Int Surg 2012;**97:**150–154

Deep Venous Thrombosis in Spine Surgery Patients: Incidence and Hematoma Formation

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Deep venous thrombosis (DVT) is a significant health care problem; a variety of factors place spinal surgery patients at high risk for DVT. Our aim is to define the incidence of DVT occurrence in spite of prophylactic measures (mechanical and chemoprophylaxis), and the development of spinal epidural hematoma as a complication of chemoprophylaxis. In a single-center prospective study, 158 patients who underwent spinal surgical procedures were evaluated by clinical evaluation and lower limb Doppler ultrasonography imaging. Only one patient (0.6%) developed DVT; this patient was treated successfully without thrombus progression, with full recanalization. Three patients (1.8%) developed spinal epidural hematoma, but only one required surgical evacuation, and none sustained neurologic deficit. Careful evaluation for DVT risk on an individual basis and good prophylaxis helps to minimize the risk of DVT. The neurosurgeon is thus left to weigh the risks of postoperative hematoma formation against the benefits of protecting against DVT.

Key words: Deep venous thrombosis – Pulmonary embolism – Spinal surgery – DVT prophylaxis – Low molecular weight heparin – Doppler ultrasonography

Deep venous thrombosis (DVT) is a significant health care problem, causing considerable mortality and morbidity; it occurs both in medical and surgical patients. DVT is the most frequent systemic complication in patients undergoing neurosurgery.[1] Pulmonary embolism (PE) can still be fatal.[2]

As the complexity of spinal surgery has increased, so too has the incidence of DVT and PE. In spite of the use of different prophylactic methods, venous thromboembolism (VTE) is still a significant complication following spinal surgery. In surgery of the lumbosacral spinal, the lowest quoted rates are 0.6% for DVT and 0.3% for PE.[3]

The precise indications and/or timing of anticoagulation for thromboembolic prophylaxis following spinal surgery is not clear.[4] Neurosurgeons must weigh the benefits of DVT prophylaxis against the risk of bleeding complications. Unfortunately, no consensus has been reached regarding a DVT prophylaxis regimen.[5]

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In this study, the principle variables studied were the incidence of DVT in major spinal surgery patients who were under DVT prophylaxis and the incidence of postoperative spinal epidural hematomas (SEH) as a potential complication of DVT chemoprophylaxis.

Materials and Methods

A consecutive cohort of patients who had spinal surgery performed in the Neuro Spinal Hospital (NSH), Dubai, over a 10-month period was studied. Two hundred three patients were admitted for spinal procedures during this period; however, after excluding patients who underwent same-day procedures such as facet infiltration, percutaneous vertebroplasty, epidural injection, and medial branch thermo-coagulation, a total of 158 patients were included in this study.

Patients undergoing spinal surgery were monitored prospectively both by clinical evaluation (looking for features of lower limb DVT) and by routine ultrasound-based imaging (which was done on the second and third postoperative days), with or without D-dimer measurement. Case notes were reviewed for those who developed complications during their stay, had a prolonged hospital stay, or were readmitted within 3 months of spinal surgery. Doppler ultrasonography was performed using a Siemens-Sequoia machine equipped with superficial 8 MHz transducer.

NSH VTE prophylaxis protocols

All patients undergoing spinal surgery are instructed to wear below-knee compressive elastic stockings during their entire hospital stay. In addition, chemoprophylaxis in the form of low molecular weight heparin (LMWH) (enoxaparine, Pharmatrade, City, State or country), 40 mg subcutaneous (SC), was started within 12 to 13 hours postoperatively and continued daily until the patient was ambulating well and then was discharged.

Patients were encouraged to resume early ambulation, usually within the first postoperative day. A sequential compressive device (SCD) was applied in special circumstances; perioperative, when anticipating prolonged operative time (more than 6 hours), and postoperatively in patients with severe neurologic impairment, paraplegia, or prolonged immobility.

Data collected

In addition to the presence of significant neurologic deficit that may affect time and quality of mobilization, data were collected regarding age, sex, ethnicity, history of previous surgeries, history of DVT or PE, type and level of the surgical procedure, operative time, length of stay (LOS), blood transfusion, postoperative anticoagulation dose and timing, use of elastic stockings, SCD usage and immobilization time. Moreover, patients were classified according to risk factors for VTE.

The average patient age was 43 years (12–90), while 47.5% of the studied population was over 40 years age. Sixty-one percent of patients were male and 39%, female; 65% of the patients were of Arabic descent (local Emirate and other Arabic countries).

Seventy-four percent of patients had surgery of the lumbar spine, while 26% underwent cervical spine surgery. All the procedures were performed by the same team of neurosurgeons; surgical procedures involved one to three spine levels and included microdiscectomy, decompressive laminectomy with or without fixation, total disc replacement, and vertebral body replacement. One hundred eighty surgical procedures were performed in 158 patients; operative time ranged from 50 to 700 minutes, an average of 228 minutes. All lumbar spinal surgeries were performed with the patient flat, face down in the prone position, while supine position was adopted for anterior cervical spine surgery.

The average LOS was from 1 to 115 days; however, the average LOS for 62% of the patients was from 1 to 3 days. Ambulation was resumed within 15 to 17 hours postoperatively. Regarding DVT prophylaxis, 98.4% of the patients wore elastic compressive stockings, and LMWH prophylaxis was administered to 83%, while SCD was used in only 11 patients (6.9%). Thirteen patients underwent emergency spinal surgery, 10 for trauma and 3 for acute *cauda-equina* syndrome. All patients were followed up for at least 6 months after surgery.

Results

Certain conditions appear to predispose individuals to VTE. The American College of Chest Physicians Consensus Conference on Antithrombotic and Thrombolytic Therapy listed the major risk factors. Joseph Caprini and others attempted to quantify these factors in a reproducible manner to assist the clinician in performing preoperative risk-factor assessment.[7] In the present study, risk factors for each patient were calculated to produce an overall risk factor score, which corresponded from low to very high potential for DVT development (Table 1). Patients undergoing spinal surgery are at risk of

Table 1 Thromboembolism risk factors in the studied spinal surgery patients as assessed with the risk factor point system

Risk factor	Points	Number of patients affected	Percentage from the studied group
Overweight and obese (BMI >25)	1	64	40.5%
Age 41–60 years	1	52	32.9%
Age 61–75 years	2	19	12%
Confined to bed >72 h	2	9	5.6%
Malignancy within 5 y	2	3	1.9%
Major surgery (>45 min)	2	158 (the studied cohort)	100%
Age >75 y	3	4	2.5%
History of DVT	3	1	0.6%
Spinal injury/paraplegia	5	3	1.9%

BMI, body mass index.

developing VTE. In addition, 67.7% of the patients in this study had at least one or more additional risk factors including age, bed confinement, history of malignancy, history of DVT, obesity, and spinal cord injury with paralysis.

On reviewing the risk factors for DVT development in the studied population, 31.6% were at moderate risk, while 55% were at high risk, and 13.4% were at the highest risk (Table 2).

From a total of 158 patients, only 52 (32.9%) had only one risk factor for DVT, being the spine surgery itself (*i.e.*, ''major surgery for more than 45 minutes'' is equal to a risk of 2 points), while 63 patients (39.8%) had two risk factors, and the remaining 43 patients (27.2%) had more than two risk factors.

In the whole series, only one patient developed DVT. This patient was treated with elastic compressive stockings and LMWH anticoagulation, and was ambulated 12 hours after surgery, yet he developed DVT in the third postoperative day (with pain and swelling of the left leg). Doppler study confirmed the presence of nonpropagating thrombus of the tibial veins. He had no familial or enzymatic liability for development of VTE; he was treated successfully without progression of the thrombus and followed up for 1 year, confirming the patency and recanalization of the deep venous system.

Three patients (1.8%) developed spinal epidural hematoma (SHE), all were on LMWH anticoagulation, 2 of them were treated conservatively without resulting neurologic deficit, while the third patient presented with rapidly progressive neurologic deficit, which required urgent operative decompression and evacuation of the hematoma to prevent irreversible neurologic disability; the patient had an uneventful full recovery. There was no operative mortality for the whole series.

Discussion

The objective of the North American Spine Society (NASS) Evidence-Based Clinical Guideline on antithrombotic therapies in spinal surgery was to provide evidence-based recommendations to address key clinical questions surrounding the use of antithrombotic therapies in spinal surgery. The goal of the guideline recommendations was to assist in delivering optimum, efficacious treatment with the goal of preventing thromboembolic events.[8]

The true incidence of VTE in spinal surgery remains unknown. Oda *et al*. reported evidence that the incidence of DVT after posterior spinal surgery is higher than appreciated and that increased age and posterior lumbar surgery are risk factors.[9]

A variety of factors place the spinal surgery population at increased risk for DVT; these include older age group, prolonged immobilization postoperatively, incision pain, malignant tumors, postoperative paralysis, and duration of surgery. The neurosurgeon is thus left to weigh the risks of postoperative hematoma formation against the benefits of protecting against DVT.[5]

Anecdotally, there is high risk of complications in patients who have undergone spinal surgery and in whom level-1 or equivalent heparin protocol is administered. There were no prospective random-

Table 2 Patient distribution according to DVT risk factor score

Risk factor score	0–1	2	3–4	5+
Level of risk	Low	Moderate	High risk	Highest
DVT incidence (without prophylaxis)	2%	10%–20%	20%–40%	40%–80%
Percentage in studied population	–	31.6%	55%	13.4%

ized studies regarding the use of level-1 anticoagulation therapy after spinal surgery.[10] Cain *et al.* concluded in their study that because of the high rate of major complications associated with postoperative heparinization, inferior vena cava filters were the method of choice for preventing fatal PE.[10]

Duplex scanning has 100% sensitivity and 98% specificity in symptomatic patients for proximal DVT, and 94% sensitivity and 75% specificity for distal venous thrombosis.[11] Duplex scanning role is crucial as it is required to confirm the diagnosis and to rule out other pathology. Duplex scanning has improved in precision and has gained popularity. It is safer than other invasive techniques, such as contrast venography, and also provides a more timely diagnosis in a more efficient manner than most noninvasive techniques.[12]

The fact that the fresh thrombus is not occlusive, has the same echogenicity as blood, and has a reduced consistency may jeopardizing the compressibility test, the most sensitive test for DVT. In these cases, duplex scanning should be performed 2 to 3 days later to confirm or exclude the diagnosis.[11]

The use of low-dose unfractionated heparin therapy perioperatively for prophylaxis against DVT and PE has been well demonstrated in many other surgical specialties but is less commonly used in neurosurgery for fear of causing devastating postoperative hematomas.[13] It seems possible that the extensive bone removal involved in spinal fusion and/or decompression leaves a wider potential bone surface area for rebleeding than does craniotomy. This could predispose patients undergoing spinal surgery to delayed postoperative hematoma.

Gruber *et al.* showed no statistically significant difference in intraoperative bleeding due to preoperative administration of heparin minidose in comparison with those without anticoagulation.[14]

The incidence of symptomatic postoperative SEH is 0.1% to 3%.[15–17] Numerous case reports feature an association between spontaneous SEH and the use of anticoagulation therapy.[18–20] DVT incidence in the studied group was 0.6%, while postoperative hematoma formation incidence was 1.8%, only 1 patient required urgent operative decompression and evacuation to prevent irreversible neurologic disability, and the patient had an uneventful full recovery.

These findings are comparable with other international studies and it is concluded that combined antithrombotic mechanical and chemoprophylaxis is effective in decreasing post spinal surgery DVT incidence to a minimum and, at the same time, without significant increase in the rate of bleeding complications.

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