Update on Anesthetic Considerations for Geriatric Patients

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Objectives

1. Review the physiologic and pathophysiologic changes of aging
2. Define frailty, what it means, and how to recognize and grade it
3. Discuss strategies to improve postoperative outcomes in the geriatric population, especially regarding delirium
4. Describe one approach to the geriatric patient needing surgery

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Outline

A. Definitions and background

B. Age related pathological physiology changes

C. Frailty

D. Methods to improve postoperative outcomes especially delirium and delayed neurologic recovery

E. One approach to a geriatric patient

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Definitions and Background

- A geriatric patient is defined as individuals aged ≥ 65 with frailty, cognitive impairment, or significant comorbidity, or any individual ≥ 75 years
  - They are a very vulnerable population, especially neurologically
- They have an incidence of persistent post-op delirium ranging from 4-55% after surgery and >80% in critically ill patients
- In the next 30 years the population of U.S. adults aged 65 and older will double from 46 to 98 million people
- They are 15% of the population and undergo more then 30% of all inpatient and outpatient procedures
- Preserving independence is a vital goal for all older adults undergoing surgery
- Age related physiologic changes, cognitive decline, comorbidities, frailty, and surgical stress response all contribute to decline in functional abilities and cognitive recovery, and perioperative M&M
- 35% of older adults with a new disability after surgery have no recovery after 6 months

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Perioperative Neurocognitive Disorder

- Perioperative neurocognitive disorder (PND) is defined as alterations in behavior, affect, and/or cognition which are detected during the perioperative period. It includes:
  1. Delirium which is an acute, fluctuating disturbance in attention and awareness, accompanied by a change in cognition, that develops over a short period of time and is caused by an underlying medical condition or insult
     - Manifests as hyperactive (agitation, crying, restlessness, etc..) or hypoactive (altered mental status, excessive somnolence)
     - Associated with increased mortality, longer hospital stay, functional decline, and long-term cognitive impairment
  2. Cognitive impairment with objective evidence of decline in cognition or ADLs with timing of onset and resolution specified
     - Delayed neurocognitive recovery- up to 30 days after surgery and anesthesia
     - Neurocognitive disorder- diagnosed up to 12 months post procedure
- This is where there is an excellent opportunity for us to intervene

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Age-Related Physiological Changes

- Aging is associated with a progressive loss of functional reserve in all organ systems, although there is considerable variability in the onset and extent of the changes, they do occur in all older individuals, even "healthy" ones
  - Nervous System
  - CV System
  - Respiratory System
  - Liver Function
  - Renal Function
  - Immunologic Changes
  - Pharmacokinetic changes

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Age Related Nervous System Changes

- Pharmacodynamic sensitivity is increased to agents we use, especially
  - All IV agents that act in CNS (prop, fent, midaz, etc…)
  - Volatile agents – this is seen as age related decrease in MAC
  - Anticholinergic side effects (diphenhydramine, meperidine, scopolamine)
    - Due to decrease in cholinergic receptor activity
- Decreased ventilatory response to hypercapnia and hypoxemia
  - Exaggerated response to the respiratory depressant effects of our drugs
- Cerebrovascular changes of impaired autoregulation
  - Decreased response to BP changes
- Higher pain thresholds due to reduction of myelinated fibers in PNS
  - Lead to delayed presentation of painful conditions and less pain medicine requirements
- **Increased risk of delirium through multiple, unclear mechanisms, but systemic and central inflammation thought to be important cause**

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Age Related Cardiovascular System Changes

- Vascular stiffening and autonomic NS changes influence physiologic response to our anesthetic drugs and techniques
- Blood pressure lability seen as an exaggerated response to vasoactive drugs, both vasoconstricting and vasodilating
- Autonomic NS Changes
  - Decreased B-receptor response, decreased ability to increase HR to increase CO
  - More reliant on vascular tone and preload to maintain CO
- Left Ventricular Hypertrophy very common from vascular stiffening
  - Diastolic dysfunction and Diastolic HF, and resulting reliance on atrial kick makes them not tolerate arrhythmias very well, even short-lived ones
  - Higher risk of volume overload and pulmonary edema during fluid administration

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Age Related Respiratory System Changes

- Stiffer chest wall leading to increased compliance, increased work of breathing, and increased closing capacity leading to small airway closure
  - Increased V/Q mismatch, increased dead space
  - Decreased FEV1, VC, VO2 max
  - Increased A/a gradient -> decreased PaO2
- Decreased ventilatory response to hypoxemia and hypercarbia
- Decreased respiratory muscle strength and impaired cough mechanism lead to higher aspiration risk
- More susceptible to respiratory compromise during MAC anesthesia and pre- and post-op as well for all these reasons

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Age Related Liver Function Changes

- Decreased hepatic mass and function as well as blood flow
  - Slower metabolism of most IV anesthetic drugs
- Decreased albumin levels
  - Higher free drug concentration of drugs that are highly protein bound (prop!)

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Age Related Renal System Changes

- Decreased GFR, CrCl, and renal reserve
  - Can be underestimated by BUN and Cr levels due to decreased muscle mass
  - Common comorbidities in the elderly (DM, HTN, PAD) cause further decline in renal function
- Increased concentration of renally excreted drugs and the inability to handle salt and water loads
- Increased sensitivity to nephrotoxins like IV contrast and NSAIDS

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Age Related Pharmacokinetic/dynamic Changes

- Decreased total body water and muscle mass
  - Lower central compartment volume
  - Higher initial plasma drug concentrations for many drugs
    - Especially induction drugs!
- Increased body fat leads to large volume of distribution for lipid soluble agents
  - Slow release from relatively large adipose reserve prolongs clinical drug effect

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Age Related Pharmacokinetic/dynamic Changes – Specific anesthesia drugs

- Propofol – approx. 30% more sensitive to effects, and clearance decreased
  - Decrease induction dose 40-50% and maintenance infusions decreased by 30-50%
- Etomidate – minimal hemodynamic effects, higher plasma concentration (decreased Vd and clearance) so reduce dose to 0.2 mg/kg
- Ketamine – has sympathomimetic effects of increased BP and HR and has been associated with delirium, not commonly used
- Opioids – approx. 2x as potent in geriatric patients and they are especially at risk for severe hypoventilation or apnea
  - Increased brain sensitivity and decreased clearance

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Age Related Pharmacokinetic/dynamic Changes – Specific anesthesia drugs (cont'd)

  - Morphine increased volume of distribution and it and metabolites are renally cleared -> prolonged duration of action
  - Hydromorphone – initial dose reduced by 25-50%
- Inhalation Agents – MAC decreased 6% per decade after age 40
- NMBAs- prolonged onset time as well as prolonged duration due to decreased muscle blood flow and decreased CO, age related reductions in hepatic metabolism and renal excretion
  - Recovery of function after sugammadex administration is slightly slower
    - Important to fully reverse as even a small amount of residual muscle relaxant can impair pharyngeal function
  - Patients on anticholinergics (Alzheimer's, dementia, etc..) may have prolonged duration of succinylcholine and unpredictable responses to anticholinergic agents like neostigmine
    - Also have a decrease in cholinergic receptor activity

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Age Related Immunologic Changes

- Chronic systemic inflammation and immunosenescence associated with the development of many age-related chronic illnesses including:
  - Frailty
  - Anemia
  - Others
  - Delerium?
- This all leads to exaggerated inflammatory response to surgical stress and adverse outcomes

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Frailty

- Multidimensional loss of physiologic reserve due to accumulation of age and disease related deficits
- Due to these changes of frailty, geriatric patients are vulnerable to even **minor** stressors
- Surgery involves **major** physical, physiological and psychosocial stressors and puts frail people in the highest risk strata of the perioperative population in terms of risk for major morbidity, **delirium**, cognitive decline, impaired functional recovery, and mortality
- Like a canary in a coal-mine, geriatric patients who are frail are at highest risk for all badness in the perioperative period
  - **Associated with a 2- to 5-fold greater risk of complications, mortality, non-home discharge, and development of a new disability**
- Prevalence of frailty increases with age, but chronological age does not equal frailty
- So how can we "diagnose" frailty and what does it mean for our anesthetic plan?

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Sometimes it is easier to "diagnose" frailty then other times

For when its not, there are many many clinical tools

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Frailty- instruments to identify

- Risk Analysis Index
- Fried Phenotype
- Frailty Index
- Edmonton Frail scale
- Clinical Frailty Scale

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Frailty- identify in the real world

- Clinical Frailty Scale (CFS) – rapid screen useful to us in pre-op and can help us make our anesthetic plan
  - We can get this from preop observation and a few questions
- Scale from 1-9 which is determined from baseline function (2-4 weeks pre-illness), not acute status.

CFS 1-3 (Independent & active)- independent but slow/tires or uses arms to stand, describes an active daily routine (walking, chores, errands) to mild deconditioning but no assistance required, independent ADLs, maybe fewer activities

- Normal physiologic reserve with standard anesthetic risk for age

CFS 4 (Vulnerable or Pre-Frail)- needs help with IADLs or gait aid indoors, no ADL dependence, but clear ↓ endurance, "I don't do as much anymore"

- Higher delirium and pulmonary risk

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Frailty- identify in the real world

CFS 5 (Mildly Frail)- needs help with basic ADLs or assistance onto stretcher, needs help with **instrumental ADLs,** cane or walker **inside the house,** shortness of breath or fatigue at rest

- Limited buffer for hypotension/hypoxia, small to no physiological reserve

CFS 6(Moderately Frail)- Needs help with **basic ADLs** (bathing, dressing), cannot reposition independently, often recent falls or hospitalizations

- Very high perioperative risk

CFS 7-9 (Severely Frail)- Completely dependent, Bed- or chair-bound

- Risk of non-recovery to baseline extremely high, goals-of-care discussion important, DNR/DNI status

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Frailty- identify in the real world

- Still takes too long, here's an ultrafast screen
- **FRAIL questionnaire** (5 yes/no):
  - Fatigue
  - Resistance (stairs)
  - Ambulation
  - Illnesses/comorbidities (≥5)
  - Loss of weight
  - **≥3 = frail**
- **Gait speed**: <0.8 m/s (or "can't walk") → frailty signal
- **Chair rise**: Unable to stand from chair without arms → frailty signal

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Methods to improve postoperative outcomes → delirium

1. Enhanced preoperative assessment
2. Optimal choice of primary anesthetic
3. Anesthetic depth monitoring
4. Pharmacologic delirium prophylaxis and prevention
5. Other interventions

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Strength of Evidence Grade

Grade	Definition
HIGH	We are very confident that the true effect is close to the estimate.
MODERATE	We have moderate confidence in the effect estimate: The true effect is likely to be close to the effect estimate, but there is a possibility that it is substantially different.
LOW	Our confidence in the estimate of the effect is limited: The true effect may be substantially different from the estimate.
VERY LOW	We have very little confidence in the estimate of the effect: The true effect is likely to be substantially different from the estimate.

Source: Adaptation of the article from the GRADE series: GRADE guidelines: 3. Rating the certainty of evidence[10].

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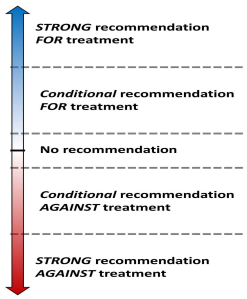
Strength of Recommendation Grade



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1. Enhanced preoperative assessment

- May include a focus on frailty assessment, mood and anxiety issues, malnutrition risk, baseline functional capacity, polypharmacy, and baseline preoperative cognitive function
- Role of cognitive and physical prehabilitation to increase physiological reserve is becoming more accepted and prevalent
  - Smoking cessation, exercise training, nutritional supplementation, plan for post-op care and discharge planning,
- In a meta-analysis this received a Conditional strength of recommendation, Low strength of evidence
- This is outside the scope of most anesthesia practices, so what can we do?

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1. Enhanced preoperative assessment

- We can identify the most important risk factors for developing a Perioperative Neurocognitive Disorder (PND)
  1. Prescence of pre-existing cognitive impairment
  2. Excessive ETOH consumption
  3. polypharmacy
  4. psychotropic drug use
  5. Serious comorbidities like vascular disease or DM
  6. Frailty
  7. Type of surgery -> bigger surgery is bigger risk
- Tailor our anesthetic plan to patients at high and highest risk based on frailty assessment and risk factors

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2. Optimal choice of primary anesthetic

- The heart of the matter for this lecture
- It has been challenging to determine whether anesthesia-related factors are clinically significant since there are so many different factors at play
- The choice of anesthetic technique for geriatric patient should be guided by the requirements of the procedure, coexisting diseases, and patient preferences
- Role of anesthetic technique in determining post-op outcomes is debated and continued to be studied
- 2 biggest areas of debate:
  - Neuraxial vs General Anesthesia
  - Total Intravenous Anesthesia (TIVA) vs Inhaled Volatile Anesthesia

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2. Optimal choice of primary anesthetic

- Neuraxial vs GA (especially in hip fractures)
  - Recent multicenter trials have failed to prove superiority of either neuraxial or general anesthesia in decreasing the risk of post-op delirium
  - Neuraxial may reduce risk of renal failure/injury and pulmonary complications
  - Results from RCTs are from studies mostly with hip fracture patients
  - Meta-Analysis showed Strong strength of recommendation to use one OR the other, moderate strength of evidence, but not one over the other
- Total Intravenous Anesthesia (TIVA) vs Inhaled Volatile Anesthesia
  - Either is acceptable in the geriatric population
  - The evidence is inconclusive with regard to the risk of post-op delirium, although some studies have shown less delirium with TIVA
  - Not enough specific trials looking at just this, variety of different procedures, end points, etc… making it difficult for meta-analyses to be conclusive
  - Meta-Analysis showed Conditional strength of recommendation to use either, low strength of evidence

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3. Anesthetic depth monitoring

- There have been large RCTs in North America which have failed to demonstrate a clear benefit of EEG-guided depth reduction of anesthesia on reduction of post-operative delirium in elderly patients, and no reduction in 1 year mortality observed (only area where mortality was looked at)
- Specifically, the ENGAGES and SHARP trials are the most recent studies

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ENGAGES Trial (Electroencephalography Guidance of Anesthesia to Alleviate Geriatric Syndromes)

- Purpose: Test whether **EEG-guided anesthetic administration** to reduce depth of anesthesia and minimize EEG suppression decreases postoperative delirium in older adults.
- Design:
  - Randomized clinical trial of adults ≥ 60 years, Compared EEG-guided anesthesia vs usual anesthetic care (blinded EEG in control)
  - Primary outcome: incidence of delirium during postoperative days 1-5.
- Key Findings:
  - No significant reduction in postoperative delirium between groups
  - Delirium occurred 26.0% (guided) vs 23.0% (usual care) in original ENGAGES study.
  - EEG-guided anesthesia did reduce anesthetic depth (lower volatile anesthetic and less EEG suppression), but this did not translate to less delirium.
  - Serious adverse events and other clinical outcomes (e.g., ICU/hospital length of stay) were similar between groups.

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ENGAGES Trial (Electroencephalography Guidance of Anesthesia to Alleviate Geriatric Syndromes) (cont'd)

- Conclusion:
  - Monitoring and adjusting anesthesia depth with EEG **did not decrease postoperative delirium** in older adults undergoing major surgery, including cardiac surgery
- Interpretation:
  - The hypothesis that "too-deep" levels of anesthesia contributes causally to delirium wasn't supported in this large trial.
  - Suggests that while EEG suppression correlates with delirium risk in observational work, modifying anesthetic depth alone may not prevent delirium.

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SHARP Trial (SHaping Anesthetic Techniques to Reduce Postoperative delirium)

- Purpose: Determine whether a **bundled approach reducing depth of anesthesia**—specifically **spinal anesthesia with lighter sedation based on BIS (Bispectral Index)**—reduces postoperative delirium compared with **general anesthesia** in older patients undergoing lumbar spine fusion.
- Design:
  - Single-center randomized controlled trial in patients ≥65 years undergoing lumbar fusion.
  - Intervention group: spinal anesthesia + targeted lighter sedation (BIS > 60–70).
  - Control group: general anesthesia with masked BIS.
  - Delirium assessed daily with Confusion Assessment Method through postoperative day 3.

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SHARP Trial (SHaping Anesthetic Techniques to Reduce Postoperative delirium)(cont'd)

- Key Findings:
  - No significant difference in incidence of delirium:
  - 25.2% in the targeted sedation/spinal group vs 18.9% in the general anesthesia group (P = 0.26).
  - BIS values confirmed lighter sedation in the targeted group, but this did not reduce delirium incidence.
- Conclusion: Spinal anesthesia with lighter targeted sedation **did not reduce postoperative delirium** compared to general anesthesia in this elective spinal surgery population.
- Interpretation
  - Results suggest that merely reducing anesthetic depth or changing anesthetic modality may not alone be sufficient to prevent delirium.
  - Baseline patient factors (e.g., cognitive status) might be more influential than anesthesia strategy alone.

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Clinical Insights (Across Trials)

- Both ENGAGES and SHARP tested anesthetic depth modification as a delirium prevention strategy.
- Neither showed significant reductions in delirium incidence with their respective approaches.
- These findings contribute to growing evidence that deep anesthesia avoidance alone may not be a robust strategy for preventing postoperative delirium in older adults.
- Delirium risk is multifactorial (baseline cognition, comorbidity, surgical stress) and may require multimodal prevention strategies beyond anesthetic depth targeting.

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4. Pharmacologic delirium Prophylaxis and Prevention

- Medications with potential for delirium prophylaxis and medications with untoward CNS effects
  - Dexmedetomidine
    - It is reasonable to consider dexmedetomidine to lower risk of post-operative delirium
    - Take into account risk of bradycardia and hypotension
    - Meta-Analysis showed Conditional strength of recommendation, moderate strength of evidence
    - So how should we use it?
    - Common timing strategies in studies:
      - Intraoperative infusion – started at induction of anesthesia.
      - Postoperative continuation – continued into recovery or ICU (e.g., up to 24–48 h).
      - Combined perioperative – starting before incision and extending into early postoperative period.

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4. Pharmacologic delirium Prophylaxis and Prevention

- Typical Dosing Regimens
  - While no single "gold-standard" dose is universally accepted, the following patterns have been used in elderly POD prevention trials:
    - Without Loading Dose (Commonly Studied)
      - Dexmedetomidine infusion:
      - 0.1–0.5 µg/kg/hr IV started with induction and continued through surgery (and in some studies into postoperative hours).
      - Lower infusion rates (~0.1–0.2 µg/kg/hr) are frequently associated with reduced delirium incidence with fewer hemodynamic adverse effects.
    - With Loading Dose
      - Loading dose: 0.4–1.0 µg/kg IV over 10–15 minutes
      - Followed by 0.2–0.7 µg/kg/hr infusion during surgery.
      - Higher doses may impart stronger sedative effects and potentially greater POD reduction in certain studies, but also higher rates of hypotension/bradycardia.
    - Postoperative Infusions (ICU/Recovery)
      - 0.1–0.2 µg/kg/hr for 12–48 hours post-operatively.
      - Often titrated for light sedation, analgesia, or sleep modulation rather than deep sedation

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4. Pharmacologic delirium Prophylaxis and Prevention– other drugs

- Benzodiazepines
  - 4 RCTs and 4 nonrandomized trials did not detect a difference in delirium incidence comparing short acting vs placebo or no drug
  - 2 large RCTs reported lower incidence of delirium with short acting benzos and a higher incidence of delirium with long-acting benzos
- Antipsychotics (Haldol, olanzapine, or any other)
  - 5 RCTs reported lower delirium rates with antipsychotics vs placebo or no drug
  - 3 RCTs were inconclusive concerning delirium
- Ketamine
  - Pooled analysis of of 4 RCTs comparing ketamine with placebo did not detect a difference in delirium

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4. Pharmacologic delirium Prophylaxis and Prevention– other drugs

- Anticholinergics
  - 2 studies, 1 small RCT and one retrospective studies did not detect a difference in delirium incidence comparing any anticholinergic to placebo
- Corticosteroids
  - 4 RCTs were inconclusive concerning delirium incidence and 2 RCTs showed lower delirium incidence with corticosteroids vs no drug
- NSAIDS
  - 2 large retrospective database studies showed lower incidence of delirium with NSAIDS compared to no drug
- Gabapentin
  - 1 RCT did not detect a difference and 1 large retrospective study found an increase incidence of delirium

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4. Pharmacologic delirium Prophylaxis and Prevention– other drugs

- Take home message:
  - Weigh the risks and benefits of giving these medications based on patient's condition, chronic medications, comorbidities especially pre-existing neurocognitive disorders, and the planned procedure
  - Also consider the issue of polypharmacy, a known risk factor for delirium, as well as drug-drug interactions with medications the patient is currently taking or will be taking beyond the perioperative period.

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5. Other interventions

- Avoid extremes of blood pressure
  - Keep blood pressure within 20% baseline, with MAPS > 65 mmHg
- Multimodal pain management
  - Meta analysis of > 4000 patients saw reduced incidence of PND during first post-op month in those receiving a supplemental block (neuraxial or regional)

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Here is my approach to the Geriatric Patient…

Broken up into the three phases:

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Preoperative phase: Stratify Risk = Frailty + Brain + Meds/Physiology

- Identify Geriatric patient
  - Age > 75 or > 65 with comorbidities
- Screen for Frailty
  - CFS or at least eye ball test (Slow gait, low muscle mass, poor posture, etc…)
- Brain Health Assessment
  - Pre-existing diagnosis, prior delirium
  - High risk features (dementia, CFS >5, prior delirium, polypharmacy, ETOH)
- Medication and physiology review
  - How many and what type drugs
- Shared Decision making and setting expectations
  - Functional recovery
  - Discuss anesthesia plan with patient and family/caregivers

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Intraoperative phase: Protect brain and maintain physiology

- Regional/neuraxial +/- sedation vs GA
- Decreased doses of all our drugs
- Monitor depth of anesthesia (despite equivocal evidence) and keep on lighter side, avoid deep anesthesia and burst suppression
- Strict hemodynamic parameters, MAPs > 65 or 10-20% of baseline
- Multimodal analgesia – Tylenol, Regional, low dose opioids sparingly
- Strongly consider dexmedetomidine
- Delerium Prevention Bundle:
  - Normoxia, Normocapnia, Normoglycemia, Normothermia, minimize anti-cholinergic
- While this is basic common sense, it is right that our most vulnerable patients need and deserve our very best care

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Postoperative Phase: Delerium is a medical condition

- **Agitation is delirium until proven otherwise**
- First line treatment is non-pharmacologic
  - Re-orient early and often
  - Ensure glasses and hearing aids
  - Treat pain appropriately
  - Protect sleep
  - Early mobilization
  - Remove lines/catheters
- Last Resort Medications
  - Low dose Haldol or anti-psychotics
  - Benzos only for ETOH withdrawal

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Thank you very much!

Questions????

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