STRONG CHILDREN'S RESEARCH CENTER

Summer Research Scholar

Name: Dev Dwivedi

School: Albany Medical College

Mentor: Dr. Justin Smith MD & Dr. Joseph Kuebler MD, MBA

ABSTRACT

Title: *A Quality Improvement Initiative in Central Venous Catheter and Anticoagulation Use to Reduce Venous Thromboembolism and Chylothorax in the Pediatric Cardiac ICU*

Background: Central venous catheters (CVCs) are placed in 86% of neonates and 72% of infants in the pediatric cardiac intensive care unit (CICU) and contribute to the majority of pediatric venous thromboembolic events (VTEs).[1, 2] CVCs can also increase risk for chylothorax, which can increase infection risks and delay enteral feeding.[3] With limited pediatric-specific guidelines for VTE prevention, this quality improvement initiative aimed to optimize CVC use and prophylactic anticoagulation practices to reduce CVC-associated thrombus and chylothorax in pediatric cardiac surgical patients ≤ 1 year of age by 25% by December 2024.

Methods: Pediatric cardiac intensive care unit patients <1 year of age undergoing congenital heart surgery from 1/1/2021 to 12/31/2024 were identified from the University of Rochester Medical Center Pediatric Cardiac Critical Care Consortium database. Plan-Do-Study-Act (PDSA) Cycle 1 (July 1, 2023) prioritized non-upper extremity CVCs. PDSA Cycle 2 (December 20, 2023) replaced risk-based enoxaparin with universal low-dose heparin (10 units/kg/hour) initiated within four hours of admission, following an October 2023 washout. The primary outcome measure was the rate of VTE with secondary outcome measures including rate of chylothorax and upper extremity VTE. Process measures were monitoring including central line location and type of anticoagulation. Balancing measures included were hematochezia or clinically significant bleeding as defined by the Bleeding Assessment Scale in critically Ill Children (BASIC).[4] A univariate analysis was performed for pre-intervention (Era 1) and post-intervention (Era 2) cohorts.

Results: Baseline clinical demographics and characteristics were similar between the pre- (n=230) and post-intervention (n=96) cohorts (p>0.05). Era 2 saw reduced upper extremity CVC count (1 [1–2] vs. 1 [1–1], p<0.001) and duration (6 [3.75–15] vs. 5 [3–7.25] days, p=0.041), increased non-upper CVC count (0 [0–1] vs. 1 [0–2], p=0.001) and duration (10 [4–23.75] vs. 16 [10.75–24.5] days, p=0.038), and no enoxaparin use (p<0.001). Rates of VTE (14.8% vs. 15.6%, p=0.846) and chylothorax (10.9% vs. 7.3%, p=0.322) remained unchanged. There was no increase in the balancing measures of hematochezia or clinically significant bleeding (p>0.05).

Conclusion: Implementation of this quality improvement utilizing low-dose heparin and minimizing upper extremity central lines did not VTE or chylothorax in this cohort despite strong compliance with the process measures. Future initiatives should explore adjunctive strategies such as periodic VTE ultrasound screening and standardized CVC removal protocols to further mitigate CVC-associated complications.

References:

1. DiPietro, Lisa M. MD1; Gaies, Michael MD, MPH2; Banerjee, Mousumi PhD3; Donohue, Janet E. MPH2; Zhang, Wenying MS3; DeSena, Holly C. MD1; Graham, Eric M. MD4; Sasaki, Jun MD5; Moga, Michael-Alice MD6; Prodhan, Parthak MBBS7; Goldstein, Stuart L. MD8; Tabbutt, Sarah MD, PhD9; Cooper, David S. MD, MPH1,8. Central Venous Catheter Utilization and Complications in the Pediatric Cardiac ICU: A Report From the Pediatric Cardiac Critical Care Consortium (PC4)*. Pediatric Critical Care Medicine 21(8):p 729-737, August 2020. | DOI: 10.1097/PCC.0000000000002306
2. Monagle P, Azzam M, Bercovitz R, Betensky M, Bhat R, Biss T, Branchford B, Brand√£o LR, Chan AKC, Faustino EVS, Jaffray J, Jones S, Kawtharany H, Kerlin BA, Kucine N, Kumar R, Male C, Pelland-Marcotte MC, Raffini L, Raulji C, Sartain SE, Takemoto CM, Tarango C, van Ommen CH, Velez MC, Vesely SK, Wiernikowski J, Williams S, Wilson HP, Woods G, Zia A, Mustafa RA. American Society of Hematology/International Society on Thrombosis and Haemostasis 2024 updated guidelines for treatment of venous thromboembolism in pediatric patients. Blood Adv. 2025 May 27;9(10):2587-2636. doi: 10.1182/bloodadvances.2024015328. PMID: 40423983.
3. Borasino S, Diaz F, El Masri K, Dabal RJ, Alten JA. Central venous lines are a risk factor for chylothorax in infants after cardiac surgery. World J Pediatr Congenit Heart Surg. 2014 Oct;5(4):522-6. doi: 10.1177/2150135114550723. PMID: 25324248.
4. Nellis ME, Tucci M, Lacroix J, Spinella PC, Haque KD, Stock A, Steiner ME, Faustino EVS, Zantek ND, Davis PJ, Stanworth SJ, Cholette JM, Parker RI, Demaret P, Kneyber MCJ, Russell RT, Stricker PA, Vogel AM, Willems A, Josephson CD, Luban NLC, Loftis LL, Leteurtre S, Stocker CF, Goobie SM, Karam O; Pediatric Acute Lung Injury and Sepsis Investigators (PALISI) Network; and the Pediatric Critical Care Blood Research Network (BloodNet). Bleeding Assessment Scale in Critically Ill Children (BASIC): Physician-Driven Diagnostic Criteria for Bleeding Severity. Crit Care Med. 2019 Dec;47(12):1766-1772. doi: 10.1097/CCM.0000000000004025. PMID: 31567407; PMCID: PMC6861687.