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Incidence and Risk Factors of Catheter-Related Deep Vein Thrombosis in a Pediatric Intensive Care Unit

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Abstract

Background: Central venous catheters (CVC) are essential in a critical care setting. Thrombosis is one of the very important associated complications that lead to increased morbidity and mortality.

Objectives: The aim is to find out the incidence of catheter related thrombosis in pediatric intensive care unit with the help of color Doppler sonography, its extent, risk factors and clinical impact

Methods: 70 patients admitted in the pediatric intensive care unit having central line inserted for more than 48 hours were included in this prospective study. Color Doppler Ultrasonography was performed on the 2nd and 7th days after CVL insertion and weekly until catheter removal. The size of the thrombus was noted. Presence of history of deep venous thrombosis, history of previous central line insertion, lumen number and the clinical probability of Well Deep score were noted.

Results: Thrombus was detected in 46 of 70 (65.70%) patients. The incidence in males was 79.3% and in females was 20.7%. Males had a significantly higher incidence of thrombus (p=0.013), with Doppler at day 2 Well Deep score and history of previous DVT were more significant associated findings. With day 7 Doppler pitting edema, positive CRP, increased platelet count and positive blood culture were associated with increased risk. Weekly Doppler showed significant risk with immobilization, positive blood and CVL tip culture and previous DVT.

Conclusion: CVC-related thrombosis is common and has the potential for serious complications. The presence of positive history of previous DVT and presence of CVL infection were the most associated risk factor for the development of catheter related thrombosis. Color Doppler sonography provides an easily available, noninvasive means of detecting a thrombus. More studies are needed to establish a consensus for prophylaxis and treatment of asymptomatic CVC-related thrombosis.

Keywords: Central Venous Catheters (CVC); Thrombosis; Pediatric intensive care unit

Introduction

Venous Thrombosis (VT) is a frequent complication in infants with Central Venous Catheters (CVCs). We perform this study to identify risk factors, to put risk-reduction strategies of CVC-associated thrombosis in infants, and to characterize sonographically detected thrombi in the critical care settings [1]. Anticipation of the risk of CVC-related thrombosis and the identification of certain high-risk patients, who are prone to develop thrombosis and secondary complications, is essential to initiate early preventive measurements such as prophylactic anticoagulation. The need for anticoagulant prophylaxis is however still a subject of discussion. Finally, for the treatment of established CVC-related thrombosis, several therapeutic options were evaluated in literature. General recommendations of anticoagulant treatment and whether CVC removal is necessary or not, is warranted [2]. Asymptomatic CVC-related thrombosis is common in critically ill children. This study was done to characterize risk factors for central venous catheter (CVC)-related deep vein thrombosis (DVT) in a pediatric intensive care unit and to determine the current incidence and acute complications of asymptomatic central venous catheter (CVC)-related venous thrombosis in a pediatric intensive care unit.

Patient and Methods

Patients admitted to a pediatric intensive care unit (70) at Abo El Reesh hospital, Faculty of medicine, Cairo University included in this prospective study. Doppler ultrasonography of the catheterized veins at days 2 and 7 after insertion and weekly thereafter until CVC removal no exclusion criteria.

An informed consent was obtained from all patients-the guardians-before in the study as no interventional process was done and there was no perceived risk. The aim and nature of the study will be explained for each parent before inclusion. All the human studies have been approved by the Ethics Committee of

the Cairo University Hospital. Clinical data of the patients were collected including: patient age, sex, diagnosis upon admission, days of hospitalization, admission Pediatric Risk of Mortality score (PRISM III). Outcomes (mortality, duration of mechanical ventilation, and PICU length of stay), Well Deep score, system organ assessment, complete blood count, coagulation profile-reactive protein and serum electrolytes

The catheters were introduced by experienced pediatric ICU specialist or by an anesthesiologist for post-surgical cases under complete aseptic conditions. CVC insertion location, the number and types of catheters inserted (triple lumen, double-lumen catheter).

Doppler ultrasonography was performed by the same single sonographer of the catheterized vein at days 2 and 7 after insertion and weekly thereafter until CVC removal. Data were documented and sonographic images were reviewed by one independent radiologist. When a visible intraluminal thrombus was identified, several of its characteristics were evaluated to determine its relative age.

A more direct approach to the diagnosis of catheter thrombosis involves use of compression ultrasonography [3] made by the findings such as abnormal compressibility of the vein, abnormal Doppler color flow the presence of an echogenic band. The chronicity of the thrombus may be inferred from the echogenicity of the clot because older clots appear more echo-dense.

Statistical Analysis

Pre-coded data was entered into the Statistical Package of Social Science Software program, version 21 (SPSS) to be statistically analyzed. Data was summarized using range, mean, standard deviation and median for quantitative variables and frequency and percentage for qualitative ones. Comparison between groups was performed using independent sample t-test or Mann Whitney test for quantitative variables and Chi square test for qualitative ones. Backward stepwise regression models were conducted to explore the significant predictors of thrombosis at different time measures. Kaplan Meier survival analysis was performed to represent the incidence rate of thrombi. p values less than 0.05 were considered statistically significant.

Results

Demographic characteristics of the total study population. The mean age was 26.7 ± 34.7 months, 43(61.4%) males and 27(38.6%) females. The most common admission diagnosis was neurological disease (28.6%) followed by respiratory failure (17.2%). Mean ± SD. Pediatric Risk of Mortality and WELL scores were 18.6 ± 10.6 and 51.8 ± 25.3, respectively. PICU mortality was 41.4% (29 of 70).

The catheter size ranged (4-5.5 mm).The number of veins involved was usually (1 to 3). 29 (41.4%) case had CVC infection, history of previous CVC insertion and previous DVT was positive in 18(25.7%), 26(37.1%) respectively. Although most children had only one catheter in place for the duration of therapy, some patients had as many as four separate CVCs. **Table 1** describes the characteristics of the catheters used in the study.

Table 1: Catheter related factors associated with CRT.

Various risk factors associated with CRT	Patients n=70
Catheter size	5 ± 0.4 ,5(4-5.5)
Insertion site	
Internal jagular Right Left Subclavian Femoral Right Left	61 (87%) 32 (45.7%) 29 (41.4%) 1 (1.5%) 8 (11.4) 3 5
CVP line infection	29 (41.4%)
Lumen number	
Double lumen Triple lumen	34 (48.6%) 36 (51.4%)
Previous CVC insertion	18 (25.7%)
Previous DVT	26 (37.1%)
Catheter tip location	
SVC RA Right ventricle	31 (44%) 20 (28.5%) 19 (27.5%)

Out of 70 patients, CRT was detected in 46 patients 22 patients on 2 days of CVL insertion and in 12 patients within 7 days of CVL insertion while 12 patients were diagnosed beyond 14 days of CVL insertion.

The incidence of catheter related thrombosis at day 2, 7 and weekly (new cases)was 31,25 and 25% respectively.

Day 2: There was positive Doppler in (22/70) symptomatic in (6/22) and asymptomatic in (16/22). There was significant difference with Well Deep score (p:0.023), history of previous thrombosis (p:0.001), double lumen (p:0.021) also was significant with thrombosis at day 7.

Backward stepwise regression analysis with Doppler findings at day 2 only Immobilization and Previous DVT were the significant predictors ($p<0.05$) (odds ratio=3.340, 95% confidence intervals =1.094-10.191; p=0.034) for immobilization and (odds ratio=7.754, 95%; Confidence intervals=1.961-30.655; p=0.034) for previous DVT.

Day 7: Positive in (26/70), symptomatic in (10/26) and asymptomatic (16/26) there was significant difference with pitting edema (p:0.060), positive CRP (p:0.010), positive blood culture (p:0.025) and history of previous thrombosis (p:0.040).

Weekly Doppler: Positive in (29/70), symptomatic in (11/29), asymptomatic in (18/29), significant difference with immobilization (p:0.048), pitting edema (p:0.046), positive blood culture (26/29)(p:0.003), previous central line insertion at the same place (p:0.049) and previous thrombosis (p:0.012).

Backward stepwise regression analysis to predict thrombosis at day 7 and weekly, among (+VE culture, +VE CRP and +VE CVP line infection), concluded that only presence of CVP line infection was the significant predictor. (odds ratio=3.815, 95% confidence intervals=1.37-10.598; p=0.010).

Discussion

The total incidence of CRT by Color Doppler Ultrasound imaging done at day 2,7 and weekly was (31.4%), (25%) and (25%) respectively, With the highest rate on day 2 and decrease afterward. this in agreement with a study done by Kamphuisen and Lee [4].

In our study the incidence of asymptomatic thrombosis at day 2, 7 and weekly was 72.7, 61.6 and 62% respectively while the symptomatic thrombosis was 27.3, 38.4 and 38% respectively and this was in agreement with previous studies stated that The incidence of asymptomatic CVL-related VTE is estimated at 66 percent of all children with a CVL and up to 40 percent of general hospital patients [5].

In our study, the incidence of internal jugular vein thrombosis ranged from 31 to 42% while the femoral vein thrombosis varies from 23 to 30.5%, and the subclavian 1.4%. In a study by Kujur et al. [6] showed near incidence. The incidence of catheter-related thrombosis in right-sided IJV catheter to be 33.0%.and this was consistent with our results.

The multi- lumen catheter was significantly associated with thrombosis and this was in agreement with Rooden et al. [7] published data who concluded that multi-lumen CVCs had higher DVT rates than did single-lumen CVLs, and this was contrary to Malinoski et al. study in which higher lumen number didn't reach statistical significance [8].

In our study the history of previous thrombosis is one of the most significant factors for thrombosis in CVL to occur and this was similar to a study done by Saber et al. [9] and Setty et al. [10].

History of previous CVL insertion was a strong predictor of catheter related thrombosis in our study and this was described by Rooden et al. [7]. The placement of another CVC again puts patients at risk for related complications, which include another DVT, infection, and mechanical and insertion complications.

High platelet count at time of CVL insertion was associated with thrombosis in this study which was a similar finding in a study done by Jonas et al. [11] and this was in contrast to a study done by Tesselaar et al. [12] who concluded that Platelet counts were not associated with the development of catheter-related thrombosis [13-15].

Conclusion

The presence of immobilization was one of the most important predictor of thrombosis in this study and this goes in line with Howard et al. Pitting edema was also an important predictor of thrombosis as we noticed in our study and it goes with the study done by James et al. and Malinoski et al.

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