed
You saw that coming, didn’t you?

This is an area of active research, and compared to what we need to know, very little has yet been discovered.

In the meantime, various multimodal approaches are the best we can do regarding preventing or ameliorating postoperative changes in cognition.

Thank You!
References by following the link:
Ambulatory Anesthesia: What Do You Need to Know?
Kim Strupp, MD
Alison Brainard, MD
Kyle Marshall, MD

Objectives
- Discuss the required components of a preoperative evaluation for patients undergoing ambulatory surgery, including special considerations for patients with obesity, obstructive sleep apnea, and advanced age.
- Define screening criteria for patients presenting for ambulatory surgery.
- Identify patients who may benefit from prehabilitation prior to ambulatory surgery.
- Analyze the differences between prehabilitation and medical optimization in patients undergoing ambulatory surgery.
- Describe the critical components of the pathway for effective ambulatory anesthetic management.

History
Reed and Ford opened first free-standing ASC in 1970 in Phoenix, AZ
Strict patient selection (ASA I or II)
Low surgical acuity
Procedures < 1 hour
53 million ambulatory surgeries in the US in 2009 (CDC data)
More than 66% of all surgeries performed (American Hospital Association 2014)

Defining Risk
- Goal: predictable cases with defined risk
- Estimated mortality 1:50,000 to 1:100,000
- Serious complications < 1%
- Patient satisfaction
- Surrogate markers (admission/readmission)
- Admission rate 1%

Morbidity/Mortality
- NSQIP data 2005-2010
- 244,397 surgeries
- 232 (0.1%) cases experienced early perioperative morbidity or mortality
- Surrogate markers: readmission, mortality

The presenters have no conflicts of interest to disclose.

https://www.ascassociation.org/50yearsofascs/home

Keyes 2004, Keyes 2008, Mathis 2013, Walsh 2018

Mathis 2013
Mathis 2013

Seven independent risk factors for 72-h morbidity or mortality

- COPD
- History of CVA/THA
- Renal failure
- Prior PCI/Coronary Surgery
- Prolonged Operative Time
- Hypertension
- Overweight BMI

Admission/Readmission
- 400 patients out of 20,657
- 200 required admission, 200 controls
- Multiple logistic regression analysis
- Length of surgery > 1 h
- ASA III or IV
- Age >80
- BMI 30-35

Reason for Admission

Table 4 Risk factors for unanticipated hospital admission
- Surgical
- Plan
- Bleeding
- Extensive surgery
- Surgical complications
- Abdominal surgery
- ENT and oral surgery
- Anesthesia
- Nausea and vomiting
- Somnolence
- Aspiration
- Social
- Discharge without escort
- Medical
- Discharge complications related to DM, IHD, and sleep apnea
- Medication error
- ENT, ear-nose-throat; DM, diabetes mellitus; IHD, ischemic heart disease.
Poll: Which patients are candidates for your ambulatory surgery center?

- ASA I & II patients only
- ASA III patients
- ASA IV patients
- A & B
- All of the above
- I don’t work at an ambulatory surgery center

ASA Physical Status

ASA III patients commonplace
- European multicenter study 57,709 procedures (ASA I, II & III)
- Major complications were low
- No deaths definitively related to surgery

ASA IV patients starting
- Well equipped ASCs
- Low acuity procedures
- Local anesthesia with minimal sedation
- Higher rate of block failure
- Unplanned admission 7%

Age/frailty

- Variability with data
  - Increased mortality > 85 (Finster 2004)
  - Increased admission > 85 (De Oliveira 2015)
  - Pulmonary complications > 70 (De Oliveira 2017)
  - Physiologic age vs chronologic age
  - Functionality matters
  - Frailty = decreased physiologic reserves
  - 10-20% > 65
  - 40% > 80

Walsh 2018

Pre-Op Screening

<table>
<thead>
<tr>
<th>Comorbidities</th>
<th>Surgery recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe, unstable comorbidities that cannot be optimized further</td>
<td>No elective surgery</td>
</tr>
<tr>
<td>Severe comorbidities likely to become unstable perioperatively</td>
<td>Elective surgery inpatient</td>
</tr>
<tr>
<td>Moderate to severe comorbidities that can be optimized</td>
<td>Optimize then outpatient</td>
</tr>
<tr>
<td>Mild, moderate or severe optimized comorbidities</td>
<td>Outpatient</td>
</tr>
</tbody>
</table>

Rajan 2020

Frailty and NSQIP

- Shah 2018
  - 1 million patients assigned frailty score
  - Complications: low scores (3.2%) versus high scores (36.4%)
  - Higher failure to rescue
- Seib 2018
  - 140,000 patients
  - Overall complication rate of 1.7%
  - Increased risk for intermediate (OR=2.0) and high (OR=3.95) frailty groups

Pre-op testing

- Only indicated if patient would need the test even if not having surgery
- Increases costs and delays
- Does not increase adverse outcomes in ASA I & II patients

Rajan 2020
Prehabilitation – an ounce of prevention is worth a pound of cure

- Goals: improve preoperative functional capabilities
  - Nutritional status, physical activity levels, and mental state
  - Nutritional supplementation
  - Exercise programs
  - Targeted activities to improve cognitive function
  - Smoking cessation
  - Stress-reduction strategies

Prehabilitation – Outcomes/Benefits

- Clear expectation setting
- Encourages patient participation and engagement in their recovery
- Reduces anxiety
- Increases patient satisfaction

Optimization of comorbidities

- Should start when surgery is scheduled
- Goal: avoid delays/cancellations & improve outcomes
- 3 categories of opportunity:
  - Shared (collaborative) decision-making
  - Comorbidity management
  - Collaborative behavioral change

Pre-op phone call

- 1-2 days before
- NPO instructions
- Arrival time
- Medication instructions
- What to bring: CPAP, home meds, ambulation assist devices, hearing aids, glasses

What BMI cut off do you use in your ambulatory practice?

- < 40
- < 50
- Other
- No cut off
- I do not provide ambulatory care

Obesity

- Complications increase significantly BMI > 50 \(\rightarrow\) inpatient (Joshi 2013)
- BMI alone (>50) poor predictor of periop risk
- BMI > 40 strong association with OSA \(\rightarrow\) periop risk (Grewal 2019)
- CV (cardiomyopathy), Respiratory (OSA), endocrine (DM)
- Functional capacity, full H&P
- ERG for limited functional capacity plus 1 risk factor (hx heart disease, hx CHF, hx CVD, periop insulin, Cr >2)
- LBBB, right heart hypertrophy

Walsh 2019, Grewal 2019
Outpatient Cancer Study

- 13,957 patients, 2016-2018
- Higher BMI ➔ higher rate of transfer (p=0.014)
  - Mean risk 0.8% for BMI 25 vs 1.3% for BMI 40
  - 111 patients with BMI 40 would need to be treated at the main hospital to prevent one transfer
  - No association (p=0.7 for all)
- No association for urgent care visits or readmissions within 30 days
- Outpatient LOS
- Operative time for outpatient procedures (p<0.0001)
  - 59 vs 63 min for BMI 25 vs 40

OSA

- Risk associated with postoperative respiratory events and need for postoperative narcotics
- Risk prolonged PACU stay
- STOP-BANG screening tool validated
- No need to delay surgery for sleep study
- Need CPAP available

OSA/Obesity

- Benzodiazepines with caution due to respiratory depression
- Hypoxic events during procedural sedation with propofol—careful titration
- Ketamine (does not decrease upper airway muscle activity)
- REGIONAL ANESTHESIA

References


2022
References


Images courtesy of Pixabay: https://pixabay.com/
Freestanding ASC’s and COVID

Alison Brainard MD
Associate Professor
Director Cherry Creek North Ambulatory Surgery Center

No financial disclosures, though Dr. Angela Seiler gave me 7 of the slides in this talk.

Timing of Surgery with COVID infection

Original Article
Timing of surgery following SARS-CoV-2 infection: an international prospective cohort study

COVID-19 Collaborative and GlobalSurg Collaborative

140,231 Patients from 116 countries
Primary Outcome, 30-day mortality

Overall 30-day postoperative mortality

| No pre-operative SARS-CoV-2 | 1.47 (1.41-1.53) |
| 0-2 weeks | 4.06 (3.30-4.81) |
| 3-4 weeks | 3.86 (2.60-5.12) |
| 5-6 weeks | 3.59 (2.01-5.16) |
| >7 weeks | 1.49 (0.91-2.07) |
Conclusions of COVIDSurg Trial:
- Asymptomatic COVID infections confer a higher mortality rate for 7 weeks after infection.
- Patients with continued symptoms after 7 weeks have an increased mortality rate.
- Data were collected until Oct, 2020:
  - Unvaccinated patients
  - Predominantly Alpha, with Beta and Delta variants
- COVID Surg 3 trial: collecting data Feb, 2022
  - More vaccinated patients
  - Predominantly Omicron variant

"Decisions should be tailored for each patient since the possible advantages of delaying surgery for at least 7 weeks following SARS-COV-2 diagnosis must be balanced against the potential risks of delay."
Would you do this case at a freestanding ASC?....?

- 24 year old F presenting for tracheal dilation
  - FMHx: Idiopathic Tracheal Stenosis, RAD
- 46 year old M presenting for creation of AV fistula
  - FMHx: CCF on dialysis, IDDM, Obesity (BMI 45), CSA
- 31 year old F presenting for hysteroscopy
  - FMHx: RAD, Obesity (BMI 45)
- 19 year old F presenting for CRIF distal radius
  - FMHx: 18 weeks pregnant, otherwise healthy
- 78 year old M presenting for greenlight laser prostate
  - Obesity (BMI 36), NEDH, HTN, STOP-BANG score 6

STOP-BANG

- STOP–Bang = Snoring, Tiredness, Observed apnea, High BP, BMI, Age, Neck circumference, and Male gender

<table>
<thead>
<tr>
<th>STOP-Bang Score</th>
<th>Key OSI ($\text{RI} \times \text{RI}$)</th>
<th>Moderate/Severe OSI ($\text{RI} \times \text{RI}$)</th>
<th>Severe OSI ($\text{HI} \times \text{RI}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>8.40 (0.39-6.15)</td>
<td>8.00 (0.35-3.59)</td>
<td>6.94 (0.25-3.08)</td>
</tr>
<tr>
<td>3</td>
<td>57.0 (45.2-8.70)</td>
<td>5.60 (3.86-6.45)</td>
<td>4.12 (0.69-6.19)</td>
</tr>
<tr>
<td>4</td>
<td>68.0 (68.4-6.9)</td>
<td>8.00 (3.86-6.45)</td>
<td>6.94 (0.35-3.08)</td>
</tr>
<tr>
<td>5</td>
<td>57.0 (45.2-8.70)</td>
<td>8.00 (3.86-6.45)</td>
<td>6.94 (0.35-3.08)</td>
</tr>
<tr>
<td>6</td>
<td>67.0 (44.4-8.1)</td>
<td>6.90 (2.75-5.9)</td>
<td>6.70 (2.60-5.9)</td>
</tr>
<tr>
<td>7 and 8</td>
<td>67.0 (44.4-8.1)</td>
<td>6.90 (2.75-5.9)</td>
<td>6.70 (2.60-5.9)</td>
</tr>
</tbody>
</table>

Data are given as probability (95% CI).


Same Day Cancellation Policy

- General:
  - Unsuitable vital Signs:
    - Hypertensive crisis
    - Systolic blood pressure greater than 220
    - HbA1c less than 8%
    - History of serious complications from anesthesia
    - Personal/previous history of MI
    - Known Pregnancy
    - DNR status that is not revoked for ENTIRE perioperative period (until patient is in their car)
    - Emergent procedure
    - Greater than 500 lbs
    - BMI greater than 44
    - Patient must be at least 12 years old and > 40 kg
    - ASA Status is NOT an exclusion criteria
Cardiac:
- Active chest pain
- New onset arrhythmia
- New onset syncopal episodes
- MI within last 6 months
- Uncompensated or severe CHF
- Critical Aortic Stenosis
- DVT within last 3 months
- PE within last 6 months
- Implanted AICD
- Pacemaker Dependent (>40% paced), surgery above umbilicus, and unable to place magnet
- Severe Pulmonary HTN
- Cardiac Stents with ASA therapy where surgeon wants ASA discontinued for procedure
- Bare Metal stents placed less than 6 weeks ago
- Angioplasty done less than 6 weeks ago

Pulmonary:
- Pneumonia less than 6 weeks from start of antibiotics
- Known difficult airway
- Tracheostomy in place without ENT surgeon operating
- Patients with tracheal stenosis/tracheomalacia or other vocal cord dysfunction w/o ENT surgeon

Endocrine:
- Uncontrolled or "brittle" diabetics (Hgb A1C > 12)
- Blood sugar preoperatively >300
- Significant electrolyte abnormalities

Neurology:
- Active untreated seizure disorder
- History of TIA/CVA within 9 months
- Symptomatic or severe carotid stenosis

Renal:
- Stopping dialysis for surgery

Social:
- Patients MUST have a responsible caregiver (ride to and from EDN unless local only case
- Acute intoxication (alcohol or marijuana)
- Active substance abuse (illicit drugs)

Mobility:
- Requires a Hoyer lift

Type of Procedure:
- Any procedure where there is an increased likelihood of blood transfusion
- Need of invasive monitoring (arterial line)
- Any patient requiring factor administration prior to surgery

Infectious Disease:
- COVID or other pandemic - follow current documents/guidelines
Ambulatory Total Joints

Kyle Marshall, MD
Associate Professor
University of Colorado

Same-Day Discharge Total Joints

- It's coming to all...
  - Changes in Reimbursement
  - It can be done safely
  - Cost savings
  - Beds can be used for something else...
    - Like COVID patients!

Same-Day Discharge Hips/Knees

- Perhaps you're thinking:
  - Wait!? This isn't new!!
    - Correct!
    - Ambulatory THA/TKA have been around for years
      - Healthier patients
      - Orthopedic specialty hospitals
      - Strict criteria for eligibility

Same-Day Discharge Total Joints

- How can it work for patients that would have been admitted in the past?
  - Patient education/preparation
  - Compliance with best-practices
  - Multi-disciplinary collaborative effort

COVID-19 Update: Orthopedists Suspend Bro Hugs for 60 Days
Stakeholders
- Orthopedic Surgery
- Anesthesiology
- Pharmacy
- Physical & Occ Therapy/Rehab
- Pre/Intra/Post-op Nursing staff
- Pre/Post Clinic staff
- Social Work/Home Healthcare
- Internal Medicine

Let's break this down... for Anesthesiology
- Pre-operative
- Intra-operative
- Post-operative

Pre-operative - Anesthesiology
- Pre-Hospital/Surgi-center:
  - Determine exclusion criteria
  - Schedule these cases early in the Day!
  - If we don’t evaluate and clear the patients...
    - THEY WILL
    - All of us know what that means...

Pre-Operative - Anesthesiology
- Day of Surgery:
  - Multimodal management starts in Pre-op!
    - Acetaminophen 1000mg
    - Meloxicam vs. Celecoxib
    - Adductor Canal for TKA - 20mL 0.5% Ropi or Bupi
    - Avoid opioids, gabapentinoids
    - Minimize/Avoid benzodiazepines

Intra-Operative - Anesthesiology
- Primary Anesthetic -
  - Spinal vs. General
    - The age-old argument

Intra-operative - Primary Anesthetic
- SPINAL
  - PRO
    - Opioid sparing
    - Nice wake-up
    - Less PONV
    - Less delirium
    - Less airway manipulation
  - CON
    - Anticoagulation issues
    - Urinary retention
    - Obesity + Arthritis
    - Provider Dependent
Intra-operative - Primary Anesthetic

**GENERAL**
- **PRO**
  - Anticoagulation?!
  - Who cares!
  - Less provider dependent
  - Less surgeon dependent
  - No mid-case conversion
- **CON**
  - More PONV
  - More pain
  - More opioids
  - More delirium
  - Urinary retention

Spinal - Meds?
- **SHORT ACTING!**
  - Mepivacaine 1.5% - administer ~3mL intrathecal @L2/3
  - 2-3hrs duration
  - Quick onset, surgical team ready to position/prep
  - Avoid opioids - reduce urinary retention, PONV
  - Avoid epinephrine!
  - We do straight local anesthetic
  - Our surgeons are predictable

Intra-Operative

**SPINAL**
- Propofol gtt
-Phenylephrine PRN
-Anti-emetics
-Light fluid - 1L
-No Foley

**GENERAL**
-Gas/TIVA/Mix
-Multimodal analgesia!
- Ketamine - low dose
- Fentanyl PRN - Avoid long actors
- Phenytoin PRN
-Anti-emetics
-Light Fluid - 1L
-No Foley

Post-operative - Anesthesiology

- Good news! We’re mostly done...
- Oral pain meds > IV pain meds
- Ketorolac 15mg x1 (yes, on top of Meloxicam)
- If IV - stick to Fentanyl, avoid long actors
- If you must, be judicious with dosing
-Anti-emetics

References:
- Gomerblog.com
Wednesday, March 2nd
Pearls for Practice: Optimizing Patients for the OR

Angela Selzer, MD
Associate Professor of Anesthesiology
Medical Director of Pre-Procedure Services
University of Colorado

Disclosures
- I have no financial disclosures

Pearls for Practice: Optimizing Patients for the OR

- Why optimization matters
- Basics of a preop eval
- Beyond the basics: What’s new in periop
  - Functional Status Assessment
  - Anemia Prehab
  - Glycemic Control
  - Penicillin Allergy Testing

Making the Argument for Optimization

- Decreased surgical delays and cancellations
- Decreased perioperative mortality
- Reduction in excessive and unnecessary testing
- Reduction in subspecialty consults
- Increased Patient and surgeon satisfaction
- Increased regulatory compliance and operating room efficiency
- Improving information transfers (consents, H&Ps, exams)
- Improved patient satisfaction
- Improved compliance with instructions
- Implementing care coordination in a multidisciplinary context

Basics of the Preoperative Evaluation

- A basic preoperative evaluation should include:
  - List of current medical problems
  - ROS
  - List of current medications and dosages
  - List of allergies and reactions
  - Physical exam with vital signs
  - Necessary lab testing
  - Assessment of risk for surgery
  - Results of any prior testing

IM JUST SAYIN’ YOU COULD DO BETTER

IM JUST SAYIN’ WE COULD ALL DO BETTER
New Frontiers of Perioperative Medicine

- Functional Status Assessment
- Anemia Prehabilitation
- Diabetes Management
- Penicillin Allergy Testing

Functional Status Assessment

- Methods of assessing functional status
  - Ask questions
  - DASI survey
  - 6 minute walk test
  - Cardiopulmonary testing
- In General:
  - Patients OVERESTIMATE their function
  - Physicians UNDERESTIMATE function

Can you walk up two flights of stairs without chest pain or shortness of breath?

Can you walk two city blocks without chest pain or shortness of breath?

Compendium of Physical Activities

- Measured participant energy expenditure (VO2)
- Divides VO2 by 3.5mL/kg/min to calculate Standard METS

https://links.lww.com/MSS/A82

2011 Compendium of Physical Activities: A Second Update of Codes and MET Values

- [Link to compendium]

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery
Measured METs vs Standard METs

- Measured METs: Used calorimeters and accelerometers to measure actual energy expenditure for standardized activities.
- Concluded that standard MET values:
  - Generally, underestimate actual energy expenditure.
  - Especially in:
    - Women
    - Older ages
    - Overweight individuals

Medicine & Science in Sports & Exercise, September 2010

Duke Activity Score Index

6 Minute Walk Test

- 6 minute walk test (6MWT)
  - Self paced
  - Easily accomplished
  - No special equipment
  - Variability in testing
  - Need designated area
  - Takes 6 minutes!
  - Weakly correlated with outcomes (DASI is better)

https://cpcclinicalresearch.org/six-minute-walk-test/

Using Devices to Assess Function

Functional Status: PEARLS

- Consider asking different questions to assess status
- Female, older and overweight patients expend more energy with less activity
- The DASI index is a great tool to guide testing in questionable patients
  - A DASI score less than 34 having moderate to high-risk surgery may benefit from pharmacologic stress testing
  - Wearables and phones can provide more information on activity
- Prehab through function tracking apps will be the next frontier
Anemia Prehabilitation
- Anemia affects 25-75% of elective surgical patients
- Anemia is an independent risk factor for perioperative:
  - Morbidity & mortality
  - MACE
  - AKI
  - Transfusions
- Blood transfusions are:
  - Costly & poorly reimbursed
  - Associated with increased morbidity and mortality
  - Associated with increased ICU and hospital length of stays

Iron Deficiency Anemia
- Over 1/3 of preoperative anemia is associated with iron deficiency
- Iron deficiency anemia is easily treatable with PO or IV Iron
- PO Iron is often poorly tolerated and taken
- Hemoglobin levels can be corrected in as little as two weeks preoperatively if IV iron is given
- Reticulocyte counts usually double within 48 hours following a single iron infusion

Iron Deficiency Anemia
- Calculate iron for treatment with the total Iron Deficit:
  - (Target Hemoglobin - Current Hemoglobin) x Body Weight (kg) x 2.4 + 500mg
- Replete with:
  - Ferric Carboxymaltose
  - More expensive
  - Requires fewer infusions
  - Iron Sucrose
  - Ferric Gluconate
- If no known cause of IDA, should have GI/PCP follow up

Anemia Prehab: PEARLS
- Treatment of Anemia in the preoperative period is cost-effective
- Identifying and treating Iron Deficiency Anemia is a good place to start
- 3-4 weeks preop is an ideal time frame
- Patients benefit from repleting depleted iron stores in as little as 48 hours
- Preoperative clinics can successfully treat anemia due to kidney disease, chronic inflammation or B12/Folate deficiency
- More research is needed to establish improved outcomes with anemia prehab
Diabetes Management

- It is estimated that 5-10% of patients having surgery are undiagnosed diabetics.
- Hyperglycemia without a diagnosis of diabetes has a greater risk of worse perioperative outcomes than patients with a diagnosis of diabetes.
- Increased risk of:
  - Prolonged hospital stay
  - Postoperative complications: including infection, prolonged intubation
  - Perioperative mortality

Screening for diabetes

- USPSTF recommends screening:
  - Every three years:
    - All overweight adults over 35
    - All adults over 45
    - Adults of any age with risk factors (FH, HTN, CVD, PCOS, HL, Low HDL, severe obesity, high-risk racial/ethnic group)
  - Annually:
    - Patients with a diagnosis of pre-diabetes
    - Patients with a history of gestational diabetes

Methods of screening for diabetes and pre-diabetes:
- Fasting Glucose
- Oral Glucose Tolerance Test
- HgbA1c

Diagnosing Diabetes: Glucose Testing

- Random Glucose (>200mg/dL):
  - Present on BMP
  - Specific but not sensitive
  - Non-diagnostic by itself
- Fasting Glucose (>126mg/dL):
  - Requires overnight fasting
- Oral Glucose Tolerance Test (>200mg/dL):
  - Requires overnight fasting
  - Most sensitive
  - Most cumbersome
  - Can be unpleasant for patients (nausea)
  - Rarely performed as part of a preoperative assessment

Diagnosing Diabetes: Hemoglobin A1c

- HgbA1c (>6.5%)
  - Reproducible/precise
  - Standardized
  - Does not require fasting
  - Lower sensitivity compared to glucose testing
  - Reflects daily averages (not reflective of swings)
  - Reduced accuracy with many medical conditions
  - Underdiagnosis of DM

Improving Glycemic Control

In general, ADA recommends HgbA1c ≤ 7% and Glucose between 70-180 for at least 70% of the day.
- There is a clear association between increasing HgbA1c and perioperative complications.
- However, delaying surgery to lower HgbA1c has not been shown to alter outcomes.
- Interventions:
  - Lifestyle modifications
  - Diabetes educator
  - Assessment of current regimen
  - Addition/modification of medication
  - Glucose Log or Continuous Glucose Monitor
  - Referral to endocrinology/PCP
- Have a clear plan for follow-up: What specific targets to achieve by what date using what support
Measuring Improved Glycemic Control:

Hemoglobin A1c
- Glucose binds to hemoglobin within the red blood cell
- Good indicator of overall glucose control
- Takes 3 months to reflect changes in glycemic control
- Not particularly helpful to assess changes in diabetes management in the preoperative period

Fructosamine
- Glucose + Protein = Fructosamine
- Turnover is around 10-21 days
- Fructosamine levels will improve in a number of weeks with improved glycemic control
- Usually a send-out test
- Unclear how to use it!

Measuring Improved Glycemic Control:

Glucose Monitoring
- Reflects actual glucose levels throughout the day rather than an average
- Can use the estimated average glucose (eAG) to estimate a HgbA1c
- Techniques:
  - Self-Monitoring of Blood Glucose (SMBG)
    - Accurate if high patient compliance
    - Can associate with a food log for education
  - Continuous Glucose Monitoring (CGM)
    - Better at capturing fluctuations
    - Does not require patient compliance

Continuous Glucose Monitoring
- Intersitial glucose measured every 1-5 minutes
- Subcutaneously implanted enzyme electrodes
- Can be coupled with an insulin pump to create a "closed-loop control" of glucose
- Less accurate in prediabetics
- Not approved for diagnosis of diabetes
- Allows for ability to assess "Time in Range" for optimal adjustment of medical management
- Can be set with alarms to treat hyper and hypoglycemia early

Diabetes Management: PEARLS
- The majority of our presurgical patients should have screening for diabetes and pre-diabetes at least every three years
- Be especially mindful of the undiagnosed hyperglycemics
- HgbA1c levels are the best indicator for glycemic control
- Takes months to reflect changes in glycemic control
- Fructosamine levels adjust more rapidly, needing only a few weeks to reflect changes in glycemic control
- Early research is promising, but more research is needed
- Continuous Glucose Monitoring may be the best way to assess glycemic control in the preoperative period
- Requires special equipment and staffing to interpret data and educate patients
- It is not clear that improving glycemic control in the short term improves outcomes, it is inarguably better for patients in the long term
Penicillin “Allergies”

- Less than 2% of patients with a listed penicillin “allergy” will have a positive penicillin allergy test.
- 1st and 2nd generation cephalosporins are often avoided in patients with a penicillin allergy.
- Fluoroquinolones, clindamycin and 3rd gen cephalosporins are favored in penicillin allergic patients but have an increased risk of C. Diff.
- Having a listed penicillin allergy is an independent risk factor for:
  - VRE & MRSA
  - Increased hospital length of stay
  - Surgical Site Infection
  - Need for reoperation

Penicillin Allergy Delabeling

- De-label during preop assessment
- Refer for allergy skin testing
- Oral Challenge in Presp Clinic

Penicillin Allergy Delabeling

- Practical guide for evaluation and management of beta-lactam allergy: position statement from the Canadian Society of Allergy and Clinical Immunology

Penicillin Allergy Testing

- Screened surgical patients
- Low risk patients offered testing
- Of 56 patients tested in clinic, were de-labeled
- The majority of patients (70%) prefer to have delabeling occur in conjunction with supervised testing
- The majority of patients would prefer to have testing performed during the presurgical visit

Penicillin Allergy Delabeling

- Drop the Label
- Antibiotic Allergy Delabeling
- Dropthelabel.ca

Penicillin Allergy Delabeling

- Health care use and serious infection prevalence associated with penicillin “allergy” in hospitalized patients: A cohort study
Penicillin Allergy Testing: CU Experience

- 2018: launched referral process to Allergy clinic⇒100% delabelled
- 2020: Allergists begins direct to oral challenge testing in select patients
- Scheduling limited due to presurgical timeframe, patient willingness and appointment availability
- 2021: Developed a process to perform testing in low/intermediate risk patients in our clinic (rxn>10yrs ago)
- Launching in March, 2022!


Penicillin Allergy: PEARLS

- 10% of surgical patients have a penicillin “allergy” listed in their EMR
- 98% of these “allergies” are not true allergies
- Having a beta-lactam allergy listed in a patient’s EMR worsens perioperative outcomes and increases overall hospital costs
- **Low Risk Patients** with a listed beta-lactam allergy can be safely de-labeled after a careful history
- **Intermediate and High Risk Patients** can be delabeled through allergy testing in allergy, primary care or preoperative clinics

Optimizing Patients for the OR: Take Home Points

- Preoperative clinics are cost effective models of care which improve perioperative outcomes
- We aren’t great at assessing functional status: The DASI tool, 6MWT, compendium of physical activities, and wearable devices can provide a better picture of our patient’s fitness for surgery
- Treating iron deficiency anemia in the preoperative period is cost effective but more research is needed to show improved outcomes
- All patients should be screened for diabetes as the undiagnosed diabetics have the worst perioperative outcomes
- While poorly controlled diabetes is clearly associated with worse outcomes, more research is needed to show that outcomes are improved with better preoperative glycemic control
- Delabeling patients’ penicillin “allergy” improves perioperative outcomes
- Direct to oral challenge allergy testing is cost and time efficient in intermediate risk patients

Questions?

References:

43 44 45 46
Basics of TEG and ROTEM

Tim Tran, MD
Assistant Professor
Department of Anesthesiology
University of Colorado - Anschutz Medical Campus

- Everything You Need to Know About TEG/ROTEM For Your Practice
- Tran: Basics of TEG vs ROTEM
- Willey: TEG/ROTEM in cardiac surgery, cardiopulmonary bypass
- Stewart: TEG/ROTEM in liver disease/general cases
- Learn the differences between TEG and ROTEM
- How to apply whole blood global viscoelastic studies to in coagulopathy in cardiac surgery
- How to apply whole blood global viscoelastic studies to manage coagulopathy in general surgery, trauma, and other cases

Disclosures
- None

Objectives
- What are viscoelastic studies?
  - Thromboelastography
  - Rotational thromboelastometry
- What are the differences between TEG and ROTEM?
- How do I interpret abnormalities in these studies?

Viscoelastic Hemostatic Assays
- Most commonly used TEG and ROTEM
- Allows for assessment of the function of the coagulation balance
- Limitations

Thromboelastography (TEG)
**TEG Output**

- **R Time**: Start to formation at Amplitude 2mm
- **K Time**: Time to 20mm
- **Angle**: Between R and K
- **Maximum Amplitude
- **Lysis**

**TEG Basics**

- **R Time**: Start to formation at Amplitude 2mm
- **K Time**: Time to 20mm
- **Angle**: Between R and K
- **Maximum Amplitude
- **Lysis**

**R Time**

- Intrinsic coagulation factors
- Factors 2, 5, 8, 9, 10, Fibrinogen

**TEG Basics**

- **K Time**: Start of clot to 20mm
- **Fibrin/Platelets/Coagulation Factors**

**TEG Basics**

- **Angle**: Angle Between Between R and K
- **“Rate of clot formation”**
- Fibrinogen, Platelet Dependent

**TEG Basics**

- **Maximum Amplitude
- **Platelets**
TEG Basics

- Lysis 30 60
- Amount of lysis at 30 min/60min

TEG Basics

- R Time: Start to formation at 2mm
- K Time: Time to 20mm
- Angle: Between R and K
- Maximum Amplitude
- Lysis 60

Rotational Thromboelastometry

ROTEM Output

ROTEM Variables

<table>
<thead>
<tr>
<th>TEG</th>
<th>ROTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Time</td>
<td>Clotting Time (CT)</td>
</tr>
<tr>
<td>K Time</td>
<td>Clot Formation Time (CFT)</td>
</tr>
<tr>
<td>Alpha Angle</td>
<td>Alpha Angle</td>
</tr>
<tr>
<td>Maximum Amplitude</td>
<td>Maximum Clot Firmness</td>
</tr>
<tr>
<td>Ly30, Ly60</td>
<td>Clot lysis</td>
</tr>
</tbody>
</table>
### IN-TEM/EX-TEM/Fib-TEM/Hep-TEM

<table>
<thead>
<tr>
<th>Component</th>
<th>Assay</th>
<th>Comparable Lab Test</th>
<th>Purpose</th>
<th>Pathologies that affect the assay</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTEM</td>
<td>INTT</td>
<td></td>
<td>Tests intrinsic pathway</td>
<td>[PLT], fibrinogen</td>
</tr>
<tr>
<td>EXTEM</td>
<td>PT/INR</td>
<td></td>
<td>Tests extrinsic pathway</td>
<td>[PLT], fibrinogen</td>
</tr>
<tr>
<td>APTEM</td>
<td>-</td>
<td></td>
<td>Tests fibrinolysis (compared to EXTEM)</td>
<td>[PLT], fibrinogen</td>
</tr>
<tr>
<td>FIBTEM</td>
<td>Fibrinogen, INR</td>
<td></td>
<td>Eliminates PLT in clot to test fibrinogen function</td>
<td>[fibrinogen]</td>
</tr>
<tr>
<td>HEPTEM</td>
<td>-</td>
<td></td>
<td>Eliminates heparin effect (compared to INTEM)</td>
<td>Heparin effect</td>
</tr>
</tbody>
</table>

### ROTEM Variables

<table>
<thead>
<tr>
<th>TeG</th>
<th>ROTEM</th>
<th>Considerations for Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Time</td>
<td>Clotting Time (CT)</td>
<td>FFP</td>
</tr>
<tr>
<td>K Time</td>
<td>Clot Formation Time (CFT)</td>
<td>Fibrinogen</td>
</tr>
<tr>
<td>Alpha Angle</td>
<td>Alpha Angle</td>
<td>Fibrinogen</td>
</tr>
<tr>
<td>Maximum Amplitude</td>
<td>Maximum Clot Firmness</td>
<td>Platelets</td>
</tr>
<tr>
<td>Ly30, Ly60</td>
<td>Clot Lysis</td>
<td>Anti-Fibrinolytic</td>
</tr>
</tbody>
</table>

### Limitations

- The addition of the antithrombotic agent reduces the platelet-mediated clot activation signal to selectively evaluate the fibrinogen component of clot strength. In turn, platelet contribution is calculated by the difference between the viscoelastic amplitude of the tissue factor-activated ROTEM and fibrinogen ROTEM 10.
- First, there are convincing data showing that there is residual platelet noise in the fibrinogen assays caused by incomplete inhibition of platelet aggregation. This is more pronounced when a platelet glycoprotein IIb/IIIa receptor inhibitor is used and less pronounced when cytochalasin D is used. The combination of the agents leads to complete inhibition of platelet aggregation and thereby prevents any residual “platelet noise.”

### References

What We Will Cover

- Can viscoelastic testing predict bleeding in cardiac surgery?
- Do viscoelastic tests convey more benefit than standard lab testing?
- What are current recommendations in cardiac surgery related to viscoelastic testing?

Can viscoelastic testing predict bleeding in cardiac surgery?

- The rate of change of A10 in ROTEM has been correlated with bleeding. The faster the rate of change the more bleeding. This is true across all A10 channels. (General Thoracic and Cardiovascular Surgery 2021 https://doi.org/10.1007/s11748-021-01688-0)

Do viscoelastic tests convey more benefit than standard lab testing?

  - 17 studies. 15 of the 17 published between 2001 and 2012.
  - All studies compared viscoelastic testing with standard of care.
  - TEG/ROTEM guided transfusion management:
    - significantly decreased the odds for patients to receive alloimmune blood products
    - significantly decreased the re-expansion rate due to postoperative bleeding
    - resulted in less postoperative AKI and thromboembolic events
    - no statistical differences: stroke, length of stay in ICU or hospital, or in-hospital mortality

  - TEG, ROTEM And Sonoclot.
  - 15 trials; included 9 from the previously mentioned meta-analysis.
  - 8,737 patients.
  - One trial had 7,402 patients. The other trials ranged from 22-228.
  - Analysis showed that viscoelastic testing did decrease transfusion of red blood cells and platelets.
  - There was no decrease in emergency reoperation, length of intubation, ICU or hospital length of stay, stroke or mortality.
  - There were 4 studies that reported on AKI and the incidence of this was significantly decreased.
Do viscoelastic tests convey more benefit than standard lab testing?

- A more recent metanalysis
- 8 trials, 1035 patients
- Viscoelastic testing results in less RBC, Plasma, and Platelet transfusion as well as decreased bleeding at 12 and 24 hours.
- Also, less re-exploration for non-surgical bleeding.

What are current recommendations in cardiac surgery related to viscoelastic testing?

What do our guidelines say?

- The SCA endorses creation of a multidisciplinary blood management team.
- The SCA endorses the creation of transfusion algorithms with defined triggers “measured by POC or other rapid turnaround coagulation test”.
- “It is the working group’s opinion that viscoelastic coagulation tests are superior to conventional coagulation laboratory studies in guiding transfusion therapy in patients undergoing cardiovascular surgical procedures”.
- They do recognize that everybody does not have access to these testing methods, so they provide an algorithm for non-viscoelastic testing transfusion.
What do the European guidelines say?


- "Perioperative treatment algorithms for the bleeding patient based on viscoelastic POC tests should be considered to reduce the number of transfusions."
- Unlike the SCA, they do not give treatment recommendations based upon viscoelastic values.

What are some other viscoelastic algorithms?


In Summary

- Viscoelastic testing does not predict bleeding well.
- Viscoelastic testing as part of a transfusion algorithm in cardiac surgery results in less transfusion than standardized testing.
- There are multiple different published algorithms for coagulation resuscitation using viscoelastic testing.

Test Time

- a) Is normal
- b) Suggests fibrinolysis
- c) Suggest that we need fibrinogen
- d) Suggests that we need protamine

Answer: A
This ROTEM
a) Is normal
b) Suggests fibrinolysis
c) Suggest that we need fibrinogen
d) Suggests that we need protamine

Answer: B
This ROTEM

a) Is normal
b) Suggests fibrinolysis
c) Suggest that we need fibrinogen
d) Suggests that we need protamine
**Objectives**

- Consider the advantages and limitations of using viscoelastic testing to manage coagulopathy in perioperative patients
- Review coagulopathies found commonly in patients undergoing non-cardiac procedures and discuss expected findings in viscoelastic testing
- Examine the literature supporting the use of viscoelastic testing in guiding the management of these coagulopathies
- Interpret viscoelastic test tracings for a variety of coagulopathic states

**Perioperative use of viscoelastic testing (VET)**

- Provides a visual representation of the cell-based model of hemostasis by providing measures of clot kinetics, strength, stability and dissolution
- Faster turn around time as compared to standard laboratory coagulation studies (aPTT, PT/INR, platelet count, fibrinogen, etc) and can be used as “point of care” testing in the operating room
- Can help to distinguish between a wide variety of coagulopathies whereas a single standard coagulation study cannot
- May avoid inappropriate transfusion thereby decreasing the utilization of blood products and reducing transfusion related complications
- May portend a clinical benefit in terms of patient outcomes in specific settings but this is yet to be fully elucidated in use for all non-cardiac procedures.

**Limitations of VETs**

- Cannot accurately assess the contribution of endothelium to coagulation so cannot be used to evaluate conditions that effect adherence to the endothelium (i.e. VWD)
- VETs bypass primary hemostasis using reagents that activate coagulation - cannot be used to evaluate anti-platelet agents or disorders of primary hemostasis.
- Cannot quantify coagulation effects of external factors such as hypothermia, acidosis, etc

**Coagulopathy in trauma**

- Hypothermia
- Acidosis
- Disseminated intravascular coagulation
- Dilutional coagulopathy
- Trauma-induced coagulopathy
Use of viscoelastic testing in trauma

- TEG parameters such as MA have been shown to better correlate with transfusion requirements than standard coagulation studies in the first 24 hours after admission.\(^{17}\)
- TEG parameters are more closely associated with survival as compared to INR.\(^{13}\)
- Use of TEG parameters in goal-directed resuscitation has been shown to improve mortality and decrease utilization of blood products.\(^{7,11,17}\)


Dysregulation of fibrinolysis in trauma

- Hyperfibrinolysis
  - Reduced clot formation due to excessive breakdown of mature fibrin defined by an LY30 greater than 3%.\(^{16}\)
  - Related to release of tissue plasminogen activator (tPA) with an appropriate increase in anti-fibrinolytic plasminogen activator inhibitor-1 (PAI-1) in shock and tissue injury.\(^{18}\)
  - Associated with increased mortality in trauma patients, most commonly associated with exsanguination.\(^{16}\)

- Fibrinolysis shut down
  - State of inhibited fibrinolysis defined by an LY30 of 0.8% or less on VET (Moore) which results in a pro-thrombotic state.
  - Most common phenotype of fibrinolysis seen in initial presentation of trauma patients.\(^{16}\)
  - Physiologic mechanism is less clear.
  - Associated with increased mortality in trauma patients however more associated with multi-organ failure.\(^{12,16}\)

Management of dysregulated fibrinolysis

- Clinical Randomization of Anti-fibrinolytic in Significant Hemorrhage (CRASH-2)
  - 2010: TXA improves survival when administered early in trauma with known or suspected hemorrhage.

- Military Application of Tranexamic Acid in Trauma Emergency Resuscitation (MATTERs)
  - 2012: Concordant with results to the CRASH-2 trial.

- Study of Tranexamic Acid During Air and Ground Medical Prehospital Transport (STAAMP)
  - 2020: TXA may be of benefit when given early to patients in severe shock.
  - Patients who present with more common "fibrinolytic shutdown" may be at higher risk of VTE. Utilizing VETs to determine early fibrinolytic phenotypes may help differentiate those who may benefit from early TXA administration.

Obstetrics

- Hypercoagulability of normal pregnancy
  - VET parameters of hypercoagulability increase as pregnancy progresses.
  - Slowly normalizes over about 4 weeks post-partum.\(^{18}\)
  - TEG has been used to determine anticoagulant effect but further investigation into best dosing for anticoagulation in VTE pps in pregnancy is needed.
Obstetrics

- Post-partum hemorrhage
  - ROTEM may be helpful in detecting hypofibrinogenemia in PPH and guiding resuscitation with fibrinogen
  - FIBTEM is an independent early predictor of progression to severe hemorrhage
  - May consider administration of fibrinogen concentrate with FIBTEM A5 less than 12 mm in women with PPH
  - Using ROTEM to guide resuscitation may lead to reduced utilization of blood products, reduced incidence of circulatory overload, lower transfusion rates, reduced rates of ICU admission and hospital LOS

- Assessing platelet function in thrombocytopenia
  - Data is limited
  - One prospective case series suggest that neuraxial anesthesia may be safely performed in pregnant patients with a platelet count greater than 564 and a normal TEG
  - Standard TEG is unable to detect platelet dysfunction in severe pre-eclampsia

End-stage liver disease

- Quantity and function of liver-dependent coagulation factors as well as platelets are disturbed in ELD resulting in a propensity for both bleeding and thrombosis
- Correlation of prolonged INR with bleeding risk has not been established
- Studies of VET in cirrhotic patients have shown relatively preserved hemostasis even in the context of abnormal standard coagulation studies (INR, low platelet count)
- Use of VET has been shown to reduce transfusion when incorporated into resuscitation protocols during liver transplantation however a clear survival benefit has not been demonstrated to date

POST-TEST

Which of the following therapies should be considered in a trauma patient presenting with this VET tracing?

A. Aminocaproic acid
B. Tranexamic acid
C. Aprutilin
D. Platelets
E. Fibrinogen

This VET tracing would be expected in which of the following clinical scenarios:

A. Within the first 24 of a resuscitation for massive hemorrhage
B. Dilutional coagulopathy during a liver transplantation
C. A patient with metastatic cancer
D. A patient on warfarin therapy
POST-TEST

This VET profile is most consistent with which of the following:
A. COVID-19 infection causing critical illness
B. Hemophilia A
C. Early DIC
D. Late DIC
E. Antiplatelet therapy

References

Neuroanesthesia Panel
The Toolbox for Providing the Best Clinical Care

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University of Colorado School of Medicine

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University of Colorado School of Medicine

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Neuroanesthesiology Fellow
University of Colorado School of Medicine

Delirium and Postoperative Cognitive Dysfunction

Claudia F. Clavijo, MD
Associate Professor of Anesthesiology
Director of Neuroanesthesiology
University of Colorado School of Medicine

Learning Objectives

- Define Delirium and postoperative cognitive dysfunction (POCD)
- Review risk factors for delirium and POCD
- Understand possible mechanisms
- Summarize anesthetic considerations
- Review current recommendations for the prevention of delirium and POCD

No conflict of interest to disclose

What is Delirium/POCD?
Why is this important?

Delirium
- A set of fluctuating changes in attention, mental status and level of consciousness
- Common after surgery/anesthesia

POCD
- Cognitive impairment present after full recovery of consciousness that persists beyond the expected pharmacological and physiological effects of anesthetic drugs
Importance

- Cognitive changes after surgery/anesthesia have been identified for >100 years
- More than 250 M major surgical procedures worldwide per year
- Implications of anesthesia in patients with preoperative CD
- Age >65 undergoing surgery is 30%
- Incidence 50-80% discharge, 20-50% at 6 weeks and 10-30% at 6 months.

- Longer life expectancy
- Prevalence of Dementia 46.8 M in 2015 and 113 M in 2050
- Impact of CD on morbidity, mortality, LOS, economic burden
- Characterization of role of anesthetics and other perioperative factors is needed

Risks Factors

- Advance age
- Preexisting cognitive impairment (poor memory and attention)
- Lower level of education
- Lower IQ
- Duration of surgery
- Respiratory complications
- Infection
- Reoperation
- Health/pain status

Mechanisms
Role of anesthetic agents and techniques

- General vs other (regional, neuraxial, local, sedation)
- TIVA vs inhalational anesthesia
- Anesthesia depth
- Hypotension
- Hypoxemia
- Hyperthermia
- Cerebral perfusion
- Cerebral oxygenation
- Glucose control

Possible treatments

- Dexmedetomidine
- Ketamine
- Anti-inflammatories (Parecoxib/COX-II inhibitors)
- Minocycline
- Statins
- Pregabalin
- Lidocaine

Efficacy of perioperative dexmedetomidine on postoperative delirium: systematic review and meta-analysis with trial sequential analysis of randomised controlled trials

Conclusion: Dexmedetomidine can reduce POD incidence for adult cardiac and non-cardiac surgical patients. The optimal dose and timing of dexmedetomidine and influence on other outcomes or particular patient populations with risk factors warrants further studies.
Intraoperative ketamine for prevention of postoperative delirium or pain after major surgery in older adults: an international, multicentre, double-blind, randomised clinical trial

Michael S Ackerman, Hannah M Myklebust, Ade Book Abdulrahman, Bert Jacobs, Phillip A Voon, Robert A Vaudel, Hilary P Greenhill, Samuel A Armstrong, Emma A Bell, Edith Voulgaris, Karl J Walaas, Ely Jiang, Nadia Yong, Simon M Lo, Christopher M Bangs, Vitoria R A K wey, Fees P L Ng, Nataraj A Katipally, Bradley A Feltis, Athina Sami, Shawn T. O’Reilly, Georgia A. A. Warden, on behalf of the PODCAST Research Group

There was no difference in delirium incidence between patients in the combined ketamine groups and the placebo group (19.45% vs 19.82%, respectively; absolute difference 0.36%, 95% CI −6.07 to 7.38, p=0.92). There were more postoperative hallucinations (p=0.01) and nightmares (p=0.03) with increasing ketamine doses compared with placebo.

Recommendations

1. Consent

Consensus Statement

“All patients over age 65 should be informed of the risks of PND including confusion, inattention, and memory problems after having an operation.”

2. Screening

Consensus Statement

“Baseline cognition should be objectively evaluated with a brief screening tool during preoperative evaluation in all patients over the age of 65 and in any patient with risk factors for preexisting cognitive impairment.”
Recommendations

3. Intraoperative

“A number of studies have examined whether using specific drugs to maintain general anesthesia affects the rates of various types of PND, but no clear consensus recommendations have emerged from these studies.”

“The current literature does not support the recommendation that a regional anesthetic technique should be used in place of (or in addition to) general anesthesia to reduce delirium or PND rates.”

“There was widespread agreement among the participants that anesthesiologists should use age-adjusted MAC fraction in older adults to adjust end-tidal volatile anesthetic concentrations during surgery, which at least provides a population-derived starting point for dosing inhaled anesthetics.”

Table 4. Intraoperative Recommendations to Promote Postoperative Brain Health

Avoid centrally acting anticholinergics, benzodiazepines, meperidine, and other drugs listed in Table 3
Avoid relative hypotension
Monitor age-adjusted end-tidal MAC fraction
Use EEG-based intraoperative brain monitoring to titrate anesthetic administration

Recommendations

4. Follow up
Conclusions

- Potential association between surgery/anesthesia and POCD
- Patients with dementia (Alzheimer’s) are at increased risk
- High quality studies are needed prioritizing pts with preexisting CD
- True effect of anesthesia
- Anesthetics with protective profile
- High priority in neuroscience
- Current recommendations to prevent/decrease are available
Awake Craniotomy

Leslie C Jameson, MD
Clinical Professor Anesthesiology
Denver Colorado

The AWAKE Brain during surgery.

Goal:
- Maintain patients with neurologic disorders
- Invasive Low Grade Glioma
- Degenerative Movement Disorders (e.g., Parkinson’s)
- During awake or minimal anesthesia care!

Audacious

Medical Diagnosis that most frequently are scheduled for Awake Craniotomy -- 2022

Low Grade Glioma (LGG)
- Grade 1-2 for growth and infiltration rate
- 20% of all brain tumors
- New diagnosis/year est. 20,000
- All are ultimately fatal

Intractable Seizure Disorders
- Minimally invasive craniotomy
- MRI and Computer technology
- (ROSA™) with general anesthesia
- Numbers Unknown --- Millions

Movement Disorders (MD)
- Parkinson's disease (90% to 93%)
- Essential Tremor (10 million or 4% population age over 40 years)
- Tourette’s Syndrome - Childhood diagnosis estimate 138,000 (CDC)

Other
- Obsessive Compulsive Disorder

Minimally invasive craniotomy—
- MRI and Computer technology
- (ROSA™) with general anesthesia
- Numbers Unknown --- Millions

Awake Craniotomy—
Management Dilemmas

Anesthesiology practices vary with what “Awake” requires.
- Patient Characteristics
- Surgical Location and Technique
  - Invasive - Craniotomy—Supratentorial Tumor (LGG)
  - Minimally invasive - “Electrodes” Placement (e.g., Deep Brain Stimulation)
- BOTH have significant risk of severe permanent injury and death.

Why should an intracranial procedure be awake?

Neurosurgeon

Awake Procedures MUST allow neurologic function to immediately be identified, evaluated, and next action assessed.
YOU KNOW WHEN TO STOP!

Issues: neurologic injury, patient resilience,

Depiction of the “first” awake craniotomy.
Performed London UK 1886 by Sir Victor Horsley
Can J Anesth 2017 DOI 10.1007/s1263-017-0804-1

Surgical & Anesthesia’s Team View

Even if patient can almost maybe follow directions (not necessarily perform the required activity—GO!!!)

Why the total surgical commitment to an awake procedure?

Better patient outcomes!!!

Surgeon’s and Neurologist’s View- GO!!

Time for the Anesthesia Plan anyone?

Anesthesiologist View

1. Absolute NO, NYET, FORGET IT, NEVER!!
2. Pretty close to NO- Cannot/will not lay in position requested
3. Not a good idea- Significant risk even with COLLABORATIVE plans

Significant medical illness that will make supine and unable to move a problem

Anesthesiologist during any AWAKE anesthetic.

- Entertainer
- Comedian
- Friend
- Student-Learn how to run a cattle ranch even when you have never seen one.
- Perform miracles
- Talk for hours about anything
- Learn to count again and again and again and again then do nursery rhymes.
- Give drugs
- Discuss how to teach a 3rd grader to improve his reading skills when you don’t have children.
- Restrain the patient
- Occasionally give DRUGS

Patient Evaluation For Awake Craniotomy

Low Grade Glioma - Patient Characteristics

- young adults (mean age 37-41 years)
- good health
- presenting symptom is seizure in 85%
- medical complications headache, visual impairment, diminished consciousness, weakness or numbness.
- cognitive & emotional function irregularities:
  -“forgetting” words, issues at work—judgment
  - mood disorder—anger, anxiety, emotionally labile difficulty with working memory, attention
- diagnosis requires imaging and complete neuropsychologic evaluation often obtained after first seizures
- Patient often appear to be using drugs

International Review of Neurobiology
Glioma - Testing during procedure

- **Memory test:** Repeat language exercises
- **Cognition test:** Explain how two items are like. For instance, if you see a picture of a dog and a cat, you might answer that they’re both animals or that they are both pets.
- **Verbal communication test:**
  - Identification-communication-Name items, given a letter of the alphabet and told to list words that start with that letter.
  - Spontaneous communication - Teach me to run a farm tractor
- **Motor tests:** Show fingers, wiggle feet, squeeze hand

Subjective: When have neuro deficit CAN remain calm!

Rehabilitation

- **Psychological Resilience:** Can they tolerate RAGE, stress, PTSD symptoms, disorientation, anxiety yet remain functional and calm.

Surgeon’s and Anesthesiologist view in Low Grade Glioma

We must !!!!

- Overall Survival about 6 years in case of single biopsy
- Survival now is around 14–15 years when extensive tumor removal (awake + mapping) has been achieved at diagnosis.

Low Grade GLIOMA

Awake surgery is currently the gold standard for cerebral mapping, because this is the sole technique enabling a direct identification of neural networks crucial for brain functions.

Neurosurgical Review

https://doi.org/10.1007/s10143-020-01418-9 2020

Patient Evaluation

Awake Deep Brain Stimulator Placement

Movement Disorders

Primarily Parkinson's Disease

Common Medical Conditions & Risks PRESENT for any surgical procedure.

https://www.parkinson.org/understanding-parkinsons
Newer surgical philosophy has shifted DBS treatment to early not rescue end stage treatment

Moving toward an “offer” when start medications before severe disability

Common Medications (Standard in Parkinson Disease)
- Artane, Azilect, Cagentin, Corlan, Dorap, Larodopa, Mirapex, Neupro, Requip, Sinemet, Tasmar (just some)

Common drug regimen includes 3-7 drugs often as every 3 hours 24/7
- As Meds fail—cycling—“break through events”
- Symptoms so severe place NG tube during long routine surgical cases to give meds

Whenever Drugs are withheld

Dopamine Agonist Withdrawal Syndrome (DAWS) include:
- anxiety, PANIC ATTACK, dysphoria, obsessions, restlessness, hallucinations (often mistaken for confusion)
- fatigue, DYSAUTONOMIA, deep disturbance, generalized pain, SEVERE RIGIDITY, dyskinesia
- INCREASED CV LABILITY (HR, BP)
- Urgent Periop Treatment TREATMENT: APOMORPHINE sublingual (FDA release 5-2020)
- Pain increased by psychostimulant withdrawal syndromes

Reported success with DBS

<table>
<thead>
<tr>
<th>MEDICAL CONDITION</th>
<th>EFFICACY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parkinson’s Disease</td>
<td>47-98%, average 88%</td>
</tr>
<tr>
<td>Essential Tremor</td>
<td>Awake 78%, Asleep 69.7% (NS-all)</td>
</tr>
<tr>
<td>Dystonia</td>
<td>52%</td>
</tr>
<tr>
<td>Tourette Syndrome</td>
<td>40-70%</td>
</tr>
<tr>
<td>Obsessive Compulsive Disorder</td>
<td></td>
</tr>
<tr>
<td>Medically Refractory Depression</td>
<td>40-70% (Europe)</td>
</tr>
</tbody>
</table>

Credible Evidence--Better outcomes today

There are Times to say LATER or NO

- Patient must have reasonable control of the medical issues
- Primary issue is autonomic instability
  - Prior to entering OR if have
    - severe hypertension
    - poorly controlled arrhythmias
    - POTS - usually cannot do MRI without anesthesia/drug assistance
  - Fix it first or do it anesthetized with the right drugs!

ALL or NOTHING

How do we manage the anesthetic?

Anesthesia Decisions

Cannabinoids
They are commonly used to self medicate particularly emotional disorders in ALL AGES
(PLEASE READ)

Cannabis Use Disorder (CUD) RX Marinol, Casamet
Cannabis Use Disorder (CUD) and Awake Craniotomy

- Baseline use: daily with 2-9 joints/day in studies
- Up to 40% of regular cannabis users develop moderate-severe CUD
- Withdrawal symptoms (DSM-5, 2015) - Three or more symptoms within a week
  - Irritability, anger, aggression,
  - Nervousness or anxiety or depressed mood,
  - Physical symptoms: abdominal discomfort, pain, tremor, sweating, fever, chills, headache
  - Increased appetite, weight loss, insomnia

FDA approved Synthetic Cannabinoids Possibly Useful—Rescue Drugs for NV

Dronabinol (Marinol)—activates cannabinoid receptors
- Schedule III, 1985 for Chemotherapy Nausea and Vomiting (5-15mg/m² to 6X/day)
- Effects: Decrease symptoms of withdrawal at 40mg to 90mg doses (N=41 multiple studies)

Nabilone (Casamet)
- Schedule II, 2006 for Nausea and Vomiting, 1-2 mg q8-12 hours ca
- Effects: Decrease symptoms of withdrawal at 1 to 10 mg (N=30)

Awake Craniotomy In the Operating Room

Low Grade Glioma AND DBS
Can I rescue this airway? NO?
Then Awake means AWAKE!!!!

Supratentorial Glioma—Position

NO!! Who could do cognitive assessment anyway?

LMA vs Tracheal Tube

Recommended

Must be able to ventilate and interview!!!!

Anesthesia Care

Glioma

Resilience

Foolhardy

To prescribe an anesthetic technique to this learned group.

This is more of a remember moment!
Anesthetic Choices - Low Grade Glioma (LGG)

- Awake + TAP + Field Blocks: Sedation
- Asleep

With or without breathing device (56%)

- Sedation: Awake
- Asleep

Asleep Group: 82% LMA to start and finish with 71% LMA/29% tube to finish

Determined by Neurosurgical desires & Anesthesia skills = Choice

Fantasy Anesthetic Goal (MY Organization's)

How awake are they???

Language - No delays

Speech spontaneous without word salad

Judgement: Identifying objects and use

Attention

Emotional control

Blood Pressure is below 140 systolic - Period

Common Drug Combos that Work

Propofol + Remifentanil
- May have airway issue, Short duration

Dexmedetomidine
- Less arousable, better airway

Low dose Antitoxin INFUSION only

Propofol + Remifentanil

<table>
<thead>
<tr>
<th>Drug</th>
<th>Stress</th>
<th>Peak effect</th>
<th>Half life</th>
<th>Duration</th>
<th>Conduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol</td>
<td>15-30 sec</td>
<td>6</td>
<td>30-40</td>
<td>5-10</td>
<td>Short</td>
</tr>
<tr>
<td>Remifentanil</td>
<td>5 min</td>
<td>15</td>
<td>120</td>
<td>120 to 182</td>
<td>Long-very long</td>
</tr>
</tbody>
</table>

Dexmedetomidine

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<td>Long-very long</td>
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</tbody>
</table>
DBS -- How awake?

End Goal for STN placement

The subjective grading and objective change (program calculations)
- tremor
- paresthesia
- dysarthria
- Reduction in rigidity (bradykinesia) with stimulation

Requirements in My Practice—Deep Brain Stimulation
- Blood Pressure Below 140 mmHg:
  - Intravenous calcium channel blockers
  - (Nicardipine, Cleviprex has rebound hypertension associated with it’s use)
  - Direct vasodilator; hydralazine, nitroglycerin
  - TINY tiny doses of fentanyl OR remifentanil
- NEVER HAVE MENTAL STATUS CHANGE (FOR VERY LONG) FROM DRUGS ADMINISTERED.
- Patient with Rigidity symptoms -
  - NEVER Remi with symptoms of rigidity, tardive dyskinesia, myotonia
  - NEVER use a beta blocker in movement disorders—ends MER testing

Any Patient taking Levodopa

DRUGS TO AVOID—Period!!!
- OK AT LOW DOSE
  - Ondansetron
  - Compazine
  - Haldol
  - Psychiatric Drugs which Deplete Dopamine
    - (e.g. tetrabenazine)

Effect on MER Activity

**HYPNOTICS**

<table>
<thead>
<tr>
<th>DRUG</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzodiazepines</td>
<td>Anxiolysis</td>
<td>Single dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Abolishes MER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alters stimulation threshold</td>
</tr>
<tr>
<td>Propofol</td>
<td>Predictable, short acting</td>
<td>EASY TO TITRATE!!!</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CONSISTANT EFFECT, RAPID RECOVERY</td>
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<tr>
<td></td>
<td></td>
<td>Abolishes tremor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decease MER firing</td>
</tr>
<tr>
<td>Dexmedetomidine</td>
<td>Selective α2-adrenoceptor agonist</td>
<td>low dosage small MER effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anxiolytic and analgesic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintain spontaneous respiration</td>
</tr>
<tr>
<td>Etomidate</td>
<td>Minimal BP, HR effects</td>
<td>Predictable, Single dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Abolishes MER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adrenal Suppression</td>
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</table>

**Analgesia**

<table>
<thead>
<tr>
<th>DRUG</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl</td>
<td>Minimal effect on MER</td>
<td></td>
</tr>
<tr>
<td>Remifentanil</td>
<td>Minimal effect on MER</td>
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<tr>
<td>Sufentanil</td>
<td>Minimal effect on MER</td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td>Minimal effect on MER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analgesic and Opioids</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maintenance of spontaneous respiration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transient increase in ICP</td>
<td></td>
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<tr>
<td></td>
<td>Hypersalivation</td>
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<tr>
<td></td>
<td>Hyperreflexia</td>
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<tr>
<td></td>
<td>Muscle hypertonicity</td>
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<tr>
<td></td>
<td>Hemodynamic variability?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Agitation?</td>
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</tbody>
</table>

Caution with rigidity. Slow and Small doses but effective for hypertension. Rigidity can be reversed by Narcan, BUT CAN NOT EFFECTIVE WITH REMIFENTANIL.
**Effect on PARKINSONS SYMPTOMS**

Anything that decreases MER

<table>
<thead>
<tr>
<th>DRUG</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-hypertensive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta-blockers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nicardipine</td>
<td>Attenuation of tremor for symptom control</td>
<td>Uses infusion pump</td>
</tr>
<tr>
<td>Hydralazine</td>
<td>Direct vasodilating drug, bolus administration</td>
<td>Intermediate acting intravenous formulation</td>
</tr>
<tr>
<td>Anti-emetic/Psychiatric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ondansetron</td>
<td>Antiemetic</td>
<td>Extrapyramidal side effects</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>Best antiemetic</td>
<td>None reported</td>
</tr>
</tbody>
</table>

**DONE**

43
A Multidisciplinary Approach to Preoperative Assessment of Complex Surgical Spine Patients

Julio Montejano MD
Neuroanesthesia Fellow
University of Colorado School of Medicine Dept. Anesthesiology

Disclosures

None

Learning Objective

- Describe preoperative evaluation and intraoperative goals in patients undergoing spine surgery with complex medical and surgical features.

What is Complex Spine Surgery?

- Surgery involving 2 or more levels of the spine
- Associated with cardiac and pulmonary events, stroke, wound complications, prolonged hospitalization, high readmission rates, and often discharge to rehab facilities
- Surgery to correct deformity in patients often includes 5 or more levels with major instrumentation
- Patients with pre-existing hardware that will be removed or is infected should also be considered complex
- >400,000 patients undergoing spinal fusions each year in the US Lumbar fusion is the most common procedure followed by cervical and thoracic spinal fusions

Preoperative Evaluation

- Reduced case-delays and cancellations
- Decreased hospital length-of-stays and lower in-hospital mortality rates
- Physical exam, review of medical history, risk assessment, indicated laboratory testing and imaging
- High risk surgeries will need preoperative testing
- Hemoglobin, platelet count, electrolyte panel including baseline glucose, coagulation studies and a type and screen
- Screening for osteoporosis and nutritional testing
- Other testing per patient history

Cardiac Assessment

- EKG is not routinely indicated unless prompted by the patient’s history
- In patients in whom functional status cannot be accurately assessed TTE and other non-invasive testing may be indicated, such as pharmacologic stress testing
- The Gupta Index is one tool to assess risk for perioperative myocardial infarction (MI) and cardiac arrest (CA)
- The American College of Surgeons (ACS) developed an online Surgical Risk Calculator (SRC) which assesses individual risk for twelve different adverse events
- The result is a visual representation of relative risk including death or discharge to nursing or rehab facility
Pulmonary Assessment

- Baseline SpO2 should be obtained in clinic and day of surgery
- PFTs are not routinely performed unless indicated by the patient’s history
- ARISCAT pulmonary risk calculator predicts the likelihood of pulmonary complications
- Pneumonia, respiratory failure requiring interventions such as reintubation or prolonged intubation
- Highest risk group have a 44% risk of pulmonary complications throughout the perioperative period
- Age, preoperative SpO2, respiratory infection within one month, anemia, surgical incision site, duration of surgery and emergency surgery are considered

Obstructive Sleep Apnea Risk Assessment

- Patients with untreated OSA have a significantly higher rate of postoperative pulmonary complications, longer hospitalizations and higher risk of mortality
- Complications can be reduced by preoperative diagnosis and implementation of CPAP therapy
- The STOP-Bang assessment tool is sensitive for OSA
- Patients with a positive STOP-Bang identified mild OSA (AHI>5) in 84% of cases, 93% of moderate OSA (AHI>15) and 100% of severe OSA cases (AHI>30)
- Low specificity (37-56%), patients with high scores should proceed with formal testing

Frailty as a Predictor for Surgical Outcomes

- Poorly defined high risk state portends negative surgical outcomes across all patients
- It has been described as a pro-existing pro-inflammatory state characterized by increased levels of cytokines such as IL-6, TNF alpha and CRP as well as hormonal derangements including increased cortisol and insulin resistance
- Frail patients have increased rates of mortality (18% vs 3%), readmissions, falls and disability
- There are dozens of calculators aimed at identifying frail patients
- Modified FI (mFI) has been shown to be predictive of postoperative complications
**Nutrition and Osteoporosis**

- Vitamin D levels, albumin and pre-albumin can be obtained.
- DEXA scans will be routinely obtained by the surgical team.
- The Nutritional Risk Index (NRI) takes into account a patient's albumin, pre-albumin and BMI.
- The use of high protein oral nutritional supplements has been associated with decreased post-operative complications, decreased length of hospitalization and decreased admission costs.
- High dose vitamin D supplementation is usually indicated.
- Referral to endocrinology should be considered in severe cases.

**Glycemic Control**

- Baseline blood glucose should be obtained.
- Patients at risk for diabetes are screened with a HgbA1c.
- Risk factors include age >45, sedentary lifestyle and obesity.
- Hyperglycemia (glucose >180mg/dL) and poorly controlled diabetes mellitus (DM) have been shown to increase the morbidity and mortality of spine surgical patients.
- Poorly controlled or uncontrolled DM (Hgb A1c >7 and <9) increases risk of surgical site infections (SSI).

**Identifying and Treating Anemia**

- Screening patients for anemia, thrombocytopenia and coagulopathies is recommended.
- Patients with preoperative anemia (in men Hgb<13 and women Hgb<12) have increased need for transfusions, perioperative mortality, morbidity and cost.
- Iron studies should be performed to identify iron deficiency.
- Iron supplementation should be implemented.
- The effects of oral iron supplementation are delayed.
- Preoperative patients typically qualify for IV iron therapy.
- Iron supplementation should be administered weeks in advance.

**Smoking Cessation**

- Nicotine testing is indicated in patients with a history of smoking to assure cessation.
- Patients are more likely to quit in the perioperative period.
- Smokers have an increased 30-day mortality and major morbidity including pulmonary complications, infection, ICU admissions, wound complications, neurologic complications and septic shock.
- Following spine surgery, smoking is a significant predictor for postoperative infections and non-unions after fusion.
- Increased post-operative pain scores and opioid consumption.
- Cessation can decrease these effects to near non-smoker levels.
- Even brief periods of cessation can be beneficial in reducing wound and pulmonary complications.

**Pre-habilitation Programs: PREPARE**

- Presurgery physiotherapy can decrease pain, risk of avoidance behavior, and worsening of psychological well-being, and can improve quality of life and physical activity levels before surgery.
- PREhabilitation, Physical Activity and exercise Trial.
- A physiotherapeutic, person-centered prehabilitation program based on a cognitive behavioral approach.
- The prehabilitation phase should start 8 to 12 weeks before surgery.
- Even "conventional care" shows a positive effect in improving outcomes.

**Complex Plus**

- Multimodal analgesia is based on surgical complexity.
- Pain and postoperative nausea and vomiting (PONV).
- Pain management using regional anesthesia is the focus, including use of tramadol (IV/PO), acetaminophen, and steroids.
- Regional anesthesia is used in all cases, with the exception of certain cases with a history of severe PONV.
- Postoperative nausea and vomiting (PONV) is managed using a combination of medications, including antiemetics.
- In cases with a history of severe PONV, a more aggressive approach is used, including the use of a combination of medications and intravenous fluids.
- All cases are managed by the anesthesiologist, with close monitoring of pain and PONV.
Our Model: Complex Spine Conference

- Using EPIC Procedure Pass to identify patients
- Patients are discussed weeks to months in advance to allow ample time for interventions to be performed if needed
- Weekly to bimonthly meetings to discuss upcoming cases
- Representatives from all ortho spine clinics are present
- Representatives from the Neuroanesthesiology team are present and discuss patients from a medical perspective
- Preoperative services, Social work and chronic pain are involved
- Pre-Anesthesia Clinic Visit is compulsory
- Labs, testing and imaging are reviewed
- Follow-up and coordination of repeat labs, indicated testing and referrals
- Surgery team then performs in-depth planning for the surgery
- Patients are then stamped with a seal of approval if no other interventions are needed

Question

How is the preoperative evaluation of Complex Spine surgery patients different than that of patients undergoing other major surgery?

Improvements, Challenges and Future Directions

- Procedure Pass identifying patients and missing urgent cases
- Challenges
  - COVID-19 patients
  - Patients with stable deformity may deteriorate due to postponement of surgical intervention
  - Coordinating out of state care
  - Referral centers
  - Difficulty coordinating care or having patients travel to be seen at UCH
  - Involvement of other ancillary services such as nutrition, PT and OT, chronic pain, and pain psychiatry

References

References Continued

Trauma Panel 2022

Drs. Bethany Benish, Ryan Laterza and Steve Bourland

No financial disclosures

Panel Objectives:
- Discuss some hot topics & controversies in Trauma Anesthesia
- Review volume resuscitation principles and techniques in trauma care
- Discuss some principles/techniques of pain control/regional anesthesia in trauma population

What’s New in Trauma Anesthesiology?

Bethany Benish MD
Associate Professor CUSOM
Associate Director, Director of Trauma
Denver Health Medical Center

Trauma Anesthesia Update

Objectives of my talk:
- Brief review of Acute Coagulopathy of Trauma & Damage Control Resuscitation
- Discuss transfusion strategies, including component ratios & Whole Blood
- Discuss the controversial role of TXA in trauma
- Review the role of ECMO in trauma
Trauma Epidemiology

- Trauma remains the 4th leading cause of mortality in the U.S.
- Major cause of mortality worldwide, responsible for nearly 5 million deaths annually.
- Leading cause of years of potential life lost prior to age 65 years, exceeding heart disease and cancer.

Challenges in Trauma

- Prehospital care
- Prompt recognition of need for surgery
- Airway management
- Safe induction
- Hypoxia-lung injury
- Cardiac injury (tamponade, contusions, failure)
- Neurologic injury (TBI, SCI)
- Postop complications... MOF, long term M&M, pain

Exsanguination due to uncontrolled bleeding is the leading cause of potentially preventable deaths among trauma patients.

Acute Coagulopathy of Trauma

- Massive hemorrhage accounts for over 30% of trauma deaths
- Outcomes have improved for bleeding trauma patients in the last 30 years (MTP, Ratios, Damage Control Resuscitation).
- 1/3 of trauma patients are coagulopathic on arrival to Emergency Department

Acute Coagulopathy of Trauma

- Develops very rapidly following tissue trauma and hemorrhagic shock.
- Hypocoagulation and hyperfibrinolysis.
- Independent predictor of transfusion, multi-organ failure and mortality.

- In patients with the same Injury Severity Score, the presence of coagulopathy nearly doubles mortality.

Management of Bleeding Trauma Patients

Damage Control Resuscitation:

- Permissive hypotension
- Correction of both endogenous & iatrogenic causes of coagulopathy
  - Minimizing crystalloid
  - Early & high ratio FFP, Platelets
  - TEG/ROTEM goal directed management of traumatic coagulopathy

Hemostatic Resuscitation & MTP

- Massive Transfusion Protocols
  - Predefined ratios delivered by blood bank
  - Reduces provider variability, facilitates staff communication and compliance
  - MTPs are effective in decreasing mortality in trauma

- Best if blood is readily available (thawed) in trauma bay when patient arrived
- Faster blood product delivery, better outcome (duh!)
  - Every minute from MTP activation to arrival of 1st cooler increases odds of mortality by 5%.
Let's talk Ratios...

Transfusion Ratio Studies:

Borgman & Holcomb et al. '07: Retrospective Review
- High Plasma to RBC ratio (1:1.4) independently associated with survival, decreased death from hemorrhage

PROMTT Study Holcomb et al. '13
- The PROspective, Observational, Multicenter, Major Trauma Transfusion Study (PROMTT)
- First 6 hours, patients receiving ratios of less than 1:2 (FFP: RBC) were 3-4 times more likely to die than those receiving 1:1 or higher

J-OCTET '16 (Japanese Observation Study for Coagulation and Thrombolysis in Early Trauma)
- Transfusion of FFP/RBC ratio 1:1 or higher within first 6 hours reduces death by 60%

Conclusions on Ratios...
- Sufficient evidence to support high ratios of plasma and platelet transfusion to improve survival and decreased hemorrhagic death
- MTP should utilized between 1:1:1 and 1:1:2 ratios (Plasma: Platelet : RBCs)

What about whole blood? Better than the sum of its parts?

What does “whole blood,” reconstituted in a 1:1:1 ratio of pRBC, PLT, FFP, actually contain?

A. 680 mL, HCT=29%, PLT= 80K, Coag Factors=65% (of original)
B. 800 mL, HCT=32%, PLT= 100K, Coag=75%
C. 600 mL, HCT=37%, PLT=140K, Coag=85%
D. 500 ml, HCT=43%, PLTs=150-400K Coag Factors=100%
History of Whole blood

- Whole Blood (WB) was the traditional transfusion product in military trauma since WWII.
- Component therapy was introduced in 1960s. By 1990—only component therapy in civilian hospitals.
- WB resurfaced in global war on terror in the form of “walking blood bank.”
- Source of platelets in a field expedient fashion.

WB studies:

- Spinella et al ’09. Retrospective Military study, 354 pts
  - Warm Fresh Whole Blood (WFWB) group: (100 pts; 28%)
  - Component Therapy (CT) group: RBC, plasma, aPLT no WFWB (254 patients; 72%)
- Primary outcomes: 24 hr. and 30 day mortality

Spinella et al Conclusions:

- “It is our belief that WFWB is more efficient than stored CT at correcting coagulopathy and shock in [trauma patients]...”
- WFWB is a more concentrated product than CT to prevent/correct shock and O2 debt in critically ill patient.
- Minimizes adverse effects of transfusion of “storage lesion” of older RBCs.
- WFWB group received less anticoagulants and additives than CT group.

Civilian Literature:

- Civilian study, Single Center (Houston), RCT, modified Whole Blood, ’13
  - 55 Cold Whole blood vs 52 Component Therapy.
- Conclusions:
  - No significant survival advantage
  - Compared with CT, WB significantly reduce transfusion volumes (11 vs 16 units) in severely injured patients predicted to receive massive transfusion

Cold-stored WB vs CT

- Two center, Case matched, Retrospective Study comparing CWB to CT (’19)
- Endpoints:
  - Trauma bay mortality
  - 10-day mortality
  - Lab values at 4 hours and 24 hours
  - Overall blood product utilization
- 91 Patients CWB vs 182 CT
  - Significantly lower death in trauma bay vs CT (2.2% vs 8.8%), higher mean Hgb at 24hrs.
  - No difference at 24hr or 30-day, no difference in transfusion requirement.
Outcomes in WB National Trauma Database

- Nationwide Analysis, Retrospective Review Civilian trauma
  - 280 (WB + CT) vs 8214 (CT only)
  - WB group: significantly lower 24-hr Mortality (17% vs 25%)

Authors’ Conclusions:

- “The use of WB as an adjunct to CT is associated with improved outcomes in resuscitation of severely injured civilian trauma patients. Further studies are required to evaluate the role of adding WB to massive transfusion protocols.”

Myths/Challenges with WB:

- WB (both cellular and AB components) needs to be ABO matched to its recipient
  - Solution: Low Titer O WB (male O donors with low AB titers)

- WB must be leuko-reduced, which destroys platelets
  - New platelet sparing leukoreduction filters preserve platelets

- Cold storage of WB destroys platelets
  - Platelet lifespan is reduced from 7 days to 2-4 days with cold storage
  - “Cold activated platelets”
    - Cold storage (‘C) better pro-thrombotic product than room temperature storage

Whole Blood Therapy

- Storage at 1-6°C
- Up to 35 days
- LTOWB – Low levels of anti-A and anti-B IgM
  - O- WB isokellets for all males and females over 50
  - O- WB for females of child-bearing age

- Content: WB 500mL
  - HCT 36-50
  - Pts 105-405K
  - 100% of plasma coagulation factors
  - 1g Fibrinogen

Conclusion on WB:

- Promising studies using cold stored LTOWB as well as Warm WB
- WB is better than the sum of its parts
- Lower transfusion requirements
- More concentrated than components
- Survival advantage
- Safe (decades of evidence)
- Stored up to 35 days (platelet function diminishes over time)
- Role in Prehospital care
  - Minimizes product/factor delays in critical first hour of trauma
  - Minimized delays in transfusion

Initial safety and feasibility of cold-stored uncrossmatched whole blood transfusion in civilian trauma patients

Mark H. Yarem, MB, Byron Jackson, MD, Jason L. Sperry, MD, Leon Shulman, MD, Darrell J. Trinkle, MD, and Alan B. Naylor, MD, Pittsburgh, Pennsylvania

- Participants: 12
- Methods:
  - Randomized, double-blind, placebo-controlled, cross-over study
  - LTOWB (4°C) vs Warm WB
  - Initial safety and feasibility

- Results:
  - No adverse reactions
  - Comparable transfusion requirements

- Conclusion:
  - Cold stored WB safe and feasible for civilian trauma patients
Whole Blood at Denver Health

- 4 bags of Whole Blood on arrival (in ED fridge)
- Followed by balanced component resuscitation

Next controversy: TXA in trauma patients

Tranexamic Acid (TXA)

- Synthetic derivative of Lysine, irreversibly inhibits the proteolytic action of plasmin on fibrin clot and platelet receptors
- Inhibits fibrinolysis

What is Hyperfibrinolysis?

- Incidence varies widely in trauma literature
  - 2-15% of trauma patients on arrival
  - 34% of trauma patients requiring massive transfusion (DHMC study)
- Hyperfibrinolysis independently and significantly predicts mortality in trauma patients
  - Associated with very high mortality (70-100%)
  - Even low levels of hyperfibrinolysis predicts poor outcome in trauma

Diagnosing Hyperfibrinolysis

- Most studies use TEG/ROTEM for diagnosis
  - On rapid TEG: LY30>7.5% or EPL >15%
  - LY30<2% is associated with initial significant increase in mortality

The CRASH 2 Trial

- Largest randomized placebo-controlled trial reporting effect of early TXA (20,211 Pts)
  - Significant reduction in all-cause mortality with TXA: 14.5% vs 16% (p=0.035)
  - Significant reduction in risk of death due to bleeding with TXA: 4.9% vs 5.7% (p=0.0077)
  - No increase in fatal or non-fatal vascular occlusive effects
  - Early treatment (<1hr from injury) had the greatest reduction in mortality, after 3hrs from injury had increased mortality
Problems with CRASH 2

- Only 5% patients had bleeding as cause of death
- Only 50% patients received a transfusion, and TXA did not reduce blood transfusions
- Majority of patients enrolled were in low-income or developing countries where massive transfusion protocols and hemostatic resuscitation are not routinely used
- No data on lab values, injury severity & subtypes of transfused products (pRBC, FFP) were reported

TXA trials in developed countries

- Miami Ryder Trauma Center -
  - Trauma patients arrived sooner after injury (<1hr vs 2.8hrs), earlier operative intervention and earlier use of fluid & blood products
  - RESULTS: In highest injury acuity patients, TXA was associated with increased mortality, regardless of time it was administered.
  - Compared to CRASH2, Miami patients were more hypotensive, had more penetrating injuries, 97% transfused, 78% required surgery

  Authors Concluded: Lack of benefit from TXA, may be attributable to rapid availability of fluid/blood and emergency OR.

More TXA trials in Developed countries:

- Swendsen et al. ‘13 - Retrospective multiple cohort, 126 trauma patients US Level 1 trauma center
  - Confirmed early TXA survival benefit
  - BUT:
    - Increased DVT/PE
    - Increased Acute kidney injury
    - No difference in transfusion

Fibrinolysis in Trauma is complex

- Trauma patients have both promoters and inhibitors of fibrinolysis
- Shock promotes tPA-mediated fibrinolysis
- Tissue injury inhibits fibrinolysis
- Spectrum of fibrinolysis in severe trauma has been described with hyperfibrinolysis at one end to “fibrinolytic shut down” at the other end
TXA and thrombotic events in trauma patients

- Trauma patients are prone to thrombotic events (approaching 60% with surveillance)
- Majority of severely injured patients have low VHA-measured fibrinolysis at 12hrs
- Low rate of clot degradation (by VHA) is associated with increased mortality
- Observational have shown an association between fibrinolysis shutdown, and ROTEM/TEG hypofibrinolysis, TXA and venous thrombotic events
- TXA → increased mortality in patients with physiologic levels of fibrinolysis and no benefit when given to patients in fibrinolytic shutdown
- TXA use is associated with persistent fibrinolysis shutdown (microvascular thrombosis, MOF)

Goal directed TXA use (AKA VHA directed)

- Even Goal Directed TXA has NOT been associated with improved overall survival in trauma
- PROPPR Database: Admission Ly30>3% on TEG → increased survival at 6hrs but did not improve long-term outcomes in severely injured
- Meta-analysis 2018 of RCTs TXA use -9 reduction in 24h mortality, NOT 30d mortality
- Recent Review Anesthesia & Analgesia on this:
  - 2 Interpretations:
    - TXA reduces early bleeding, but increases risk of delayed death from subsequent fibrinolysis shutdown
    - VHA are insensitive to the identify which patient that are hyperfibrinolytic

My Conclusions on TXA:

- In populations represented by CRASH-2, early use of TXA is recommended
- Other patients, consider more judicious & selective TXA administration, ROTEM/TEG guided
  - if no TEG, consider TXA in those who are likely to have the highest mortality reduction (MAP <70, severe hemorrhagic shock, less than 3hrs from injury)
- More studies needed to predict which patients benefit from TXA
- Fibrinolytic shutdown phenotype is an independent risk factor for increased mortality (up to 5 fold)
- Associated with high plasminogen activator inhibitor-1 (PAI-1) activity
- t-PA TEG Assay may differentiate between these phenotypes and determine which patients will benefit from TXA

Role of ECMO in Trauma

- Twenty-three studies between 1 January 1980 and 30 June 2018 were included in the analysis (466,861 patients, 52,561 with posttraumatic ARDS)
- No change in the mortality of trauma-induced ARDS over the last several decades, and the mortality ranges from 20.6 to 25.8%

Increasing use of ECMO in trauma:
Roles for ECMO in trauma

- Most common injuries:
  1. Thoracic Trauma
  2. Spine Fracture
  3. Abdominal Injury
  4. Ortho Fracture
  5. Burn
- Most common indication: ARDS
- Most placed on V-V ECMO

ECMO in Trauma

- V-V ECMO for Chest trauma
  - Traumatic Pneumonectomy – VV ECMO in OR
  - Bronchopulmonary fistula - allow injury to heal
- Intractable ARDS/Severe pulmonary contusion (similar to other indications for ECMO MICU setting – PaO2/FiO2 ratio
  - Improve PaO2/FiO2 ratio
  - Decrease barotrauma of ventilation
  - Decrease hyperoxia/free radical damage
  - Option after maxed ventilator support

V-A ECMO?

- V-A ECMO for Massive trauma with hemodynamic compromise
  - Traumatic cardiac contusion (rare indication)
  - Sepsis post trauma
  - Massive PE with HD compromise
  - Severe polytrauma at time of arrival or in ED (?)

Advantages of V-A ECMO

- Support the heart/Augment C.O.
- Decreases acidemia/shock/reperfusion time
- Warms the blood
- Increases cannula for transfusion

Directly reverses lethal triad of trauma

- Corrects pH, Base deficit, hypothermia (warms)
- Corrects plasma factors, INR, fibrinogen by restoring perfusion
- Restores the microscopic mucosal integrity by reversing shock physiology
- Decreases end cellular damage of multi-organ failure (AKI, Cardiac) animal models

What about bleeding risk?

Literature review of bleeding risk:

- If no systemic heparin (only ECMO circuit) – no increased risk of bleeding
- Small study (Italian, 375 Pts, 30 on ECMO)
  - Quicker lactate correction
  - Better pH
  - Decreased inotropic support
  - No increase in bleeding risk
- Scandinavian study
  - No increase in bleeding
  - Even included Burn injuries and Ortho trauma with fat emboli

Anticoagulation strategies

- High risk of bleeding: Initiate heparin free for several days (esp if severe TBI), heparin bonded circuit only
- Moderate risk of bleeding: heparin infusion with lower ACT goal (150)

Our institution:

- Institutional therapeutic and "subtherapeutic" anticoagulation protocols with differing PTT targets
- Routinely hold heparin until bleeding resolves
- Pay close attention to oxygenator and circuit; preparation for urgent circuit change
ECMO induced Coagulopathy

- Multifactorial.
- Heparin to counteract the increase in procoagulant factors due to biomaterial exposure.
- ECMO induces acquired vWF disease.
- Specific to the patient and the disease process.

Balance of anticoagulation in ECMO needs to be individualized and reassessed regularly by the trauma team.

2020 Systemic Review of ECMO in Trauma

Table 3 The summary of other ECMO-related complications in trauma

<table>
<thead>
<tr>
<th>Complication</th>
<th>Description</th>
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<tbody>
<tr>
<td>Bleeding</td>
<td>Excessive bleeding, requires clotting abnormalities.</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Cardiac failure, ARDS, tamponade, tension pneumothorax.</td>
</tr>
<tr>
<td>Infection</td>
<td>Bacterial, fungal, or viral infections.</td>
</tr>
<tr>
<td>Renal</td>
<td>Acute renal failure, ARF.</td>
</tr>
<tr>
<td>Hypothermia</td>
<td>Body temperature drops below normal levels.</td>
</tr>
</tbody>
</table>

Survival in trauma

- CESAR Trial (2010): UK, VV ECMO for Respiratory Failure, less than 7 days.
  - >60% survival (not just trauma).
  - Rec: Mortality benefit of VV ECMO, led to resurgence of ECMO use in adults.

Small studies in trauma:
- Guirand et al: VV ECMO 26pts propensity matched for age and PaO2/FiO2:
  - Survival 60% vs. 23%.
- ECLS Registry: ARDS/Postop/Trauma:
  - 6000 cases, 56% survival (similar to non-trauma).
  - Average run 11 days, longest run 83 days.
- Germany Trauma Study Registry:
  - 85% came off ECMO, 60% survival.

Trend toward improved mortality in trauma ECMO

- Overall decrease in mortality in extracorporeal membrane oxygenation patients.

ECMO in traumatic cardiac arrest

- Predictors of survival:
  - Penetrating injury.
  - Signs of life Prehospital or in ED.
  - Short length of prehospital CPR.
  - Cardiac movement on POCUS.
  - Pediatric patient.
  - Reversible cause (Tamponade or Tension Pneumothorax).
Any Contraindications to ECMO?

- "Elderly" some institutions have age cut off
- Oxygen requirement prior to injury
- Jehovah’s Witness (not accepting blood)
- Cirrhotic liver
- Abdominal compartment syndrome

American Association for the Surgery of Trauma
Critical Care Clinical Consensus on ECMO in 2019

- ECMO can be considered for partial or full support in cases of potentially reversible posttraumatic cardiopulmonary failure
- No specific diagnoses are absolute indications or contraindications to ECMO therapy, other than Treponemal injury
- Traumatic brain injury (TBI) should no longer be an automatic exclusion to ECMO

Summary of ECMO in Trauma

- Based on small studies and initial view of National Trauma Database
- Role of ECMO (VV & VA) in Trauma
- ECMO Service/Team available
- Time to cannulation/Expertise likely improves outcome in massive trauma patients
- Complications: bleeding, limb ischemia (add distal antegrade perfusion catheter to minimize
- Weaning off? Patient specific—further runs if limited to lung injury

References:

Volume Resuscitation and Assessment in Trauma

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Disclosure Statement: I have no commercial, financial, or any other conflict of interest pertaining to the content of this presentation.

Learning Objectives
- Review the history pertinent to volume resuscitation
- Review the harm caused by excessive crystalloid administration in the setting of trauma
- Discuss the concept of permissive hypotension and how it pertains to volume resuscitation
- Review the basic physiology governing volume homeostasis
- Review the evidence for various volume assessment modalities
  - Static Modalities: Physical Examination, Shock Index, Base Deficit
  - Dynamic Modalities: A-a Gradient, Pulse Contour Analysis, Pleth Variability, Esophageal Doppler

History

Intravenous Saline

First reported use of intravenous saline for the treatment of disease:
- Dr. Latta’s letter to the Lancet on the success of saline for a patient with cholera
  May 23, 1822

She had apparently reached the last moments of her earthly existence... the sharpened features, and sunken eye, and fallen jaw, pale and cold, bearing the manifest impress of death's signet, began to glow with returning animation; the pulse, which had long ceased, returned to the wrist.


Permissive Hypotension in Trauma

In August, 1917, the Medical Research Committee (Great Britain) appointed a Special Investigation Committee to undertake the coordination of inquiries into surgical shock and allied conditions (during World War I).

Injection of a fluid that will increase blood pressure has dangers in itself. Hemorrhage in a case of shock may not have occurred to a marked degree because blood pressure has been too low and the flow too scant to overcome the obstacle offered by a clot. If the pressure is raised [with fluid] blood that is sorely needed may be lost.
Volume and Complications

Hypovolemia
Acute Renal Failure
Massive Intestinal Stomal Death

Hypervolemic
Acute Renal Failure
Polyuric Edema
Central Edema
Death

EGDT Studies (Sepsis) 2001 - 2016

- Meta-analysis of RCT trials
- Meta-analysis of observational trials

Restrictive vs Liberal Fluid Resuscitation in Trauma Patients

Restrictive vs Liberal Fluid Resuscitation in Trauma Patients

- Meta-analysis of RCT trials
- Meta-analysis of observational trials


- Increase Mortality (OR 2.3) and Coagulopathy (OR 3.1)
- Increase Mortality (OR 1.1)
- Increased Mortality (HR 1.1, p < 0.05)
- Increased Mortality (OR 3.1)
- Increased Mortality (OR 1.1)
- Increased Risk of ARDS (OR 3.4), Multiple Organ Failure (OR 2.9), and Surgical Site Infection (OR 2.8)
- Increased Risk of Abdominal Compartment Syndrome (9.9 L vs. 2.7 L, p < 0.001)
- Increased Mortality (HR 1.1) and Coagulopathy (PTT 56 vs 39.1, INR 2.2 vs 1.4)
- Secondary abdominal compartment syndrome after severe extremity injury: are early, aggressive fluid resuscitation strategies to blame? J Trauma. 2008 Feb;64(2):280-5.
Permissive Hypotension in Trauma

- Permissive hypotension is permitting the blood pressure to be low by deliberately giving less crystalloid in active bleeding trauma patients.
- The intervention is restrictive volume resuscitation not deliberate hypotension.
- This is analogous to permissive hypercapnia for ARDS whereby the intervention is low tidal volumes and permitting hypercapnia.

<table>
<thead>
<tr>
<th>Disease State</th>
<th>Intervention</th>
<th>Permissive</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhagic Shock</td>
<td>Restrictive Fluid Resuscitation</td>
<td>Hypotension</td>
<td>Limit harm due to crystalloids</td>
</tr>
<tr>
<td>ARDS</td>
<td>Low Tidal Volume</td>
<td>Hypercapnia</td>
<td>Limit harm due to VILI</td>
</tr>
</tbody>
</table>

Permissive Hypotension

- European Trauma Guidelines 5th Ed, 2019:
  - We recommend permissive hypotension with a target systolic blood pressure of 80-90 mmHg in hemorrhagic shock. Systolic blood pressure should be maintained until major bleeding has been stopped in the initial phase following trauma without brain injury.
  - In patients with severe TBI (GCS ≤ 8), we recommend that a mean arterial pressure ≥ 80 mmHg be maintained.
  - Note, patients with spinal cord injury should also have higher BP goals (MAP > 85).
- Advanced Trauma Life Support 10th Ed, 2018:
  - Does not endorse specific blood pressure goals.
  - “Administering excessive crystalloid solution can be harmful.”
  - “Early administration of pRBCs, plasma, and platelets in a balanced ratio to minimize excessive crystalloid administration may improve patient survival.”
  - “Delaying aggressive fluid resuscitation until definitive control of hemorrhage is achieved may prevent additional bleeding.”

Blood Volume Homeostasis

- Volume: What regulates it?
  - Kidneys
    - SLOWCIT
    - Governed by RAAS and SDFH
  - Interstitial space
    - SLOWDR
    - Governed by Starling forces
  - Venous system
    - FAST
    - Governed by stress or unstrained volume
    - Increased output of extravascular volume during hemorrhage

Venous Function

- Veins contain 70% of blood volume
- Serve as a reservoir for blood
- 30 times more compliant than arteries
- C-501AP
- Veins contain a high population of alpha-1 receptors
- Clinically, this pertains mostly to the splanchic vasculature (highly compliant vessels) and to a lesser degree the cutaneous vasculature (compliant, but less than splanchic veins).
**Dualities: Artery vs Vein**

- Arteries function as large resistors and small capacitors
- Veins function as large capacitors and small resistors

**Stress vs. Unstressed Volume**

- **Example: Fluid Bolus**
  - Healthy patient with high vascular compliance
  - Volume bolus expands unstressed volume
  - Stressed volume stays the same and CVP is unchanged

- **Example: Fluid Bolus**
  - CHF patient with low vascular compliance (arteriosclerosis)
  - Arteriosclerosis and high catecholamine state decrease vascular compliance
  - Volume bolus expands stressed volume
  - Unstressed volume stays the same and CVP increases

**Example: Hemorrhage**

- Healthy patient
  - Catecholamines increase causing vasoconstriction (decrease venous compliance)
  - Volume moves from unstressed to stress volume to maintain CVP

- CHF patient with low vascular compliance (arteriosclerosis)
  - Vasoconstriction in response to catecholamines is blunted
  - Stress volume decreases and CVP decreases
Stress vs Unstress Volume Clinical Implications

- Explains why CVP is not an accurate modality to assess volume status
- Explains why young, healthy patients may lose a significant amount of blood with little change in vitals
- Studies show that maternal vitals may initially be normal in PPH despite losing up to 1000 mL of blood
- Explains how vasopressors may be a useful temporary adjunct to maintain preload in a variety of clinical scenarios: spinal anesthesia, neurogenic or septic shock
- Explains why more sophisticated measures to assess volume status should be utilized instead of relying on vitals alone to guide volume resuscitation

Volume Status Assessment Modalities

Modalities to Assess Volume Status

- Static Modalities
  - Shock Index, Base Deficit, Capillary Refill Time, etc.
- Dynamic Modalities
  - Arterial Line Variability, ΔCO2 with Fluid Bolus, Pleth Variability Index, etc.

Shock Index

- Shock Index = \(\frac{HR}{SBP}\)
- SI ≥ 1.0 is highly predictive of massive transfusion (MT) in trauma patients
- SI ≥ 1.0 for 9.67 (95% CI 6.09–15.36) for MT >10 units in 24 hours
- SI also highly predictive of post partum hemorrhage (SI > 1.4, sensitivity 100%, specificity 70%)
- Heart rate is not predictive of MT in the geriatric (>65 years) trauma patient population.
- MT and non-MT groups (HR of 92.6 vs 87.4, P > 0.05).
- SI in this demographic is still predictive of MT (SI 1.3 in MT vs 0.67 in non-MT, P <0.001)

Base Deficit

- Base Deficit (BD) or Base Excess (BE) measures the metabolic component of the acid/base disturbance
- BD is calculated in the following manner:
  1) Calculate what the pH would be if the CO2 was 40 mm Hg
  2) Calculate the amount of HCO3- (mmol/L) that would then be required to normalize the pH to 7.4
- Formal Definition
  - Base excess is the amount of strong acid (in millimoles per liter) that needs to be added in vitro to 1 liter of fully oxygenated whole blood to return the sample to standard conditions (pH of 7.4), Po2=40 mm Hg, and temperature of 37°C

- BD is not an accurate modality to assess volume status
- BD is highly correlated to lactate levels
- Lactate kinetics are sluggish
- Lactate T1/2 = 30 minutes assuming normal liver function
- BD may not reflect hypovolemic shock in the following situations
  - Administration of normal saline or HCO3-
  - Renal Failure
  - DKA
  - Prolonged CO2 retention (e.g., COPD)
  - Toxins (methanol, ASA, ethylene glycol)
  - Cardiogenic, Septic, or Neurogenic Shock

- BD is superior to lactate in trauma.

Capillary Refill Time

- Apply firm pressure for 10 seconds to the distal tip of the finger or toe until the nailbed is blanched then release pressure.
- Color should return to normal within 3 seconds if perfusion is normal.

**ANDROMEDA-Shock Trial**
- RCT comparing CRT to lactate-based resuscitation for septic shock.
- 28 hospitals, 5 countries, 424 patients.
- Mortality was 34.9% (CRT) vs 43.4% (Lactate), P=.06.


Dynamic Modalities

- Dynamic tests
- Physiological basis, optimize Frank-Starling curve
- Gold standard
- ∆CO = 10% with 250ml fluid challenge or passive leg raise
- Other indices such as ∆SV, ∆SVI, ∆CI may also be used
- Requires use of PIC, Esophageal Doppler, Pulse Contour Analysis (PiCCO, LiDCO), Echocardiography, or Bioreactance.

- Other tests
  - Arterial Line Variability
  - Esophageal Doppler
  - Pulse Contour Analysis
  - Pleth Variability Index

Volume Optimization Goals


Receiver Operating Curve (Review)

Arterial Line Variability

- ∆SV is a function of Preload/afterload
- Positive pressure ventilation
- Increases RV preload
- Increases RV afterload
- Decreases SV
- Requires
  - TV > 8ml/kg
  - No dysrhythmias
  - No spontaneous breathing
Arterial Line Variability: Calculation

- Systolic Pressure Variation
  \[ \text{SPV} = \frac{(\text{SP} - \text{SBP})}{\text{SBP}} \times 100\% \]

- Pulse Pressure Variation
  \[ \text{PPV} = \frac{(\text{PP} - \text{SBP})}{\text{SBP}} \times 100\% \]

- Interpretation
  - Volume responsive: SPV or PPV > 12%
  - Not Volume Responsive: SPV or PPV < 8%

Arterial Line Variability: Evidence

- Meta-analysis of 29 studies
  - SPV ROC: 0.86
  - PPV ROC: 0.94


Arterial Line Variability: Eyeball Technique

The Ability of Anesthesia Providers to Visually Estimate Systolic Pressure Variability Using the “Eyeball” Technique

- Methods
  - 50 Anesthesia Providers (30 residents and 20 attendings)
  - Asked to give volume or not based on visually observed arterial line variability
- Results
  - 3% elected to treat when (SPV < 8%)
  - 60% elected to treat when (SPV 8 – 12%)
  - 37% elected to treat when (SPV > 12%)


Pulse Contour Analysis

- Analysis of arterial waveform to calculate stroke volume
  - Pulse Pressure x Stroke Volume
  - Pulse Pressure x Heart Rate

- Calibrated
  - PiCCO, LiDCO
  - Uses thermodilution to calculate compliance for calibration

- Uncalibrated
  - FloTrac
  - Uses patient demographic data to calculate compliance

Pulse Contour Analysis: Evidence

- 2nd Generation FloTrac Software
  - Volume Responsive: Δ CO > 15% with 500ml fluid
  - ROC: 0.92
  - Δ SV > 15% with PLR

- 3rd Generation FloTrac Software
  - Volume Responsive: Δ CO > 15% with 250ml fluid
  - ROC: 0.85
  - Δ CO > 9% with PLR


Esophageal Doppler Monitor

Esophageal Doppler
- Esophageal probe measuring blood velocity in the descending aorta
- Aortic area can be approximated by demographics (age, height, weight)
- Stroke Volume = Aortic Area x VTI
- VTI (height) = distance column of blood moved during systole
  \[ VTI = \frac{\text{Distance}}{\text{Duration}} \]

Esophageal Doppler: Evidence
- Stroke Volume Variation (i.e. ΔSVV)
  \[ SVV = \frac{SV_{max} - SV_{min}}{\text{Mean SV}} \times 100\% \]
- SVV > 14% predictor of fluid responsive
- FTc – Systolic ejection time corrected for heart rate
- SVV ROC: 0.91
- FTc ROC: 0.49


Esophageal Doppler: Pitfalls
- Descending aorta receives approximately 70% of total blood flow
- EDM does 70:30 correction to calculate total CO
- Shock states divert blood away from mesenteric circulation
  Lowering percentage of blood flow in the descending aorta
- Velocity Calculation
  - EDM assumes 45 or 60° correction of doppler signal
- Blood flow is laminar and not uniform
- EDM assumes aortic area using patient demographics

Pleth Variability Index
- Perfusion Index (PI) is calculated as the pulsatile infrared signal (AC) indexed against the non-pulsatile infrared signal (DC). The AC and DC signals reflect the absorption of infrared light.
  \[ PI = \frac{AC}{DC} \times 100\% \]
- The Pleth Variability Index (PVI)
  \[ PVI = \frac{TV - TV_{min}}{TV_{max} - TV_{min}} \times 100\% \]
- Requires
  - TV > 8 ml/kg
  - No dysrhythmias
  - No spontaneous breathing

Pleth Variability Index: Evidence

**Advantages**
- Non-invasive
- Large meta-analysis of 25 studies both in the operating room and the intensive care unit showed a ROC of 0.82

**Disadvantages**
- Proprietary technology from Massimo
- Qualitative analysis of the waveform is not accurate due to automatic gain adjustment to maximize the appearance of the signal
- Unclear cut-off value
- Studies utilize a range of cut-off values from 7-20
- PVI is inaccurate in the setting of large volume resuscitation
- A study in patients undergoing orthotopic liver transplant found a ROC of 0.58


Questions
Thoracic Wall Analgesia

Steven Bourland DO, MS
Pediatric Anesthesiologist
Denver Health Medical Center
Children’s Hospital of Colorado

Objectives
- Rib fractures and the problems they cause
- Introduce fascial plane blocks
- Mechanisms
- Anatomy
- Analyze which plane blocks to use for rib fractures
- Technique
- Complications

Rib Fractures

Most common type of clinically significant blunt traumatic injury to thorax
- MVC, MVC vs pedestrian, falling & crush injuries
- Estimated 248,000 ED encounters, 46,000 inpatient admissions

Pulmonary Complications Associated With Rib Fractures

A 2005 analysis of 64,750 patients entered into National Trauma Data Bank
- 1 or more rib fractures
- 13% (n=8,473) developed 13,086 complications, of which 6,292 (48%) were related to chest wall injury
- Overall mortality for pts with rib fractures was 10%
- Incidence of the following increased with each additional rib fracture
  - Pneumonia
  - Pneumothorax
  - Acute Respiratory Distress Syndrome
  - Empyema
  - Aspiration Pneumonia

ANALGESIA PMG FOR INPATIENTS WITH RIB FRACTURES

Ice and heat to soft tissues
- Ketorolac 15 mg IV q6H x 48 Hr
- Acetaminophen 650 mg PO q6H
- Diazepam 5 mg PO TID PRN (if age < 65 years)
- Oxycodone 5‐10 mg PO Q4HR PRN IV narcotic push

Loco-regional modalities
- Thoracic epidural catheter or Pain pump (bupivacaine infusion)
or Liposomal bupivacaine intercostal nerve blocks or erector spinae (ESP) catheter

Parameter Points
- Numeric pain score ≥ 51
- Incentive spirometry < 50% predicted
- Respiratory rate ≥ 20
- Poor cough

SCARF Score
- Sequential Clinical Assessment of Respiratory Function
- Tier I
  - SCARF = Sequential Clinical Assessment of Respiratory Function
- Tier II
  - Advance to next tier if SCARF score remains ≥ 2 after intervention(s)
- Tier III
  - Advance to next tier if SCARF score remains ≥ 2 after intervention(s)

Background
- Rib fractures associated with significant morbidity and mortality
  - M/M increases with age and number of fractures
  - Hyperventilation (poor incentive spirometry) leads to atelectasis, pneumonia, respiratory failure
  - Invasive ventilation strategies
- Trauma centers develop protocols focused on early pain management to assist with rapid mobilization, improves respiratory care and decreases length of stay in ICU
- Multi-modal opioid sparing regimen
Thoracic epidural = gold standard
- Reduces mortality
- Alternative methods to provide regional analgesia
  - Fascial Plane Blocks
    - Placement of local anesthetic between two fascial layers, muscle and/or bone
    - Local anesthetic bathes nerves coursing through these planes to provide analgesia
    - Depending on location of injection, mechanisms vary

**Location: Posterior, Lateral, Anterior**

**Indications**
- Targeted regional anesthesia
- Provides unilateral analgesia
- Thoracotomy & rib fractures
- Favorable physiology
  - Reduces episodes of hypotension secondary to sympathectomy caused by thoracic epidural
  - Reduces interplane analgesia
- Fewer contraindications
  - Safe when anticoagulated (LMWH, systemic heparinization)
  - Can be placed when patient is intubated

**Mechanism of Action**
- Local dispersion via injection between layers of the plane
- May spread to adjacent fasciae and/or through porous communications in the plane
- Spreads into neuraxium if close to vertebral column
- Paravertebral by proxy
- Vascular uptake
  - Local anesthetic acts on site of injury in periphery and also in central pain centers of neuraxium (dorsal horn of spinal cord, thalamus)
  - Systemic effect of elevated plasma concentrations
Posterior Rib Fractures

Erector Spinae Muscle
- Paraspinal muscle group
  - Iliocostalis
  - Longissimus
  - Spinalis
- Originate medially from spinous processes and transverse processes
- Insert along angle of ribs all the way down to sacrum

Erector Spinae Plane Block
- First described in 2016
- Used to manage thoracic neuropathic pain caused by metastatic disease
- Rib fractures
- Complications
  - LAST
  - Pneumothorax
  - Infection
  - Epidural puncture/injection

Technique
- High frequency linear US probe
- In plane approach
- Parasagittal cranio-caudal orientation
- 3 cm lateral to midline, needle deep to ESM on transverse process
- ESM should lift and injectate spread cranio-caudally
Infusions
- Duration of action single bolus of 0.4mg/kg bupivacaine
- Acute rib fracture analgesia ~ 3 hours
- Programmed intermittent bolus
  - 15-20mL 0.1-0.2% bupivacaine every 4-6 hours
- Continuous infusion
  - 0.1-0.2% @ 8-12/hr

Serratus Anterior Muscle
- Fan-like muscle originating from lateral thorax, ribs 1-9
- Inserts on underside of medial scapula
- Innervated by long thoracic nerve
- Accessory inspiratory muscle
Serratus Anterior Plane Block

- First described in 2013 in volunteer study
- Complications
  - LAST
  - Infection
  - Pneumothorax
  - Hemothorax

Serratus Anterior Plane Block: Technique

- High frequency linear US probe
- Patient remains supine with abduction of arm to expose anterior axilla
- Target rib in middle of the fractured ribs for optimal spread
  - Ribs 4-8, target rib 6
- Evidence for both superficial and deep catheter placement
  - Superficial to SAM appears to have increased duration and greater spread
    - T2-T9, single injection duration ~730mins
  - Deep to SAM can be easier if trauma to area obscures superficial plane
    - T2-T7, single injection duration ~330mins

Anterior Fractures

Parasternal Pecto-Intercostal Plane Block

- Sternal fractures
- Sternotomy
- Anterior Rib fractures

Pecto-Intercostal Plane Block

- Targets anterior suprarenal branch T2-T6 to provide anterior chest wall analgesia
  - Intercostal nerve (ventral ramus)
  - Superficial Plane
    - Between pectoralis major & internal intercostal muscle
  - Deep Plane
    - Between internal intercostal and transversus thoracic muscle
- Planes difficult to visualize in patients s/p CABG especially if Internal Mammary artery used
- Complications:
  - LAST
  - Pneumothorax/Hemothorax
  - Arterial Puncture & Hematoma
  - Pericardial/pleural Infection
  - Infection
Pecto-Intercostal Plane Block

- Superficial & Deep

Moving Forward

- High variability amongst studies
- Small sample sizes
- Studies with isolated thoracic wall injuries
- Inter-individual variability

References

1. Ki Jinn Chin, Thoracic wall blocks: From paravertebral to retrolaminar to serratus to erector spinae and back again – A review of evidence, Best Practice & Research Clinical Anaesthesiology, Volume 33, Issue 1, 2019, Pages 67-77
References


Thursday, March 3rd
Objectives

- Discuss minimally invasive pain procedures including newer options that are becoming more common
- Intrathecal drug delivery systems (IDDS) or intrathecal pumps (ITPs)
- Intrathecal medication delivery
- Spinal cord and dorsal root ganglion stimulation
- ReActiv8
- Peripheral nerve stimulation
- Vertiflex - Superion Interspinous Spacer
- MILD (minimally invasive lumbar decompression)
- Intracept Relievant
- Others
- Highlight procedural aspects important for the anesthesiologist

ITPs

- Basics
  - ITP is a method of delivering medications directly to the spinal cord
  - Medications in the reservoir are programmed to be delivered through a catheter that sits in the intrathecal space
  - Since medication is delivered directly to spinal cord, much lower doses and volume needed
  - Less systemic and less cerebral effects

Placing The Device

- Most commonly lateral position but prone if placing in back/buttock
- General or MAC
- Incision/wet tap/catheter
- +/- spinal dose for surgical analgesia
- Abdominal pocket
- Tunneling
Indications for ITP Therapy

- Cancer pain
- Non-cancer chronic pain
- Spasticity
- Overlap

Intrathecal Medications

- FDA approved
  - Morphine
  - Baclofen
  - Ziconotide
- Non-FDA approved
  - Bupivacaine
  - Dilaudid
  - Clonidine
  - Fentanyl
  - Sufentanil
  - Ketamine*
  - Buprenorphine*
  - Midazolam*
  - Ropivacaine*
  - Suprarenaline*

*Very little information in literature and use recommended with caution

Complications

- Loss of analgesia or spasticity control
- Infection
- CSF leak
- Pump or catheter issues
- Drug side effects
- Drug overdose/underdose
- Seroma
- Granuloma
- Intra-op catastrophes (spinal cord injury, epidural hematoma...)
- Intra-op ITP med related issues (hypotension, high spinal)

Improved pain and QOL

- Smith et al, J Clin Oncol, 2002
  - RCT, ITP compared to conventional medical treatment in 143 patients with cancer and VAS >5
  - Follow-up 4 weeks post
  - IDDS group with more successful pain relief
  - More patients reporting <50% reduction in pain and drug toxicity (58% vs. 37.5%, p = 0.02)
  - IDDS group primary benefits - decreased fatigue and depressed level of consciousness

Case Presentation

- JU: 40 yo male with a h/o metastatic (chest, abdomen, pelvis) colorectal cancer s/p right hemicolectomy 3/2016 and multiple rounds of chemo/radiation
- Large metastatic superficial abdominal mass eroding through skin
- Continued severe abdominal pain despite mod/high dose opioids
  - Methadone, Dilaudid PO
- Underwent retroperitoneal block, CPB x2
  - Blocks provided relief but pat hoping for more long-term relief in context of worsening dx and decrease in pain
- Decided to go forward with ITP
Spinal Cord Stimulation

- ITT pump placed in OR under MAC
- Due to large abdominal mass, reservoir placed in flank
- Catheter to T6
- Observed for 24 hours then discharged
- Pump with Dilaudid and Bupivacaine
- Started 1TP 0.25 mg/day Dilaudid
- Small adjustments as outpt and gave PTN function (self bolus)
- Patient weaned off methadone in 2 weeks, rarely takes oxycodone 5 mg prn
- Pain down to 1-2/10, improved sleep, function, ability to play with son, took trip to Disney World prior to passing away

Spinal Cord Stimulation

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Spinal Cord Stimulation

- Mechanism of Action
  - Gate control theory (Melzack and Wall, 1965(6))
  - Supraspinal effects/descending pain pathway
  - Increasing inhibitory and decreasing excitatory pathways (WDR neurons, interneurons)
  - Increase GABA and serotonin (inhibitory)
  - Decrease glutamate and aspartate (excitatory)
  - Sympathetic effects, improving blood flow
  - Glial Cell effects
  - Last 5 years explosion in technology for SCS centered around types of stimulation, MRI compatibility, battery size and life

Spinal Cord Stimulation

- Complications
  - Infection (<5%)
  - Superficial vs. deep, pocket vs. back
  - Epidural hematoma
  - Spinal cord injury
  - Epidural hematoma
  - Wound dehiscence
  - Lead migration or fracture
Advancements in SCS

- Boston Scientific: Combination therapy, FAST
- Medtronic: Differential target multiplexed therapy (DTM)
- Nevro: HF10 high frequency stimulation
- Abbot: Burst therapy, DRG

- Systematic review of RCTs, 2018
- Strong (1A-2B) evidence for SCS for FBSS, ischemic pain, and neuropathic pain
- Improvement in function, QOL, and analgesic use
- Dorsal root ganglion stimulation also effective compared to dorsal column stimulation for neuropathic pain

Case Presentation

- CV: 68 yo male with a h/o AAA, HTN, multiple lumbar spine surgeries (including L3/L5 fusion), and arachnoiditis with continued 8/10 mostly bilateral low back pain
- Tried extensive PT, medications (neuropathic, anti-convulsants, antidepressants and anti-inflammatory drugs), injections, massage, acupuncture, chiropractor prior to seeing me
- Did one caudal ESI which provided 60% relief for 1 month
- Patient wanting longer term solutions, not a candidate for repeat surgery

- Great results from trial, >90% relief
- Permanent implant placed
- >80% relief now at 1 year post op
- Significantly improved QOL: able to walk, bike ride, exercise which he was unable to do prior
- Very happy patient

Spinal Cord Stimulation

- Dorsal Root Ganglion (DRG) Stimulation
  - Similar concept to dorsal columns but leads are placed specifically over DRG of nerve involved in pain
  - For mononeuropathies in limited areas
  - Groin - T12, L1, L2
  - Knee - L3, L4
  - Foot - L4, L5, S1
  - Pelvis - L1/L2, S2
  - Trial often done in OR as more stimulating than dorsal column
  - Will sometimes need to wake patient up for testing but this is temporary

Case presentation

- DS: 35 yo male w/ a h/o chronic left groin pain for >6 years after inguinal hernia surgery
- Pain refractory to all treatments
- Limited duration relief from blocks, radiofrequency ablation
- DRG leads x2 placed left L1 and L2
- Great relief from DRG trial
- 75% relief from permanent implant, sustained now >2 years
Instead of modulating pain like with SCS, goal is to stabilize the spine.
- Activate the multifidus muscle which is involved in stabilizing the spine and is inhibited in chronic low back pain.
- Candidates:
  - Chronic low back pain
  - Failed conservative treatments (PT, medications, injections including MBB/radiofrequency ablation)
  - MRI findings of multifidus atrophy +/- positive prone instability test.

International, double-blind, sham-controlled trial
- 204 patients with mechanical low back pain and positive prone instability test +/- multifidus muscle atrophy on MRI
- Sham stimulation vs. therapeutic stimulation
- Unblinded at 120 days, patients in sham group switched to therapeutic stimulation
- Followed for 1 year
- Primary endpoint inconclusive at 120 days but benefits accrued out to 1 year end point and were clinically meaningful.

2 year data
- 71% participants with >50% improvement in low back pain, 65% resolution
- 61% with ODI reduction >20 points
- 87% continued device use at 2 years

Peripheral Nerve Stimulation
- Electrical stimulation applied directly to peripheral nerves
- Increasingly being utilized
- Indications
  - CRPS
  - Neuralgias
  - Amputee pain
  - Low back pain
Peripheral Nerve Stimulation

- Trial of diagnostic injections often precede placement although not necessary.
- Pain must be along identifiable nerve distribution.
- Never devices with no internal battery or very small battery.
- Can also use traditional SCS leads and place peripherally (external generator with pocket needed).
- Done in OR vs. procedure room (newer devices).

Advantages

- Less invasive than SCS.
- No needles near the spinal cord.
- No internal battery for some devices.
- Can be done with limited (if any) sedation and local.
- Longer lasting than injections and radiofrequency ablation.
- Recovery faster than SCS as no incision for the newer devices.

Complications

- Lead migration, fracture.
- Nerve, vascular injury.
- Hematoma, seroma, site erosion.
- Infection.
- Increased pain/discomfort, numbness.
- Reaction to external battery adhesive.

Placing the device

- Theoretically any accessible peripheral nerve can be targeted.
- Femoral, iliohypogastric, G
- Femoral, ilioinguinal, I
- Genicular, S
- Superficial peroneal, S
- Superficial peroneal, S
- Suprascapular, S
- Tibial, T
- Cluneal, C
- Occipital, O

Testing is done around nerve to confirm placement.

Temporary PNS - SPRINT

- PNS lead left in for 60 days, then removed.
- Typical PNS indications:
  - Low back pain - targeting medial branch nerve.
  - Phantom limb pain.
  - Acute post op pain.

Treatment of chronic low back pain via left iliopsoas percutaneous medial branch PNS: Primary and point results from a prospective, multicenter trial.
Case presentation

- JU
- 34 yo male w/h left ankle CRPS related to ankle surgery in 2016
- Tried multiple medications (Gabapentin, Cymbalta, Nortriptyline, topicals, Lyrica, NSAIDS), PT, CAMs
- Left saphenous nerve block performed, great relief for ~1 week
- Left saphenous RFA performed with good but again temporary relief
- Decided to perform left saphenous peripheral nerve stimulation
- Pain went from 8/10 → 2/10 post PNS placement, ongoing
- 80-90% improvement overall with improved function
- “life changing relief”

Lumbar Spinal Stenosis (LSS)/Neurogenic Claudication

- Symptoms of LSS/neurogenic claudication
  - Walking intolerance
  - Standing intolerance
  - Pain in back, buttock, legs
  - Improved with rest, sitting down
  - Improved with back flexion (“shopping cart sign”)
- Causes
  - Listhesis, hypertrophic facets, herniation, disc bulge, foraminal stenosis, ligamentum flavum hypertrophy
- LSS Epidemiology
  - Most commonly seen in patients >50
  - Growing prevalence due to aging population
  - 250,000-500,000 US residents with LSS
  - Most common reason for spine surgery in elderly patients
  - By 2029, 20% of US population expected to be > 65 yo

Treatment – Conservative therapy

- Physical therapy
- Medications
- Epidural steroid injections
- Less than 40% of patients with moderate to severe LSS with claudication improve long-term with conservative treatment
- May improve but many pts want longer periods of non-treatment

Treatment - Surgery

- Effective but side effects/complication profile should be considered
  - Nerve root damage (1 in 1000) or bowel/bladder incontinence (1 in 50,000)
  - CSF leak (1-3%)
  - Infections
  - Postop operative instability of operated on level (5-10% of cases)
  - No improvement in pain (10-40%)
  - Pseudoarthrosis (5-40%)
  - Continued/worsening pain
Treatment - Surgery
- Poor operative candidates
- COPD
- CHF
- Uncontrolled HTN
- Osteoporosis
- Obesity
- High dose opioids use
- Low BMI
- Do not want surgery

Minimally Invasive Lumbar Decompression (MILD)
- MILD = PILD
- PILD: percutaneous image guided lumbar decompression
- MILD: minimally invasive lumbar decompression
- MILD is a decompression tool kit by Vertos medical

MILD Indications
- Symptoms of neurogenic claudication (walking, standing)
- Improved with rest (sitting), leaning forward
- Ligamentum flavum hypertrophy (LFH) >2.5 mm
- DDD, disc bulge, facet hypertrophy ok to co-exist if not severe or primary cause of symptoms

MILD Instruments
- Portal
- Portal Stabilizer
- Depth Guide
- Bone Rongeur
- Tissue Sculptor

Procedure
- Prone position
- Eliminate lumbar lordosis
- MAC/induction
- Epidural needle at or below working level
- Contrast into epidural space to create epidurogram at working space
**Procedure**

- **Contralateral Oblique View**
- Remove superior and inferior parts of lamina using bone rongeur
- Using tissue sculptor, remove components of ligamentum flavum
- Assess post-decompression contrast flow

**MILD Complications**

- Adverse events within clinical trials:
  - None (Dural tear, Hematoma, Neural avulsions, Blood loss-transfusions)
- Adverse events outside of clinical trials:
  - Dural tear reported
  - Epidural hematoma in patient with “low platelets” requiring evacuation. No long-term sequelae
  - Report of foot drop and numbness in patient with PF due
  - Risk similar to epidural steroid injection

**MIDAS ENCORE**

- 2018
- Randomized, multi-center, comparative outcomes study of MILD vs. ESI
- Medicare patients, 65+ years, suffering from lumbar spinal stenosis (LSS) with neurogenic claudication and ligamentum flavum hypertrophy
- **Primary Endpoint:**
  - Oswestry Disability Index (ODI) Statistical superiority of the proportion of ODI responders from Baseline to 1 Year. (Responder = ODI change ≥ 10)
- **Secondary Endpoint:**
  - Zurich Claudication Questionnaire (ZCQ)
  - Numeric Pain Rating Scale (NPRS)
- **Timeframes:** 6 Months & 1 Year Required +2 year follow up of MILD arm

**MIDAS ENCORE**

- Followed the MILD group for another year
- Did not follow control group
- At 2 years, ODI improved by 22.7 points, VAS by 3.6 points, ZCQ symptom severity and physical function by 1.0 and 0.8, respectively
- No serious device/procedure related AEs, 1.3% non serious AE (intra-op oozing, post op pain)
- No Mild patient underwent repeat Mild
- 5.6% underwent surgical procedure at index level
- 15.4% underwent ESI or block at same level
- Including 1 SCS, 1 rhizotomy, 1 ITP

**Vertiflex – Superion Interspinous Spacer**

- Neurogenic Intermittent Claudication (NIC)
  - Canal and foraminal space for nerve decrease in extension
  - Canal and foraminal space increase in flexion
Vertiflex – Superion Interspinous Spacer

- Indications
  - NIC secondary to moderate lumbar stenosis = 25-50% reduction in central canal, lateral recess or foramen
  - Relief in flexion

- Contraindications
  - Instability, > grade 1 spondylolisthesis, fracture, cauda equina syndrome, osteoporosis, infection, fusion at target level, BMI> 40

- Complications
  - Spinous process fracture
  - Migration/dislodgement
  - Infection
  - Bleeding
  - Dural injury

- Prospective, multicenter, randomized controlled IDE trial
  - 391 NIC patients w moderate LSS randomized to Vertiflex (n=190) vs. X-stop (n=201) device
  - Initial study 2 year follow up, then followed for 5 years
  - Evaluated pain scores, disability, claudication index

Results – Secondary Outcomes

<table>
<thead>
<tr>
<th>Secondary Efficacy Components</th>
<th>Baseline</th>
<th>24 mo</th>
<th>36 mo</th>
<th>48 mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZCQ Physical Function domain</td>
<td>72.5%</td>
<td>79.6%</td>
<td>80.0%</td>
<td>80.7%</td>
</tr>
<tr>
<td>ZCQ Symptom Severity domain</td>
<td>77.1%</td>
<td>84.3%</td>
<td>83.4%</td>
<td>75.0%</td>
</tr>
<tr>
<td>ZCQ Patient Satisfaction domain</td>
<td>84.0%</td>
<td>91.7%</td>
<td>86.7%</td>
<td>89.8%</td>
</tr>
<tr>
<td>VAS (Leg Pain)</td>
<td>75.6%</td>
<td>82.2%</td>
<td>78.2%</td>
<td>80.0%</td>
</tr>
<tr>
<td>VAS (Back Pain)</td>
<td>67.2%</td>
<td>76.6%</td>
<td>66.7%</td>
<td>64.7%</td>
</tr>
<tr>
<td>ODI</td>
<td>63.4%</td>
<td>67.6%</td>
<td>61.1%</td>
<td>64.8%</td>
</tr>
</tbody>
</table>

Individual outcomes listed at 3, 6, 12, and 24 months.

Results – Primary Outcomes

<table>
<thead>
<tr>
<th>Primary Efficacy Outcomes</th>
<th>Baseline</th>
<th>24 mo</th>
<th>36 mo</th>
<th>48 mo</th>
<th>60 mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall (≥ 2 ZCQ domains)</td>
<td>81.7%</td>
<td>88.0%</td>
<td>85.6%</td>
<td>84.1%</td>
<td></td>
</tr>
</tbody>
</table>

Other Observations

- No re-operations/revisions
- Any surgical intervention at treated level(s) 80.0% 78.4% 75.3% 74.7%
- No major related complications
- Infection, fracture, migration/dislodgement 86.3% 87.4% 85.8% 86.8%
- No confounding additional treatments
- Stimulators, an ESI or nerve root block 86.8% 84.2% 83.7% 82.6%
Intracept Relievent

- For patients with vertebrogenic back pain
- Patients with DDD often have evidence of vertebral endplate damage
  - Modic 1 and Modic 2 changes
- Strongly correlated with low back pain
- Basal vertebral nerve (BVN) innervates the endplates and proliferates with endplate damage
- Procedure entails ablation of the BVN in the posterior middle aspect of VB
- Performed commonly under MAC

Does it work?

- Double blind randomized sham-controlled trial
- 117 patients
  - Type 1 or 2 modic changes
  - > 6 months conservative therapy
  - VAS >4

Other minimally invasive procedures to look out for

- Percutaneous SIJ fusion
- Minimally invasive lumbar fusion
- Percutaneous discectomy

Conclusion

- Interventional pain is an exciting and technology driven field with constant innovation
- Existing devices with significant technological advancements in recent years
- New devices gaining popularity and evidence
  - Familiarity of basics of these procedures can be helpful for Anesthesiologists and proceduralists

Opioids?

Baseline: 35% on opioids
5 years: 8% on opioids (73% reduction)
Further injections?

Baseline: 39% injections within past year
5 years: 4% getting injections within past year
Contact Info

jmerkow@mdpain.net

References


Pediatric Cardiac Patients Presenting for Non-Cardiac Surgery: Decision-making and Management
Megan Albertz, MD
Pediatric Cardiac Anesthesiologist, Children's Hospital Colorado
Assistant Professor, University of Colorado

No Disclosures

Learning Objectives
Upon completion of this session, participants will be able to:
1. Assess which patients with congenital heart disease are at greatest risk of intraoperative complications
2. Identify common problems that are likely to be encountered when treating children with congenital heart disease
3. Demonstrate analytic thinking approaches to clinical scenarios associated with congenital heart disease.

Why is this topic important?

Also...

Ortho vs Anesthesia
Anesthesia-Related Cardiac Arrest in Children with Heart Disease: Data from the Pediatric Perioperative Cardiac Arrest (POCA) Registry (2010)
Mortality is higher in patients with heart disease (33%) compared with those without (23%, P = 0.048).

<table>
<thead>
<tr>
<th>Lesion</th>
<th>No. of Cardiac Arrests</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Ventricle</td>
<td>24</td>
<td>5 (25%)</td>
</tr>
<tr>
<td>Left to right shunts</td>
<td>23</td>
<td>4 (17%)</td>
</tr>
<tr>
<td>Obstructive</td>
<td>20</td>
<td>9 (45%)</td>
</tr>
<tr>
<td><strong>Aortic Stenosis</strong></td>
<td>13</td>
<td>8 (62%)</td>
</tr>
<tr>
<td>Cardiomyopathy</td>
<td>16</td>
<td>3 (20%)</td>
</tr>
<tr>
<td>Tetralogy of Fallot</td>
<td>15</td>
<td>3 (20%)</td>
</tr>
<tr>
<td>Truncus Arteriosus</td>
<td>6</td>
<td>2 (33%)</td>
</tr>
</tbody>
</table>


Post-operative Outcomes in Children with and without Congenital Heart Disease Undergoing Noncardiac Surgery

- **Minor CHD**
  - Cardiac condition with or without medication and maintenance
  - Repair of CHD with normal cardiovascular function

- **Major CHD**
  - Repair of CHD with residual hemodynamic abnormality with or without medications (e.g., TOF with free pulmonary regurgitation, HOCM including Stage 1 repair)

- **Severe CHD**
  - Unrepaired complex CHD
  - Patients with documented pulmonary hypertension
  - Patients with ventricular dysfunction requiring medication
  - Listed for heart transplant


Anesthesia-Related Cardiac Arrest in Children with Heart Disease: Data from the Pediatric Perioperative Cardiac Arrest (POCA) Registry (2010)

- **Patient risk factors**
  - Young age (< 2 years of age)
  - Single-ventricle patients
  - Aortic stenosis
  - Cardiomyopathy

- **Location of Arrests**
  - General operating room (46%)
  - Scheduled procedures (30%)
  - Maintenance > Presurgical > Postsurgical (26%)
  - Cardiac OR (21%)
  - Cardiac catheterization lab (17%)


Post-operative Outcomes in Children with and without Congenital Heart Disease Undergoing Noncardiac Surgery

- 4520 children with CHD who underwent noncardiac surgery
  - 2805 with minor CHD
  - 1272 with major CHD
  - 417 with severe CHD

- Propensity matched with controls without CHD

- Overall mortality was significantly higher for patients with major (3.9% vs 1.7%, p = 0.001) and severe (8.2% vs 1.2%, p = 0.001) CHD compared with their controls

- No difference between children with minor CHD and their matched controls
Dilated Cardiomyopathy (DCM)

- Annual incidence of 0.58 per 100,000 children
- Most common type of cardiomyopathy (60%)

Etiologies
- Idiopathic
- Familial
- Associated with neuromuscular disorders
  - Duchenne and Becker muscular dystrophy
  - Limb-girdle muscular dystrophy
  - Friedreich Ataxia
- Associated with mitochondrial disease
- Inflammatory
  - Neonatal

Preoperative Assessment

Frank Starling Curve

Volatile Anesthetics

- Volatile anesthetics depress myocardial contraction
- Mechanism: Interfere with calcium channels in the myocardium decreasing available calcium for myocardial contraction
- Neonatal myocardium is more susceptible than the adult myocardium to the reduction in myocardial contraction

Volatile Anesthetics

- Halothane
  - Neonatal: Increase in contractility
  - Adult: Decrease in contractility

- Sevoflurane
  - Neonatal: Decrease in contractility
  - Adult: Decrease in contractility

Intraoperative Anesthetic Management

- Maintain normal blood pressure to optimize coronary perfusion
- Maintenance of preload
- Avoidance of tachycardia
- Avoidance of decreased myocardial contractility
- Avoid increases in systemic vascular resistance

Volatile Anesthetics

- Halothane
  - Decrease in myocardial contractility
- Sevoflurane
  - Decrease in myocardial contractility

Propofol

- Quick onset and quick offset
- No change in CO, HR and mean PAP
- Significantly decreases MAP and SVR

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (yr)</th>
<th>IVR</th>
<th>TCI</th>
<th>CV (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24</td>
<td>66</td>
<td>TCI</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
<td>66</td>
<td>TCI</td>
<td>100</td>
</tr>
</tbody>
</table>

Dilated Cardiomyopathy

- 10yo F with a history of DCM presents for central line placement for continuous milrinone infusion
- No prior problems with anesthesia
- Ejection fraction 14% on most recent echo

How would you induce this patient?

Pulmonary Hypertension

- Diagnosis
  - Resting mean pulmonary artery pressure (mPAP) > 25 mmHg
  - Pulmonary vascular resistance index (PVRI) > 3 Woods units x m²
- Etiologies
  - Idiopathic
  - Congenital Heart Disease

Risk Assessment

- Systemic (70-100% MAP) to suprasystemic (>100% MAP) mPAP
- Decreased right ventricular function
- Elevated mPAP
- Home oxygen use
- Presence of syncope

Pulmonary Hypertension

Ventilation

- Humbert et al., NEJM (2004)
- Ilipoulos and Nelson, Prog Pediatr Cardiol (2015)
- Rudolph and Yuan, J Clin Invest (1966)
Pulmonary Hypertensive Crisis

- **8-year-old M with a history of severe idiopathic pulmonary hypertension presents for cardiac catheterization for right heart and pulmonary hypertension evaluation.**
- **PMHx includes developmental delay and genetics of unknown consequence.**
- **Medications include sildenafil and bosentan.**

**How would you manage the airway?**

Left Ventricular Outflow Tract Obstruction

- Williams Syndrome
- Critical aortic stenosis
- Subaortic membrane

Can I just tell you now that I'm falling in sick tomorrow, so I don't have to get up early tomorrow to do it?

Cardiac Abnormalities

- Supravalvular aortic stenosis (SAS)
- Pulmonary artery stenosis (PAS)
- Coronary arteriopathy
- Left ventricular hypertrophy (L VH)
- Systemic hypertension
- Prolonged QT

Case

- **8-year-old M with a history of severe idiopathic pulmonary hypertension presents for cardiac catheterization for right heart and pulmonary hypertension evaluation.**
- **PMHx includes developmental delay and genetics of unknown consequence.**
- **Medications include sildenafil and bosentan.**

**How would you manage the airway?**

Williams Syndrome

- Genetic disorder related to deletion of several genes on chromosome 7, including the elastin gene.
- **Characteristics:**
  - "Elfin" faces
  - Lack social inhibition
  - Endocrine abnormalities
  - Hypertelorism
  - Developmental delay
  - Genitourinary abnormalities
  - Renal artery stenosis
### Williams Syndrome

- AoVLV
- RV Supravalvar AS

#### Classification of Williams Syndrome

<table>
<thead>
<tr>
<th>Low Risk</th>
<th>Moderate Risk</th>
<th>High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal ECG</td>
<td>Mild stenosis of a branch of the pulmonary artery</td>
<td>Severe SVAS (&gt; 40mmHg)</td>
</tr>
<tr>
<td>Normal echocardiogram</td>
<td>Hypertension</td>
<td>Sympathetic or ECG signs consistent with ischemia</td>
</tr>
<tr>
<td>Mild or moderate extracardiac anomalies</td>
<td>Coronary disease demonstrated in EKG</td>
<td></td>
</tr>
<tr>
<td>Other mild cardiac anomalies (VSD)</td>
<td>Severe left ventricular hypertrophy</td>
<td></td>
</tr>
<tr>
<td>Biventricular outflow tract disease</td>
<td>Mitral valve stenosis</td>
<td></td>
</tr>
<tr>
<td>Mild to moderate SVPS</td>
<td>Prolonged QTc on ECG</td>
<td></td>
</tr>
<tr>
<td>Significant extracardiac disease such as difficult airway or severe GARD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Anesthetic Management

- Preservation of sinus rhythm
- Maintenance of preload, contractility and SVR
- Avoidance of anesthetic drugs that cause physiologic changes that may worsen ischemia

#### Case

- 6-year-old patient presents for a preoperative evaluation for tympanotomy and tube insertion
- PMHX includes Williams Syndrome, recurrent otitis media
- No prior anesthetics
- Last echocardiogram was done 6 months ago

Would you proceed with the anesthetic at an ambulatory surgery center?
Total Cavopulmonary Anastamosis (Fontan)

Long Term Complications
- Cardiac
  - Arrhythmias
  - Heart failure
- Pulmonary
  - Pulmonary arteriovenous malformations
  - Plastic bronchitis
  - Pulmonary Hypertension
- Hepatic
  - Liver dysfunction
- Gastrointestinal
  - Protein-Losing Enteropathy (PLE)

Ventilation
- 40% increase in PBF
- Decrease with return of PPV
- PBF continues to increase with NPV

Anesthetic Management
- Advocate for the first case of the day
- Consider fluid bolus before induction of anesthesia
- When using positive pressure ventilation consider the following:
  - Strive for normocapnia
  - Avoid acidosis
  - Long I:E ratio
  - Extravent early
- If a healthy Fontan, they can be discharged home

Case
- 15-year-old with a history of Fontan completion who presents for laparoscopic appendectomy
- Doing well clinically
- During the procedure, oxygen saturations decrease to 89%. They come up to 91% on
- Would you extubate at the end of the case? Where would you put the patient postoperatively?

Thank you
Quality Improvement and Change Management
Alma Juels, MD; Samuel Gilliland, MD; Tyler Morrissey, MD

Panel Breakdown
- Tyler Morrissey, MD - Assistant Professor, Pediatric Anesthesiology - CHCO
  - Quality Improvement Overview: “Anatomy of a QI Project”
- Sam Gilliland, MD - Assistant Professor, Anesthesiology and Critical Care - UCH
  - Perioperative Glycemic Management
- Alma Juels, MD - Associate Professor, Anesthesiology - Denver Health
  - Change Through Communication

Faculty Disclosure
- None

Learning Objectives
Upon completion of this activity, participants will be able to:
  • Describe the anatomy of a QI project using IHI’s Model for Improvement (MFI).
  • Demonstrate how the MFI can be systematically applied to create improvement in many aspects of health care.
  • Compare quality improvement data with research data.

What is QI?

Why QI?
Traced back to Institute of Medicine Quality of Health Care in America reports:
- To Err is Human (1999)
- Crossing the Quality Chasm (2001)

Current climate: growing emphasis on outcomes and costs.

Once we have a project idea, where do we start?

Engage and involve key stakeholders

This includes frontline workers

Example Process Map

The Model for Improvement

The Model for Improvement

- What are we trying to accomplish?
- How will we know that a change is an improvement?
- What change can we make that will result in improvement?


Six Sigma’s DMAIC

Define

Define the problem in detail

Measure

Measure defects (dpm, sigma level)

Analyze

Analyze under what conditions defects occur

Improve

Improve by defining and testing changes

Control

Control your results and maintain performance
Q1: What are we trying to accomplish?

- The answer to this question will become your “SMART” Aim Statement.
- Specific, measurable, answers these questions:
  - How good?
  - By when?
  - For whom?

AIM statement pointers

- Make one.
- Make sure it’s meaningful to you.
- Make sure it’s trackable.
- Set a reasonable scope.

Q2: How will we know if a change is an improvement?

Types of measures:

- Outcome
- Process
- Balancing

QI measures are different than formal research

Research vs QI

<table>
<thead>
<tr>
<th>Purpose</th>
<th>QI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine</td>
<td>Sustain improvement</td>
</tr>
<tr>
<td>Effectiveness</td>
<td></td>
</tr>
<tr>
<td>Data Collection</td>
<td>Authoritatively study for effect; Control for confounders</td>
</tr>
<tr>
<td>Method</td>
<td>One test, control bias</td>
</tr>
<tr>
<td>Hypothesis</td>
<td>Fixed</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Post-assessment</td>
</tr>
<tr>
<td></td>
<td>Regular assessment with run or control charts</td>
</tr>
</tbody>
</table>

Research QI

- Purpose: Determine effectiveness
- Data Collection: Authoritatively study for effect; Control for confounders
- Method: One test, control bias
- Hypothesis: Fixed
- Evaluation: Post-assessment

Q3: What change can we make that will result in an improvement?

Ideas for change come from several places.....
Pareto

Cassan DC, Neuhauser SL, Evens RG, Burke JP. Computerized Surveillance of Adverse Drug Events in Hospital Patients. JAMA. 1991; 266(20): 2847

PDSA


Plan

- Test and Data Collection
  - Try to answer: What information is important to collect? Why?
  - Who will collect the data?
  - Where and when (and how) will data be collected?

Do

- Perform the test!

Study

- Complete, as a team, analysis of the data
  - Compare to your prediction
  - Summarize what you’ve learned

What is a Run Chart?

Steps to a run chart

1. Develop X axis - Time
2. Develop Y axis - Measurement
3. Plot data points
4. Calculate the median

Shift

Trend

Astronomical data points

Goal: associate non-random variation (i.e. shifts and trends) with your intervention
The 3 A’s:
- Adapt
- Adopt
- Abandon

Summary - a return to objectives
We have...
- Described the anatomy of a QI project using IHI’s Model for Improvement (MFI).
- Demonstrated how the MFI can be systematically applied to create improvement in many aspects of health care.
- Compared quality improvement data with research data and illustrate common methods of displaying quality improvement data, including run charts and control charts.

Perioperative Glycemic Management
Sam Gilliland, MD
Assistant Professor, Anesthesiology and Critical Care

Problem Statement
BROAD PROBLEM: Surgical site infection rates at the University of Colorado exceed the national average when compared to risk-adjusted controls.

OUR PROBLEM: Patients receiving inpatient surgery at the University of Colorado Hospital have inadequate glucose management in the perioperative period.

CDC Guidelines
- Appropriate antimicrobial prophylaxis
- Alcohol-based skin prep
- Normothermia
- Oxygen administration
- Perioperative blood glucose <200mg/dL

Our Team

Gina Whitney, MD – Vice Chair, Quality
Sam Gilland, MD – Physician Lead
Kaitlin Undevelop, CRNA – APP Lead, Supervisor
Shelby Badani, MD – Resident Lead, Supervisor
Jen Locker, RN – PreOp RN Supervisor
Randi Norm, RN – PACU RN Supervisor
Clark Lyda, PharmD – Lead Pharmacist
Agnes Tatarka – Data Analysis
Derek Hawes – Data Analysis
Cecilia Low Wang – Director, GMT

Aim Statement

We aim to increase the proportion of hyperglycemic patients treated intraoperatively by 20% over 6 months by standardizing testing intervals and providing pathways for treatment of hyperglycemia in the inpatient surgery setting.

The Conceptual Model of the Problem

Leverage Points

POCT License – low complexity testing
POCT Acquisition – 2 units for ~40 ORs
POCT Training – all providers, yearly certification
Reliable data extraction and monitoring for compliance
Protocol Development

Data Element - %hyperglycemic patients receiving insulin intraop

Change Hypotheses

- Acquiring point of care testing credentials and testing units will give us the tools necessary to monitor our patients appropriately.
- Training all frontline providers and providing an infrastructure for yearly maintenance certification will empower them to manage perioperative hyperglycemia
- Thoughtful protocol development for intraoperative glycemic control will allow for appropriate monitoring and treatment without dramatically altering workflow
- Monitoring of provider adherence to the protocol will allow us to identify deficiencies in the process.
Lessons Learned

- Given the appropriate tools and training, we can move the needle on intraoperative glucose management
- Communication between phases of care is vital to the success of a complex process
- Development of a “source of truth” monitoring system is complex
- Nurses are far more organized than physicians

Next Steps

- Migration of protocols / new trainees and staff training
- 3 months post-intervention initiate follow-up with non-compliant providers to identify barriers
- Identify patients whose first hyperglycemic event is postoperative, review chart for risk factors
- Develop a more robust post-operative management protocol with the assistance of our glucose management team
- Develop an analogous treatment pathway for outpatient surgery

Change through Communication

Alma Juels, M.D
Associate Professor of Anesthesiology
University of Colorado School of Medicine
Attending Physician
Denver Health and Hospital
Operating Room Errors

- 10% of surgical patients
- Almost half of those can be prevented
- The majority are due to human errors


98,000 patient deaths per year due to medical errors, 72% from communication errors  To ERR Human, IOM 1999

Communication Failures

- Errors
- Adverse events
- Malpractice claims

Wrong side/site procedures
Wrong implant
Retained foreign objects
Wrong procedure

One simulation study showed team members did not share clinical relevant information 48% of the time

Communication failures occur frequently—every 7 to 8 minutes
Usually between professions not within professions
90% of the time this causes an issue such as delays, procedure error, waste of resources, near misses and other adverse events.

Tools & Strategies Summary
Barriers: Inadequate Team Membership, Lack of Time, Lack of Information Sharing, Hierarchy, Defensiveness, Conventional Thinking, Conspicuity, Varying Communication Styles, Conflict, Lack of Coordination and Follow-up With Co-workers, Distractions, Fatigue, Workload, Misinterpretation of Cues, Lack of Role Clarity
Tools and Strategies: SBAR, Call-Out, Check-Back, Handoff, Leading Teams, Brief, Huddle, Telephone
Outcomes: Shared Mental Model, Aspirancy, Team Orientation, Mutual Trust, Team Performance, Patient Safety

TeamSTEPPS®

Shift Toward a Culture of Safety

Introduction
Standardized Structured Communication

- Checklist/Briefings-timeout
- Closed loop communication
- Situation Background Assessment Recommendation (SBAR)
- Critical Language
- Common Language
- Active Listening

Successful Communication in the OR

- Structure
- Standardization
- Team integration
- Team stability
- Culture that allows anyone to speak up

How to Improve Communication

- Standardize communication
- Assertive Language
- Education

Education

- Teamwork training
- Crisis Resource Management training
- TeamSTEPPS-Team Strategies and Tools to Enhance Performance
Based on more than 30 years of research and evidence

- Improve attitudes
- Increase knowledge
- Improve behavioral skills
- Meta-analysis has shown evidence of moderate to positive effect on team outcomes

TeamSTEPPS

- Team Structure
- Communication
- Leadership
- Situation Monitoring
- Mutual Support

Communication Skills

<table>
<thead>
<tr>
<th>100 Level Skills</th>
<th>200 Level Skills</th>
<th>300 Level Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request</td>
<td>Huddle</td>
<td>CUS</td>
</tr>
<tr>
<td>Call-Out</td>
<td>Debrief</td>
<td>Two-Challenge Rule</td>
</tr>
<tr>
<td>Cross-Check</td>
<td>Handoff</td>
<td>DESC</td>
</tr>
<tr>
<td>Check-Back</td>
<td>Cross-Monitoring</td>
<td>I'M SAFE</td>
</tr>
<tr>
<td>SBAR</td>
<td>Task Assistance</td>
<td></td>
</tr>
<tr>
<td>Brief</td>
<td>Shared Mental</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Model</td>
<td></td>
</tr>
</tbody>
</table>

Tools

- Briefs-Planning, prior to start, roles, expectation, outcomes
- Huddles-problem solve, changing plans
- Debriefs-after event
- Mutual support

Assertive Phrases

- "I am concerned"
- "I am uncomfortable"
- "I feel this is a safety issue"
- CUS-Technique-Concerned, Uncomfortable, Safety issue
- May need to reach out to other resources to maintain patient safety-another provider
.Shared Mental Models
.Clear Roles laid out
.Shared Vision
.Optimize Resources
.Strong team leadership
.Regular feedback
.Collective Trust and Confidence
.Enable Cooperation and Coordination

.Surgical Checklist

- Discuss cases for the day, what is needed-concerns, equipment, anesthetic care, medication, recovery issues-first thing in the morning
- Before induction of anesthesia
- Before skin incision/start of procedure
- Before patient leaves the room

.Timeout/Briefing

- Helps with clear and good communication
- Gets everyone on the same page
- Teamwork and collaboration
- Allows team members to address concerns/problems—everyone participates
- Sets the tone for the procedure
- Improves patient safety

.Debriefing

- Verification of sponge/needle count
- Review procedure that was performed
- Confirmation of any specimens labeling
- Discuss any issues or concerns with equipment or patient recovery
- Discuss actions for next case
Positive Culture

- Reinforced by leaders by cultivating desired team behaviors and skills
- Open sharing of information
- Role modeling and effective cueing of team members
- Constructive and timely feedback
- Facilitate briefs, huddles, debriefs and conflict resolution
- Mitigation of conflict within the team
- Support ideas and feedback for effective communication

Communication in the Operating Room is Essential for Patient Safety
Scenario 1: Fasting Guidelines for Pediatric Procedural Sedation?

9-year-old, otherwise healthy female, with a closed distal radius fracture after a fall from the swing. Needs closed reduction under moderate/deep sedation. Drank milk in the ED waiting room.

Poll #1
How long should you wait prior to propofol/ketamine sedation?

1. No waiting
2. 2 hours from milk
3. 4 hours from milk
4. 6 hours from milk
Pediatric Preoperative Fasting (European Society of Anaesthesiology)

<table>
<thead>
<tr>
<th>Substance</th>
<th>Fasting Time Prior to Induction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Food</td>
<td>6 hr</td>
</tr>
<tr>
<td>Light Breakfast</td>
<td>6 hr</td>
</tr>
<tr>
<td>Non-clear Liquids</td>
<td>4 hr</td>
</tr>
<tr>
<td>Formula</td>
<td>4 hr</td>
</tr>
<tr>
<td>Non-human Milk</td>
<td>4 hr</td>
</tr>
<tr>
<td>Breast Milk</td>
<td>3 hr</td>
</tr>
<tr>
<td>Clear Fluids</td>
<td>1 hr</td>
</tr>
<tr>
<td>Chewing Gum</td>
<td>Removed prior to induction</td>
</tr>
</tbody>
</table>

A colleague is proficient in POCUS and specifically gastric ultrasound. She tells you that the gastric antrum appears empty.
Poll #2
Does this information change your NPO time prior to administering sedation?
1. YES - perform sedation immediately
2. YES - 2 hours NPO is adequate
3. YES - 4 hours NPO is adequate
4. NO - wait for 6 hours NPO

Regional Anesthesia and Pain Medicine 2018;43(7):689-98

Your hospital is considering a 1-hour NPO policy for clear liquids prior to anesthesia.

Poll #3
Does the volume of clear liquids matter?
1. NO - gastric emptying time for clear liquids is independent of volume
2. YES - only a small sip is appropriate
3. YES - up to 5 ml/kg is appropriate
4. YES - up to 7 ml/kg is appropriate

Pediatric Anesthesia 2020;30:1384-1389

Ultrasound assessment of gastric emptying time after intake of clear fluids in children scheduled for general anesthesia—A prospective observational study
ASA Practice Guidelines for fasting before procedural sedation are the same recommendations as for general anesthesia. (8:6:4:2)

- ACEP does not accept these guidelines
- ICAPS recommends individual patient risk assessment
- European Guidelines are now more liberal than ASA (6:4:3:1)

**Pearls**

- Clear liquids should not exceed 5 mL/kg to meet 1 hour recommendation
- Gastric Ultrasound may demonstrate value
- Re-evaluate population gastric volumes at various fasting times?
- Individual patient risk stratification?

**Scenario 2: Succinylcholine for Pediatric Rapid Sequence Intubation**

A 7-year-old, otherwise healthy female is struck in the face by a swing causing a near-amputation of the anterior 1/3 of the tongue. NPO is appropriate but swallowed a moderate amount of blood. She needs surgical exploration and repair under general anesthesia.

**Poll #4**

How would you induce general anesthesia?

1. Rapid sequence induction using succinylcholine
2. Rapid sequence induction using rocuronium
3. Modified rapid sequence induction using rocuronium

**Mask Ventilation During RSI?**

- Do you intubate the patient via facemask before succinylcholine is given for induction attempts?

*Eur J Anaesthesiol 2009; 26:436–44G*
Poll #5

You decide to use succinylcholine as part of a rapid sequence induction in this 7-year-old child. What dose of intravenous succinylcholine is indicated?

1. 1.0 mg/kg
2. 1.5-2 mg/kg
3. 3 mg/kg
4. 4 mg/kg
Poll #6

A colleague suggests pre-treatment with atropine prior to succinylcholine to prevent bradycardia. What dose of atropine is indicated?

1. Zero - atropine is not empirically indicated with succinylcholine
2. 10 mcg/kg
3. 20 mcg/kg
4. 100 mcg (0.1mg) regardless of weight

Atropine with Succinylcholine?

Cardiac monitors. In spontaneously breathing children (three months to seven years), well-analized and ventilated with halothane (0.5), 2.5% is oxygen, or isoflurane (1.5, 3.5)% in oxygen, a bolus of succinylcholine (0.5 mg/kg) data these different and inexplicable changes in the heart rate. (6) In contrast, an bolus of 800 mcg/kg with 1%, 0% no change in heart rate in (4) (6). Therefore, (7) succinylcholine (CVR) has been described as 0-145 (5-80) of the patients.


Pediatric Anesthesia 2009;19:561-70

Intramuscular Rocuronium?

IM succinylcholine has ALMOST ZERO incidence of bradycardia (IN THE ABSENCE OF CONCURRENT HYPOXEMIA)

Co-administration of atropine should be reserved for neonates and infants or multiple doses of succinylcholine - doses 7-14 mcg/kg with NO MINIMUM

IM rocuronium has longer onset and MUCH LONGER DURATION

Pearls

- “Controlled” Rapid Sequence Intubation is preferred in infants and children
- Peak inspiratory pressure MAX 10-12 cmH2O
- Cricoid pressure NOT beneficial
- Succinylcholine not contraindicated in laryngospasm, “full stomach,” difficult airway, IV access unavailable
- EVALUATE FOR MYOPATHY FIRST
Scenario 3: Use of Nitrous Oxide

- 5-year-old, 20kg male presents for circumcision
- No significant past medical history
- He appears stoic in pre-op, but parents think he can go back to the OR without any premedication

Poll #7

For an inhalational induction, would you use nitrous oxide?
1. Yes
2. No

Nitrous Oxide

- First recorded discovery in 1772
- Used as an anesthetic by Horace Wells in 1884
- Colorless, non-pungent gas

Hemodynamic Effects of Nitrous


Environmental Impacts

Nitrous Oxide

- **Advantages**
  - Euphoria and ambivalence to presence
  - Stable hemodynamics overall

- **Disadvantages**
  - Prohibits preoxygenation
  - Increases carbon footprint of anesthetic
  - Dysphoria common in high inspiratory fraction
  - Increases risk of nausea (maintenance)
  - Does not speed mask induction

Pearls

- Healthcare is a significant contributor to greenhouse gas emissions
- We can reduce our emissions by decreasing the use of nitrous oxide and desflurane
- Consider TIVA when appropriate
- Use low flow anesthesia when possible
Scenario 4: Uncooperative Child

- 15-year-old, 90kg male who presents for dental restoration.
- His past medical history is significant for autism spectrum disorder.
- He is nonverbal, and has a history of being combative in unfamiliar situations.

Poll #8

For anxiolysis, what premedication would you MOST likely administer?
1. Oral midazolam
2. Intranasal midazolam
3. Intranasal dexmedetomidine
4. Intramuscular ketamine

Pharmacological Options for Preoperative Anxiolysis

Autism Spectrum Disorder

- Diagnosed 1 in 68 children.
- Generally, affects boys more than girls.
- Often on medications that can have interactions with anesthesia.

Oral Midazolam vs. Midazolam & Ketamine

<table>
<thead>
<tr>
<th></th>
<th>Group A (n = 45 (%))</th>
<th>Group B (n = 45 (%))</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation score</td>
<td>1 20 (44)</td>
<td>2 16 (37)</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>2 12 (27)</td>
<td>3 16 (37)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 10 (22)</td>
<td>4 12 (27)</td>
<td></td>
</tr>
<tr>
<td>Parental anxiety</td>
<td>1 23 (51)</td>
<td>2 24 (53)</td>
<td>0.366</td>
</tr>
<tr>
<td></td>
<td>3 15 (33)</td>
<td>4 16 (36)</td>
<td></td>
</tr>
<tr>
<td>Induction score</td>
<td>1 20 (44)</td>
<td>2 20 (44)</td>
<td>0.550</td>
</tr>
<tr>
<td></td>
<td>3 15 (33)</td>
<td>4 15 (33)</td>
<td></td>
</tr>
</tbody>
</table>


Oral Midazolam vs. Ketamine vs. Midazolam & Ketamine

Funk et al. BJA (2000).
Comparison of Oral Midazolam vs. Intranasal Dexmedetomidine


Patients with Autism Perioperative Experience

Patients with autism are more likely to receive a premedication other than oral midazolam, but there was no difference in the overall experience.


Combination of oral ketamine and midazolam as a premedication for a severely autistic and combative patient

The unique flavor of Dr Pepper is well suited to increase the palatability and the acceptability of medications in children and patients with developmental delay.

Children’s Hospital Colorado Clinical Pathway

Pearls

- No single premedication is superior
- Preoperative planning is required for patients with severe and uncooperative autism
Scenario 5: Tonsillectomy and OSA

- 7-year-old obese girl with sleep-disordered breathing scheduled for tonsillectomy and adenoidectomy.
- h/o ADHD and poor school performance.
- Sleep study- Apnea Hypopnea Index -28 events/h

Preoperative Evaluation

- How is pediatric OSA different from adult OSA?
- What are you looking for in the sleep study?

Pediatric Obstructive Sleep Apnea

Sleep disordered breathing

<table>
<thead>
<tr>
<th>Primary snoring</th>
<th>Upper airway resistance syndrome</th>
<th>Obstructive sleep apnea syndrome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrent episodes of partial or complete obstruction during sleep</td>
<td>Hypoxemia</td>
<td>Hypercapnia</td>
</tr>
<tr>
<td>1-4% of all children have OSA</td>
<td>Sleep disruption</td>
<td></td>
</tr>
<tr>
<td>Snoring is not synonymous with OSA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pediatric vs. Adult OSA

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>2-6 yrs peak</td>
<td>Increased elderly</td>
</tr>
<tr>
<td>Gender</td>
<td>M = F</td>
<td>M &gt; F</td>
</tr>
<tr>
<td>Obesity</td>
<td>Few</td>
<td>Most</td>
</tr>
<tr>
<td>Tonsils/adenoids</td>
<td>Often enlarged</td>
<td>Rarely enlarged</td>
</tr>
<tr>
<td>Daytime sleepiness</td>
<td>Less common</td>
<td>More common</td>
</tr>
</tbody>
</table>

Pediatric OSA Grading

<table>
<thead>
<tr>
<th>Severity</th>
<th>AHI Scores</th>
<th>Descriptors</th>
<th>O₂ nadir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>1-5</td>
<td>SpO₂ &lt; 90% for 2-5% of sleep time</td>
<td>&gt; 92</td>
</tr>
<tr>
<td>Moderate</td>
<td>5-9</td>
<td>SpO₂ &lt; 90% for 5-10% of sleep time</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>&gt;10</td>
<td>SpO₂ &lt; 90% for &gt; 10% of sleep time</td>
<td>&lt; 80</td>
</tr>
</tbody>
</table>

Schwengel DA. Anesthesiology Clin 2014
Indications for PSG in Children

- Obesity
- Down’s syndrome
- Craniofacial abnormalities
- Neuromuscular disorders
- Sickle cell disease
- Mucopolysaccharidoses

Poll #10

Following inhalational induction and intubation, patient is maintained with sevoflurane, O₂ & air. What are your options for pain control?

1. Acetaminophen + fentanyl + dexmedetomidine
2. Acetaminophen + hydromorphone or morphine

Intraoperative Analgesia

- Fentanyl - 0.5-1 mcg/kg, titrated to RR
- Dexmedetomidine - 0.5-1 mcg/kg
- Dexamethasone - 0.5 mg/kg, up to max 10 mg IV
- Acetaminophen - PO vs. IV

Post Discharge Medications

- Alternating Acetaminophen & ibuprofen q 3 hours
- Acetaminophen 10-15 mg/kg q 4-6 hours
  - max - 75 mg/kg/day or 4 grams
- Ibuprofen 5-10 mg/kg q 6-8 hours
  - After 3 hours post op
- Oxycodone 0.05 mg/kg q 6 h for patients > 5 years

Post Discharge Medications

- NO CODEINE, tramadol and hydrocodone
- Ultra-rapid metabolizers CYP450 2D6 pathway

Overnight Admission Criteria

- Children < 3 years of age
- Severe OSA
- Comorbidities
  - Down syndrome
  - Cardiac complications of OSA
  - Neuromuscular disorders
  - Failure to thrive
  - Craniofacial anomalies
  - Obese children
PACU Discharge Criteria

- What are your PACU discharge criteria?
- Does she need to void/tolerate PO?
- How long does she need to be monitored after PACU oxycodone dose?
- What is a room air sleep challenge?

Scenario 6: Foreign body in esophagus

- A 2-year-old boy presents to ED with irritability, drooling, and refusing to eat. He was playing with his brother’s toy car remote earlier today.

Poll #11

What does the CXR show?
1. Coin
2. Button battery
3. Magnet

Poll #12

What is the mechanism of injury following button battery ingestion?
1. Leakage of chemicals
2. Mechanical obstruction
3. Caustic alkaline injury

Two Changes

- Larger diameter batteries (20-25 mm)
- Stronger lithium batteries
  - 3 volt (vs 1.5 volt)
  - Longer shelf life
  - Better stability at cool temperature
  - Lighter weight
Mechanism of Injury

It’s not leakage!

- Entrapped BB
- Mucosa bridges + & - terminals
- Circuit completed
- Generation of hydroxide radicals
- Alkaline caustic injury

Mechanism of Injury

Higher the voltage, faster the process
Visible injury within 15 minutes
Serious injury as soon as 2 hours
New vs. spent - 3.2 times higher risk

Orientation of Button Battery

Three Ns
- Negative
- Narrow
- Necrotic

Extent of Damage

- Size
- Duration
- Location
- Orientation
- Voltage
- Esophageal pathology

If a Child Swallows a Button Battery

Call the National Battery Ingestion Hotline 800-498-8666
Proceed immediately to hospital
Do not induce vomiting

1. Patient >12 months old
2. Suspected lithium battery
3. Ingested within 12 hours

National Capital Poison Control Treatment Algorithm

Button Battery in esophagus

Goal: endoscopic removal within 2 hours of ingestion
Consider Sucralfate 10 mL every 10 min (max 3 doses)
Poll #13

Would you delay the case for honey or carafate?
1. Yes
2. No

After BB Removal

Inspect esophageal mucosa for extent of damage
Note orientation of negative pole

If no evidence of perforation, irrigate esophagus with
0.25% acetic acid (50-150 mL)

Scenario 6: Elective Surgery after COVID

When to schedule elective surgery after recent COVID infection?

- 4 weeks- Asymptomatic patient
- 4 weeks- Recovery from mild, non-respiratory symptoms
- 6 weeks- Symptomatic patient, didn’t require hospitalization
- 8-10 weeks- Symptomatic patient who is diabetic, immunocompromised, or hospitalized
- 12 weeks- Patient admitted to ICU due to COVID infection