

Evaluation of Risk Factors associated with Development of Catheter-associated Venous Thromboembolism in Pediatric ICU Patients

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Background

- Central venous lines (CVL) are a major risk factor for the development of Venous thromboembolisms (VTEs) in pedatric patients
- Other factors previously found to have increased risk of VTE in pediatric patients include age under 1 year, usage of mechanical ventilation, recent surgery, and a primary diagnosis category of an oncologic, cardiac, or hematologic cause
- Pediatric patients requiring an ICU level of care often have a necessity for a CVL such as a CVC, PICC, or hemodialysis catheter
- Identification of additional factors associated with a higher risk of developing catheter-associated VTE (CA-VTE) will aid in increased identification of patients at higher risk of developing CA-VTE, allowing for increased vigilance of clinical signs of VTE in these patients

Objective

To identify factors, if any, that increase a pediatric patient with a CVL's risk of developing a CA-VTE

Methods

- Retrospective chart review of all patients at the CHCO PICU from 1/1/2016 to 12/31/2020
- Patients included who had a PICC, CVC, or hemodialysis catheter placed by either the PICU or a CHCO surgical team during their PICU admission, and who had a radiology-reviewed ultrasound of the extremity with the CVL
- Ultrasound must have been performed between time of CVL placement up to three days after removal of the line
- Patients with multiple CVLs and assessment of multiple limbs for CA-VTE were treated as multiple cases, with each possible CA-VTE counting as one case
- VTE was determined by positive diagnosis on formal radiology read of ultrasound

Results

- Patient Population: 210 cases from 169 patients were found to meet study criteria
- Univariate analyses was run for factors related to the clinical characteristics of the study population, as well as characteristics of the CVL itself

Demographic Variable	No CA-VTE	CA-VTE
# Patients,	112	98
Age in years (range)	0.06-17.99	0.18-17.66
Weight, kg (range)	3.8-106.9	3.22-151.0
Male sex (%)	59.82%	50.0%
Race (%)		
White	45.54%	48.98%
Black or African American	1.79%	3.06%
Asian	3.57%	1.02%
Hispanic/Latino	24.11%	24.49%
Native Hawaiian or other Pacific Islander	1.79%	1.02%
American Indian or Alaska Native	2.68%	0%
Mixed/Other	10.71%	11.22%
Unspecified	9.82%	10.2%

Characteristic	CA-VTE			Univariate Analysis				
	No	Yes	Total	Relative Risk	95%	Sig	NNT (Harm)	Z stat
CVL Type								
	PICC	50	42	92	1.00			
	CVC	54	53	107	1.08	.81-1.46	5831	25.77
	Hemodialysis/plasmapheresis Catheter	8	3	11	.597	.22-1.61	3080	5.441
CVL Location								
	Femoral	48	47	95	1.00			
	UV	9	7	16	.8846	.49-1.6	6838	17.47
	Subclavian	4	3	7	.86	.36-2.08	.748	15.114
	Brachial	17	11	28	.794	.48-1.31	.3692	9.815
	Cephalic	2	4	6	1.35	.74-2.46	.3309	5.816
	Basilic	31	26	57	.922	.65-1.3	.6481	25.9
	Other	1	0	1				
Number of Lumens								
	1	17	13	30	.85	.55-1.32	.4661	13.03
	2	73	76	149	1.00			
	3	22	9	31	.569	.32-1.01	.0537	4.551
CVL Duration (days)								
	0-7	52	62	114	1.00			
	8-14	17	20	37	.994	.70-1.4	.972	301.28
	15-21	9	9	18	.919	.56-1.5	.737	22.8
	22 and up	7	34	41	1.53	1.22-1.89	.0001	3.504

Significant Findings

- The clinical characteristics of: primary diagnosis category of malignancy (RR 1.74, 95% CI 1.18-2.55), and primary diagnosis category of trauma (RR 1.47, 95% CI 1.01-2.15) caused a statistically significant increase in the risk of developing CA-VTE
- The CVL characteristic of CVL duration greater than 22 days was associated with a statistically significant increase (RR 1.53, 95% CI 1.22-1.89) in risk of development of CA-VTE.

Characteristic		CA-VTE			Univariate Analysis				
Gender		No	Yes	Total	RR	95% CI	Sig	NNT (Harm)	Z stat
	Female	45	49	94	1.23	0.93-1.65	P = 0.1521	10.12	1.432
	Male	67	49	116	1.00				
History of VTE									
	Yes	4	4	8	1.07	0.53-2.18	P = 0.8425	28.86	0.199
	No	108	94	202	1.00				
Surgery within 24 hrs of Line Placement									
	Yes	20	18	38	1.02	.70-1.48	P= 0.9233	116.71	.096
	No	92	80	172	1.00				
Primary Diagnosis Category									
	Malignancy	3	9	12	1.74	1.18-2.55	P= 0.0052	3.147	2.794
	Infection	28	22	50	1.02	0.69-1.48	P= 0.9255	128.26	0.093
	Trauma	8	14	22	1.47	1.01-2.15	P= 0.0446	4.898	2.008
	Hematologic	6	2	8	0.58	0.17-1.96	P = 0.3783	5.488	.881
	Other	67	51	118	1.00				
History of Congenital Heart Disease									
	Yes	15	16	31	1.13	.77-1.64	P= 0.5344	17.233	.621
	No	97	82	179	1.00				
Interventions within 24 hrs of CVL placement									
Transfusion (Any blood products)	Yes	61	41	102	0.76	.567-1.02	P = 0.0718	7.948	1.801
	No	51	57	108	1.00				
TPN	Yes	32	25	57	0.92	.656-1.29	P= 0.6247	25.955	.489
	No	80	73	153	1.00				
Use of Vasoactive Medications									
	Yes	68	54	122	0.89	.66-1.18	P= .4078	17.429	.828
	No	44	44	88	1.00				
Anticoagulation									
	Yes	45	35	80	0.90	0.67-1.23	P= 0.5113	21.224	.657
	No	67	63	130	1.00				
Mechanical Ventilation									
	Yes	98	86	184	1.01	.65-1.58	P= 0.9555	170.86	0.056
	No	14	12	26	1.00				
Plasmapheresis									
	Yes	8	8	16	1.08	.65-1.80	P= 0.7747	27.714	0.286
	No	104	90	194	1.00				
CVVHD									
	Yes	16	7	23	0.6254	.33-1.18	P= 0.1475	5.486	1.448
	No	96	91	187	1.00				

Conclusions

Placement of a central venous line (CVL) is a major risk factor for the development of VTE in children. Increased duration of catheter placement and primary conditions of oncologic and traumatic nature were found to have increased risk of Identifying additional risk factors that further increase this risk can aid in decreasing the rate of CA-VTE in critically ill children.

Future Plans

- This project is intended to continue with a plan for analysis of the measures of catheter-to-vein ratio (CVR) against catheter-to-vein difference (CVD) as predictors of the development of CA-VTE for pediatric patients, as CVR was developed as a predictor for adult patients, and CVD is a newer measure that has not been assessed as robustly as CVR.

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