

The incidence of deep venous thrombosis in high-risk Indian neurosurgical patients: Need for early chemoprophylaxis?

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Abstract

Introduction: Deep venous thrombosis (DVT) is thought to be less common in Asians than in Caucasian population. The incidence of DVT in high-risk groups, especially the neurosurgical (NS) patients, has not been well studied. This leaves no firm basis for the start of early prophylactic anticoagulation within first 5 postoperative days in Indian NS patients. This is a prospective observational study to determine the early occurrence of DVT in the NS patients. **Patients and Methods:** We screened 137 consecutive high-risk NS patients based on inclusion and exclusion criteria. The femoral veins were screened using Doppler ultrasound on day 1, 3, and 5 of admission into the NS Intensive Care Unit (ICU) at tertiary center from South India. **Results:** Among 2887 admissions to NICU 147 patients met inclusion criteria. One hundred thirty seven were screened for DVT. There was a 4.3% (6/137) incidence of DVT with none of the six patients having signs or symptoms of pulmonary embolism. Among the risk factors studied, there was a significant association with femoral catheterization and a probable association with weakness/paraparesis/paraplegia. The mortality in the study group was 10.8% with none attributable to DVT or pulmonary embolism. **Conclusion:** There is a low incidence of DVT among the high risk neurosurgical population evaluated within the first 5 days of admission to NICU, limiting the need for early chemical thrombo-prophylaxis in these patients. With strict protocols for mechanical prophylaxis with passive leg exercise, early mobilization and serial femoral Doppler screening, heparin anticoagulation can be restricted within the first 5 days of ICU admission in high risk patients.

Keywords: Deep vein thrombosis, duplex ultrasonography, heparin, high-risk neurosurgical patients, mechanical prophylaxis

Access this article online

Website: www.ijccm.org

DOI: 10.4103/0972-5229.186223

Quick Response Code:



Introduction

Deep venous thrombosis (DVT) is a common and potentially life-threatening condition when it results in pulmonary embolism (PE). The combining entity, venous thromboembolism (VTE), is a leading cause of medical morbidity and mortality.^[1-3] It continued to be underdiagnosed and undertreated among Indians.^[4] The incidence of DVT has been thought to be lower in the

Asian population. Contrary to this belief, the incidence of DVT in Asia and India is comparable to that in Western countries.^[4] There are no reliable data from India concerning incidence of DVT among neurosurgical (NS) patients while among general surgical and orthopedic surgery cohorts, it has varied from 2.3% to 28% with

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How to cite this article: George AJ, Nair S, Karthic JC, Joseph M. The incidence of deep venous thrombosis in high-risk Indian neurosurgical patients: Need for early chemoprophylaxis?. *Indian J Crit Care Med* 2016;20:412-6.

nonuniform techniques and periods of observation.^[5] The risk of DVT is especially high in hospitalized patients but remains underdiagnosed due to being asymptomatic clinically. In the USA, thromboembolism represents the third most common cause of death after myocardial infarction and stroke.^[2]

NS patients are at a higher risk for DVT compared with other surgical and medical patient populations^[6] but often have contraindications for anticoagulation prophylaxis.^[7] Mechanical prophylaxis with pneumatic compression stockings is used for all high-risk NS patients in the Intensive Care Unit (ICU). Nevertheless, there are reports of DVT despite the use of stockings, making prophylactic heparin therapy desirable.^[8] Both unfractionated and low-molecular-weight heparin reduce the incidence of DVT consistently by 40–50% in NS patients but with an increased risk of intracranial bleeding.^[8] In spite of guidelines like the National Institute for Health and Clinical Excellence and the American College of Chest Physicians on VTE prophylaxis, there has been no consensus among the neurosurgeons and spinal surgeons on initiation of chemoprophylaxis.^[2] We undertook this study to assess the need for early chemoprophylaxis against DVT, especially in the first 5 days of the postoperative period in the Indian NS patients.

Patients and Methods

From October 2011 to September 2013, consecutive high-risk NS patients admitted into the NS ICU of our institution, a tertiary care center from South India, were screened for DVT. All the patients received passive leg exercises every two hourly and early mobilization Along with mechanical prophylaxis.

Included were those patients following elective postoperative neurosurgery and neurotrauma Who either underwent surgical or conservative management.

We used lower limb duplex ultrasonography as the screening tool which is a cost-effective, noninvasive, and simple technique with a high sensitivity and specificity for detecting DVT.^[6]

Ultrasound (USG) Doppler (Sonosite Micromaxx USG; Doppler USG with 13-6 MHz probe) examination of the femoral veins was performed by doctors who were trained in the use of Doppler on day 1, 3, and 5 of admission into the ICU as majority of DVT occurred within the 1st week after an NS procedure.^[3] Parameters

of augmentation, color flow, and compressibility were used for screening which have been shown to have a high positive predictive value.^[9,10]

The inclusion criteria were as follows:

- Prolonged immobilization for ≥ 12 h postadmission to ICU (nonambulant or sedated or paralyzed)
- Prone position of any duration in theater or in the ICU
- Femoral venous catheter placement of any duration
- Lower limb fracture
- Low sensorium defined as Richmond Agitation Sedation Scale – 4/–5 ≥ 12 h
- Ventilation ≥ 12 h.

Those excluded from the analysis were as follows:

- Children (≤ 15 years of age)
- Those with heparin initiated within the first 5 days of admission
- Those with preoperative diagnosis of DVT or systemic malignancy, history of oral contraceptive use
- Those with a prolonged period of lower limb weakness prior to ICU admission.

Statistical analysis

We used Microsoft Excel 07, Access 07, and SPSS version 15 (Chicago). The *t*-test was used for continuous covariates and Chi-square test for categorical variables.

Results

Two thousand eight hundred and eighty-seven patients were admitted in the Neuro ICU during the study period of which 143 patients were screened for DVT. One hundred and thirty-seven patients were included in the study. Four patients who received heparin as chemoprophylaxis for DVT prevention were excluded from the study. Two patients did not consent to participate.

A male predominance (102 [74%]) was observed with the mean age of 41.7 years. The case mix of the study cohort is shown in Table 1.

Table 1: Case mix of patients screened for deep venous thrombosis

Case mix	Number	Percentage
Traumatic head injury	88	64.2
Spinal surgeries	25	18.2
Nontraumatic cranial surgeries	21	15.3
Nonsurgical interventions	3	2.2

Table 2: Risk factor variables in deep venous thrombosis and nondeep venous thrombosis patients

	Variables (%)					
	Weakness	Prolonged immobilization	Femoral catheterization	Lower limb fracture	Invasive ventilation	Prone position
With DVT (n=6)	2 (33)	4 (66)	2 (33)	0	4 (66)	1 (1.7)
Without DVT (n=131)	28 (21)	96 (72)	9 (6.8)	12 (9)	95 (72)	33 (25)
P	0.289	1.000	0.051	1.000	1.000	1.000

DVT: Deep venous thrombosis

The incidence of DVT among the high-risk NS population within the first 5 days was 4.3% (6/137). Analysis for clinically important risk factors shown in Table 2 had a significant association with femoral central catheterization ($P = 0.05$) and a probable association with weakness/paraparesis/paraplegia ($P = 0.289$). The covariates for femoral catheterization when analyzed could not yield strong correlation due to few numbers [Table 3]. However, femoral cannulation on the weak limb or when associated with immobility had a high chance of developing DVT.

The six patients with neurotrauma who screened positive for DVT were not given heparin based on the presence of intracranial hemorrhage within the first 5 days of admission. They had no signs and symptoms of clinically significant PE. Two of the patients (33%) had asymptomatic DVT diagnosed only on routine screening. Among the 137 patients without use of heparin, there were 15 (10.8%) deaths, of which 11 (73.3%) suffered brain death from head trauma, 2 (13.3%) died after elective surgery, 1 (6.6%) patient from intracranial complications of trauma surgery, and the other (6.6%) from sepsis. None of the patients among those who died had DVT or clinical suspicion of PE. Twenty-one patients (15.2%) were discharged on request and against medical advice, with a poor prognosis and/or from devastating economic constraints. These data were included in the analysis irrespective of the early date of discharge.

Discussion

Postoperative NS patients are traditionally considered at high risk for developing DVT by virtue of their illness and prolonged immobility. Anticoagulation for chemoprophylaxis runs the risk of bleeding which could be catastrophic in this group. Hence, neurosurgeons are reluctant to commence prophylaxis, especially in the first 5 days of postoperative period.

In a retrospective analysis of 1277 NS patients in Western population, the lower limb venous duplex ultrasonography (VDUS) was found to be an effective tool in detecting venous thrombi.^[6,11] Patel *et al.* diagnosed 83% of DVT cases in the 1st week, thereafter the

Table 3: Femoral catheterization with covariates

	Femoral catheterization, 11 (7.9), n (%)	
	Risk factors	DVT
Weakness/paraparesis/paraplegia	1 (9)	1 (9)
Immobilization	9 (81)	2 (18)
Lower limb fracture	Nil	Nil
Invasive ventilation	2 (18)	2 (18)
Prone position	Nil	Nil

incidence reduced to 14% over 2 weeks.^[6] In the absence of thromboprophylaxis, there is a high incidence of DVT and its complications among the NS population.^[12] Routine weekly VDUS in nonambulatory NS patients yielded an incidence of 23.1% despite routine use of mechanical prophylaxis and chemoprophylaxis in 40% of cases.^[13]

With only mechanical prophylaxis in routine use, we anticipated the incidence of DVT to be high in our population during the first 5 days of observation. The surgeons resorted to unfractionated heparin for chemoprophylaxis using clinical judgment balancing the risks of thromboembolism with those of bleeding. With this strategy, the incidence of DVT among the high-risk NS population within the first 5 days of admission into the ICU was only 4.3%. The reported incidences in the literature for similar cohorts have varied from 2.8% to 43%.^[13,14] Higher incidences have been reported in spinal cord injury (SCI) patients. Chung *et al.* recorded DVT in 16 of 37 patients while on mechanical prophylaxis only, prompting them to recommend anticoagulation in all SCI patients unless there was ongoing bleeding or severe coagulopathy.^[14]

O'Connell *et al.* in their meta-analysis on the efficacy of compression devices in high-risk orthopedic and NS SCI patients found that a standardized process of application was lacking leading to high incidence of DVT despite their use. Therefore, they recommended both mechanical and chemical prophylaxis in such high-risk groups.^[15] In our study, the spinal pathology constituted 18.8% of the population. The low incidence of DVT therefore stands out despite a considerable number of SCI patients.

The death rate within first 5 days of admission was 10.8% and mostly due to traumatic brain injury and none with a DVT or features of PE. Risk factor having a significant causation to DVT in this study was femoral catheterization confounding with prolonged invasive ventilation and immobilization. There were 11 cases in total to have a femoral catheter with an average duration of 72 h *in situ*. As per protocol, femoral catheters were either removed at the earliest or changed after 5 days. Wang *et al.* evaluated the risk factors for 30 day perioperative DVT in a vast population of orthopedic cases.^[16] They found previous DVT, urinary tract infection, and creatinine >2.0 mg/dl to be important risk factors. When emergent and elective cases were stratified, number of transfusions, blood loss >2 L, deep wound infections (for emergent), and coronary artery disease and atrial fibrillation (for elective) predicted the development of postoperative DVT.^[16]

The risk of postoperative DVT in general surgical and orthopedic cohorts varies from 2.3% to 60% in the Indian population. Such data are lacking for NS group. Part of this variability is to do with the different screening methodology and the diverse population at risk, spread over three decades.^[5] Moreover, various studies have used different definitions for a clinically relevant DVT.^[17]

The low incidence of DVT within the first 5 days, in our study, is likely a result of early mobilization, early initiation of mechanical prophylaxis, and an increased awareness of DVT among the hospital staff. As the study progressed, there was an increasing input and added interest among the team members toward prevention of lower limb DVT. Active participation of family members after educating on hand hygiene and proper maneuvers yielded high dividends. The role of graduated compression stockings (GCS) is debatable.

In the stroke patients, Clots in Legs Or sTockings after Stroke trial established the futility of GCS while increasing skin complications.^[18]

Intermittent pneumatic compression (IPC) devices too are not very effective as shown in the randomized controlled trial by Vignon *et al.* for sepsis group in ICU. The group with IPC and GCS had an incidence of 5.6% DVT within 6 days as compared to 9.2% in the group with GCS alone.^[19]

The reports on bleeding related to anticoagulation have been far from consistent. Christie *et al.* reported no bleeding-related complications with the use of low molecular weight heparin,^[12] but there have also been

data showing major intracranial hemorrhage following craniotomy occurring in 1–3.9% of patients, increasing to 10.9% after the initiation of heparin.^[8] Therefore, neurosurgeons must balance the risk of PE against the increased risk of postoperative intracranial hemorrhage from early prophylactic heparin.^[2,8] Prophylaxis against DVT in NS cohort is mostly with unfractionated heparin, considering its ease of use, availability, and measurement of the level of anticoagulation. However, the administration of heparin is not standardized, and the timing and dose of prophylactic anticoagulation are made based on a clinical assessment of the risk of bleeding and the benefit of avoiding a DVT.^[20] There is a trend toward homogenization of anticoagulation with spinal surgery rather than with intracranial procedures.^[20]

It appears feasible to avoid heparin in a large number of patients within the first 5 days of ICU admission with the strategies mentioned above. A study of the incidence of DVT provides a measure of the problem and is a first step in establishing and standardizing protocols for prophylaxis.

Conclusions

A low incidence of DVT in this prospective study of high-risk NS population could be a result of early ambulation, initiation of passive limb exercises, and possibly a lower propensity to thrombosis in the population. There was a modest increase in femoral central catheter-associated DVT. Avoidance of femoral central lines could decrease the incidence further. With strict protocols for mechanical prophylaxis, early mobilization, and serial femoral Doppler screening, heparin anticoagulation can be restricted within the first 5 days of ICU admission in high-risk patients.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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