

Comparison of Central Venous Catheter Related Deep Venous Thrombosis According to Insertion Site in An Intensive Care Unit of Bangladesh

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Abstract

Introduction: Central venous catheter (CVC) is usually inserted into subclavian, internal jugular, or femoral vein in critically ill patients. CVCs are associated with intravascular (infectious, thrombotic) and mechanical complications. CVC related deep venous thrombosis (DVT) is a common intravascular complication. The study was done to see the variation in occurrence of CVC related deep venous thrombosis according to different insertion site.

Methods: It was a prospective observational study conducted in dept. of Critical Care Medicine, BIRDEM General Hospital; during a period of May, 2016 to July, 2019. Purposive sampling was conducted in patients fulfilling the selection criteria. The CVCs were percutaneously inserted using the Seldinger technique with standard operating procedure. After CVC insertion, patients were followed up daily to see any sign of deep venous thrombosis. After catheter removal [due to any cause including suspected catheter related blood stream infection (CRBSI), DVT, mechanical cause], all the study patients were investigated by duplex ultrasonography (USG) within 2 days for detection of venous thrombosis. The outcome was catheter related deep venous thrombosis (DVT).

Results: A total 349 patients, of which 167 (47.9%) patients had CVC in subclavian, 88 (25.2%) in internal jugular and 94 (26.9%) in femoral vein. Total 12 patients were suspected to have catheter related DVT, but 11 (3.2%) patients were confirmed as DVT by duplex USG. DVT occurred significantly higher in femoral catheter site (8.5%) than subclavian (1.8%) and internal jugular site (0%).

Conclusion: The occurrence of catheter related DVT was higher in femoral site than other two sites.

Keywords: CVC, Catheter related DVT, ICU

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Introduction:

Central venous catheter (CVC), also known as central line, or central venous access catheter, is a catheter placed into a large vein (subclavian, internal jugular, femoral vein). It is used to administer medications or fluids, obtain blood for tests and measure central venous pressure (in case of subclavian or internal jugular site). Central venous catheterizations are now common among critically ill patients.

Catheterization is associated with infectious, thrombotic, and mechanical complications.¹ These complications can widely be categorized into intravascular [includes catheter related blood stream infection (CRBSI), catheter tip colonization, catheter related deep vein thrombosis (DVT)] and mechanical (includes haemorrhage, haemothorax, pneumothorax, cardiac perforation, lost guidewire, catheter tip malposition etc).

The CVC related deep vein thrombosis (DVT) is an important intravascular complication which also has significant impact on morbidity and mortality. Thrombosis resulting from vascular catheter is of two types: fibrin sleeve (thrombin sheath) and vascular occlusive thrombosis (partial or total occlusion by mural thrombi). Most of the indwelling vascular catheters become engulfed in a thrombin sheath soon after insertion.² Clinically, catheter related DVT is classified into symptomatic and asymptomatic. Although the importance of catheter related DVT has been debated¹, all thromboses have the potential to embolize³.

In numerous studies, the incidence of CVC related thrombosis has been evaluated. The percentage of clinically manifest thrombosis in these studies ranged from 0% to 12%⁴. The role of the puncture-site of CVC insertion is still much debated in development of thrombosis. In a randomized trial (level 1) in ICU patients, insertion via the subclavian route had a low risk of major catheter related thrombosis as compared to a femoral route (0% vs. 6%)⁵. Timsit et al. (1998) found the occurrence of catheter related thrombosis in a cohort (level 2) study in patients with subclavian vein CVCs as compared with jugular CVCs (10.5% vs. 41.7%). In both studies patients were routinely screened by ultrasound for CVC related thrombosis. The occurrence of symptomatic deep vein thrombosis was found higher in femoral catheter site in comparison to internal jugular or subclavian sites³. Additional factors reported to increase the risk of thrombosis are percutaneous insertion procedure, prior CVC at the same puncture site and a prolonged stay of the CVC for over 2 weeks⁴.

The CVC related thrombosis have been reported to be associated with infective colonization of catheter tip. In a study in 265 critically ill patients, the risk of infection and sepsis was 2.6 fold increased in patients with catheter related thrombosis⁶. In addition, CVC related infection may also increase the risk of subsequent clinically manifest thrombosis. In a study, CVC related infection increased the risk of thrombosis markedly in comparison with those without infection (24% vs 3%) (relative risk 17.6)⁴.

The aim of this present study was to detect the insertion site wise occurrence of catheter related DVT

Methods:

This prospective observational study was done during the period of May 2016 to July 2019 in Department of Critical Care Medicine, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) General Hospital, Dhaka. A total of 349 adult patients (age ≥ 18 years) requiring new CVC insertion for fluid management, medications, inotrope support and monitoring were enrolled in the study. Antibiotic coated CVC, tunneled catheters, implantable devices, radiologically inserted catheters, dialysis catheters were excluded. CVC insertion was performed only after getting informed written consent from patient or his/her relative, when the platelet count was more than 50000/cumm and the international normalized ratio was less than 1.5, as per ICU protocol. All catheterizations were performed either by an ICU consultant, registrar or a medical officer (with a minimum prior experience of at least 25 CVC insertions under the supervision of a consultant). Insertion site selection was individualized by the treating physician. After CVC insertion, all the patients were followed up daily for any sign of catheter related DVT (pain, swelling, redness and tenderness of the affected limb). Removal of CVC was done when appropriate [development of catheter related blood stream infection (CRBSI), or DVT or no longer required]. All the information about the patient were collected by a structured data sheet and analysed by statistical package for the social sciences (SPSS) version 22.

Result:

During the study period, 167 CVC were inserted through subclavian vein, 88 CVC through internal jugular vein and 94 CVC through femoral vein. There was no significant difference among three groups (subclavian / internal jugular / femoral) in terms of age, gender distribution, presence of co-morbid illness (Table I). Though most patients had more than one diagnosis during their admission, the primary cause/diagnosis was recorded. Table II showed the primary diagnosis of the study subjects at admission. The highest on-admission diagnosis was pneumonia (22.6%), followed by AKI (20.9%), stroke (9.7%) and acute pulmonary edema (4.9%). Table III showed 12 patients were suspected to have DVT clinically, but 11 were confirmed by duplex USG; where the occurrence is significantly more in femoral than other two sites (p value = 0.002)

Table I
Age, gender and co-morbidities of the study subjects (n=349)

	Site			Total (n=349)	p value
	Subclavian (n=167)	Internal jugular (n=88)	Femoral (n=94)		
Age (years)	60.63±16.06	63.00±14.38	61.89±12.91	61.57±14.84	0.468 ^{##}
Gender					
Male	99 (59.3)	46 (52.3)	55 (58.5)	200 (57.3)	0.540 [#]
Female	68 (40.7)	42 (47.7)	39 (41.5)	149 (42.7)	
Co-morbidities					
DM	121 (96.8)	65 (97.0)	80 (97.6)	266 (97.1)	0.950 [#]
HTN	98 (94.2)	50 (84.7)	60 (90.9)	208 (90.8)	0.131 [#]
IHD	16 (40.0)	12 (40.0)	8 (26.7)	36 (36.0)	0.444 [#]
Others	13 (40.6)	13 (50.0)	14 (46.7)	40 (45.5)	0.765 [#]

^{##}ANOVA test was done to measure the level of significance

[#]Chi-square test was done to measure the level of significance

Table II
Primary diagnosis during ICU admission of the study subjects (n=349)

Primary diagnosis	Frequency	Percentage
Pneumonia	79	22.6
Acute Kidney Injury	73	20.9
Stroke	34	9.7
Acute Pulmonary Edema/LVF	17	4.9
Myocardial Infarction	16	4.6
Diabetic Ketoacidosis	13	3.7
Severe hyponatremia	12	3.4
Urosepsis	11	3.2
Meningitis	9	2.6
Hypoglycemia	8	2.3
Hyperglycemic Hyperosmolar State	7	2.0
Others	79	22.6
Total	349	100.0

Table III
Catheter related DVT of the study subjects (n=349)

	Site			Total (n=349)	p- value
	Subclavian (n=167)	Internal jugular (n=88)	Femoral (n=94)		
Signs of catheter related thrombosis	3 (1.8)	1 (1.1)	8 (8.5)	12 (3.4)	0.007
Catheter related DVT	3 (31.8)	0 (0.0)	8 (8.5)	11 (3.2)	0.002

Chi-square test was done to measure the level of significance

Table IV
Duration of CV catheter and associated DVT of the study subjects (n=349)

	Site			Total (n=94)	p value
	Subclavian (n=167)	Internal jugular (n=88)	Femoral (n=27)		
Duration of CV catheter	7.3 ± 5.1	7.1 ± 3.9	6.4 ± 3.1	7.1 ± 4.3	0.158 ^{##}
Duration of CVC					
≤10 days	134 (80.2)	67 (76.1)	80 (85.1)	281 (80.5)	0.309 [#]
> 10 days	33 (19.8)	21 (23.9)	14 (14.9)	68 (19.5)	
Catheter related DVT					
≤10 days	2 (1.5)	0 (0.0)	8 (10.0)	10 (3.6)	0.001 [#]
>10 days	1 (3.0)	0 (0.0)	0 (0.0)	1 (1.5)	0.584 [#]
p value	0.551		0.216	0.377	

^{##}ANOVA test was done to measure the level of significance

[#]Chi-square test was done to measure the level of significance

Discussion:

Complications associated with CVC have a major impact on the hospital course of patients admitted to ICU due to the morbidity, mortality and increased health care costs associated with them.

The overall incidence of catheter related DVT in this study was 3.2% which was within the range (0% to 12%) as occurred in different studies⁴. In this study, the incidence of catheter related DVT in femoral site was 8.5%, subclavian site was 1.8% and internal jugular site 0%; and the occurrence is significantly greater in femoral site (p=0.002). This study produced similar findings as published by others^{3,5}. It was found that femoral catheterization was associated with overall thrombotic complications in comparison to subclavian vein catheterization (p < 0.001). In a study, the researchers found that the occurrence of symptomatic DVT in subclavian catheters was 0.5%, in internal jugular catheters was 0.9%, in femoral catheters was 1.4%⁵. In this study, the higher occurrence of catheter related DVT in femoral site might be explained by reduced lower limb movement than other body parts causing venous stasis. Moreover, increased thrombogenicity due to microbial colonization might be a cause^{7,8}.

Incidence of catheter related DVT varies with catheter composition, indication of catheterization (total parenteral nutrition, haemodialysis, cancer or ICU patient), fluids infused (chemotherapy, lipids or heparin), and diagnostic method for thrombosis⁶. In this study, we tried to eliminate these factors. We used only non-tunnelled multi-lumen CVC for all patients. We didn't include haemodialysis catheter or CVC used for total parenteral nutrition, chemotherapy in this study. Routine 0.9% sodium chloride and heparin flush were administered in all CV catheterized

patients according to our ICU protocol. We confirmed catheter related DVT by USG study, which was also used for venous thrombosis detection by Timsit et al. (1998), Merrer et al. (2001) and Parienti et al. (2015)^{3,4,5}. Prolonged duration of catheter (> 10 days) did not impact on the occurrence of DVT in different insertion sites (Table IV) though prolonged stay of the CVC for over 2 weeks was a risk factor in some studies⁸.

Conclusion: CVC associated DVT occurrence were higher in femoral than other two sites.

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