Deep vein thrombosis in a neurosurgical intensive care: An institutional experience

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ABSTRACT

Aim: The aim of the following study is to study the incidence, clinical presentations, risk factors and management modalities in deep vein thrombosis (DVT) affecting patients undergoing cranial or spinal surgery in neurosurgical intensive care unit (ICU). **Materials and Methods:** Retrospective review of patients who developed DVT in the course of prolonged ICU stay (>7 days), following cranial or spinal surgery between September 2009 and November 2011. **Results:** A total of 260 patients were reviewed in the study period between September 2009 and November 2011. Eight patients (3.7%) were diagnosed with DVT by color Doppler during this period. The average age of the group was 47 years (range 36-70 years). 3 patients had DVT limited to the popliteal vein, 2 patients had an extension to the femoral vein and in 3 patients to the common iliac vein. Risk factors associated with DVT seen in our series included poor neurological status with immobilization in 2 patients, delayed ambulation in 3 patients, surgery in the prone position in 3 patients and old age in 1 patient. **Conclusion:** Prolong intraoperative time; post-operative long immobilization and old age are significant contributory risk factor for DVT. However, this complication can be averted by prophylactic measures like compression stockings and intermittent compression devices used in conjunction with low molecular weight heparin and low-dose unfractionated heparin.

Key words: Deep vein thrombosis, heparin, intracranial hematoma, neurosurgical intensive care, thromboembolism

INTRODUCTION

Deep vein thrombosis (DVT) is a common occult/overt complication occurring in 15-30% of patients undergoing general surgery without DVT prophylaxis.[1] Patients undergoing cranial or spinal surgeries are at risk for DVT due to a variety of causes like prolonged duration of surgery, prolonged ventilation, poor sensorium, reduced movement of lower limbs secondary to a disease process (spinal injuries/tumor), all of which delay ambulation.[2] The estimated risk of DVT in neurosurgical patients is 25%.[3] Paraplegia following surgery and frequent use of osmotic diuretics like mannitol further complicates the problem. Certain diseases such as intracranial gliomas and meningiomas have also been associated with an increased incidence of DVT.[3,4]

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The actual incidence of postoperative DVT varies depending on the threshold of clinical suspicion and the diagnostic modalities utilized. A major area of focus in perioperative care is towards prophylactic management of DVT like utilizing intermittent compression devices (ICD), unfractionated low dose heparin and low molecular weight heparin (LMWH).

However, the use of anticoagulants in neurosurgery during postoperative period maybe with the risk of intracranial hemorrhage. There have also been concerns raised about the efficacy of ICD's in preventing DVT. In addition, a consensus on the best modalities of DVT prophylaxis and the safety of anticoagulation in neurosurgical patients is lacking. In the present study, we aim to highlight our experience with DVT in patients following neurosurgical operations and review of the literature on this subject.

Aim

To study the incidence, clinical presentations, risk factors and management modalities in DVT affecting patients undergoing cranial or spinal surgical procedures in a neurosurgical intensive care unit (ICU).

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MATERIALS AND METHODS

We performed a retrospective review of patients who developed radiologically proven DVT in the course of prolonged ICU stay (>7 days), following cranial or spinal surgery. This study was conducted at a tertiary care neurosurgical center in north India between September 2009 and November 2011. Clinical information including age, sex, clinical symptoms and signs, duration of symptoms, radiological findings, surgical procedure carried out, post-operative complications and follow-up was retrieved from their case records, operation theater register and discharge summaries and our departmental computer database. Patients who developed pedal edema/pain in lower limbs following surgery were evaluated for DVT with color Doppler. Only patients with DVT demonstrated by color Doppler were included in the study. However, routine DVT prophylaxis was not performed. All patients with color Doppler proven DVT were managed with LMWH heparin with the target international normalized ratio (INR) being 2.5. Periodic follow-up color Doppler was done to assess for clot lysis. Patients were switched on to oral Warfarin for prophylaxis against recurrence of DVT. Patients were seen in the out-patient clinic after discharge at 6 week, 3-6 months.

RESULTS

A total of 260 patients were reviewed in the study period between September 2009 and November 2011. Eight patients (3.7%) were diagnosed with DVT by color Doppler during this period. The average age of the group was 47 years (range 36-70 years). The clinical indications of surgery were intracranial aneurysm (n = 2), basifrontal meningioma (n = 1), lumbar spondylolisthesis (n = 1), atlantoaxial dislocation (n = 1), vestibular schwannoma (n = 1) and chronic subdural hematoma (n = 2) [Table 1]. All patients had developed asymmetric lower limb edema, which was evaluated with color Doppler. We found that 3 patients had DVT limited to the popliteal vein, 2 patients had DVT extending from the popliteal to the femoral vein and in 3 patients the DVT had extended up to the common iliac vein. No case of the inferior vena cava extension was seen. All patients were treated with enoxaparin (0.6 ml/once daily) for 7 days and started on oral warfarin 2.5 mg once a day until resolution of the thrombus was seen, anticoagulation was maintained for 3 months and the INR was maintained below 2.5. Risk factors associated with DVT seen in our series included poor neurological status with immobilization in 2 patients, delayed ambulation in 3 patients, surgery in the prone position in 3 patients and old age in 1 patient. One patient died of pneumonia and renal failure; 7 patients were discharged after improvement in their neurological status. We did not encounter any instance of intracranial bleeding or pulmonary thromboembolism.

DISCUSSION

DVT is a complication frequently found in patients following neurosurgical operations. The incidence of DVT in various surgical series has been about 24%.[1,5] Pulmonary embolism is a life-threatening complication of DVT and occurs in about 1.5% neurosurgical patients and maybe associated with a mortality rate of 9-50%.[1,5] The incidence figures vary depending on the investigative modality used with invasive modalities like venography having a higher sensitivity rate. Many of the studies were surveillance studies where the asymptomatic patients were screened for DVT, understandably yielding

Table 1: Clinical and radiological profile of patients with DVT in our studies

Indication of surgery	Total no. *n*=260 (100%)	No. of patients with DVT out of total patients	Co-morbidity and risk factors	Position during surgery	Extent of DVT in color Doppler
Intracranial aneurysm	49 (18)	2 (0.8)	Poor neurological status and long-time immobilization	Supine	Calfvein (V)+popliteal V
Meningioma	12 (4.6)	1 (0.4)	Delayed immobilization	Prone	Calf V+popliteal V+femoral V
Lumber spondylolisthesis	12 (4.6)	1 (0.4)	Delayed immobilization obesity, HT	Prone	Calf V+popliteal V
Supratentorial glioma	76 (29)	0	-		-
Atlanto axial dislocation	46 (17)	1 (0.4)	Ventilator dependant pneumonia, prolong immobilization	Prone	Calf V+popliteal V+femoral V
Vestibular schwannoma	26 (10)	1 (0.4)	Poor neurological status and long-time immobilization	Park bench position	Calf V+popliteal V+femoral V+common iliac V
A V malformation	10 (0.3)	0	-		
Chronic SDH	12 (4.6)	2 (0.8)	Old age, HT, poor neurological status and long-time immobilization	Supine	Calf V+popliteal V+femoral V+common iliac V
Medulloblastoma	5	0	-	-	-
Pott's spine decompression	12	0	-	-	-

DVT – Deep vein thrombosis; HT – Hypertension; SDH – Subdural hematoma; V – vein

higher incidence rate.[6] Our series, the rate of DVT was low (3.7%). However, only symptomatic patients were evaluated with color Doppler, probably resulting in under diagnosis of DVT. We encourage early ambulation of post-operative patients and initiate limb physiotherapy on the day following surgery, this strategy also probably contributed to the low incidence of DVT.

Neurosurgical patients have an increased risk of DVT due to factors such as prolonged duration of surgery; lower limb paralysis, old age and certain intracranial neoplasms like astrocytomas and meningioma's, which cause a hypercoagulable state resulting in DVT.[2,7,8] Paraplegia or prolonged immobilization causes stasis of blood in the lower limbs, thereby resulting in DVT. In our series, all patients underwent surgeries longer than 6 h thereby increasing the risk of developing DVT. Three patients were older than 50 years. Co-morbid factors like DM and hypertension were seen in 6 patients; these conditions contribute to delay recovery and prolonged immobilization, thereby increasing the risk of DVT. Delayed post-operative ambulation, for instance due to poor neurological status was another important factor predisposing the patient for DVT.

The proposed modalities of DVT prophylaxis have been associated with either concerns of safety or with doubts regarding their efficiency. The focus of the question should be regarding their efficacy, appropriate time of initiation and the advantage of one modality over the other. The cheapest measure is the graded compression stockings; however, a commonly encountered the problem in our ICU is the incorrect placement, loosening and loss of elasticity of these stockings. The use of ICD's for prophylaxis against venous thromboembolism (VTE) has shown to reduce the incidence of DVT by 10-20% in neurosurgical patients,[3,9] whereas use of low-dose unfractionated heparin (LDUH) decreased the incidence by 83%, the combination ICD and LDUH was more efficacious than either modality alone.[1] Although comparing LMWH for prophylaxis, enoxaparin was shown to reduce the incidence of DVT when used in conjunction with compression stockings (CS), a decrease from 33% when only CS were used to 17% when both CS and enoxaparin were used.[3] Agnelli noted the occurrence of VTE in 17% patients and attributed it to the thrombogenic effect of spinal and intracranial tumors which constituted a majority of the study population; however the actual location of the tumor (cranial or spinal) did not influence the result of the study.[3] Sawaya noted suppression in fibrinolytic activity in patients with brain tumors, probably placing them at risk for DVT.[4] However, we encountered no association between astrocytomas and DVT. One patient in with a basifrontal meningioma developed DVT; meningiomas have been associated with a hypercoagulable state. Sawaya and Levi noted that meningiomas carry a greater risk of DVT in comparison to other brain tumors.[2,9]

An area of concern among neurosurgeons is the risk of hemorrhage following the use of anticoagulants for VTE prophylaxis. The rate of hemorrhage following the use of LDUH was 1.6% compared with the control group rate of 1.2%.[10] The use of enoxaparin has been associated with more conflicting reports. Dickinson *et al*. in their study where enoxaparin was administered pre-operatively at a dose of 30 mg and every 12 h after until day of discharge noted an increase in the incidence of intracerebral hemorrhage such that the study was terminated.[6] However, there was no increase in bleeding when enoxaparin was begun within 24 h of surgery with a significant reduction in DVT from 32% to 17% respectively. These findings suggest that the use of both unfractionated and low-molecular-weight heparin appears to be safe when used within 24 h after the conclusion of neurological surgery.[1,3] Iorio noted a similar increase in intracranial hemorrhage (2.1%) in patients receiving LMWH compared with patients on mechanical or no prophylaxis.[11] However, no patient in our series developed intracranial bleeding associated with LMWH. No patient in our series developed heparin-induced thrombocytopenia. A recent meta-analysis comparing the modalities of VTE prophylaxis in the neurosurgical population found that LMWH was associated with a significant increase in minor bleeding, but not in major bleeding when compared with mechanical modalities.[12] Hence, whereas the use of LMWH is safe in neurosurgical patients, caution have been recommended when they are used peri-operatively.[13] When used, they should be commenced within 24 h of surgery. It has been estimated that if a randomized clinical trial were to be conducted to estimate the efficacy of pneumatic compression over LDUH, more than 38,000 subjects would be needed to reach significance of 0.005 with a power of 0.8.[14] Our protocol for the management of acute DVT includes limb immobilization and initiation of subcutaneous heparin (unfractionated or LMWH) and oral warfarin until the INR is 2.0-3.0. LMWH is preferred over heparin due to the once daily dosing schedule, more predictable effect, less need to monitor the clotting profile and a reduced incidence of heparin induced thrombocytopenia.[15] Oral warfarin is continued for at least 3 months to reduce the incidence of post-thrombotic syndrome, recurrent DVT and pulmonary emboli.

Recent advances in the management of VTE include an introduction of direct thrombin inhibitors (DTI) as alternatives to heparin and LMWH, with a reduction

in the incidence of heparin induced thrombocytopenia and hematoma formation. They include argatroban, melagatran, dabigatran, ximelagatran and bivalirudin. Of these ximelagatran and dabigatran are available as oral preparations thereby increasing drug compliance.[16] Comparison with LMWH in various trials has revealed comparable efficacy with a slight increase in bleeding tendency, however when compared with warfarin, ximelagatran decreases the incidence of acute VTE with comparable rates of bleeding. When used for long-term VTE prophylaxis, DTI reduce the incidence of VTE with no increase in rates of serious or minor bleeding and however efficacy of DTI in neurosurgical patient's needs to be validated in well-designed trials.

CONCLUSIONS

The occurrence of DVT should be kept in mind while treating patients in the neurosurgical ICU, particularly when prolonged ICU care is required. While managing post-operative cranial or spinal surgery patients, prolonged surgery, immobilization and old age are important factors, which contribute in causing DVT, though further studies would be required to prove their role. However, this complication can be averted by prophylactic measures like CS and ICD's used in conjunction with LMWH and LDUH. LMWH can be used safely in neurosurgical patients with a small increase in risk of bleeding; when administered, it must be started within 24 h of surgery. The clinical suspicion and constant monitoring are vital to prevent the occurrence and aggravation of an intracranial hemorrhage following cranial surgery. The outcome following DVT remains favorable if managed carefully.

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