

Editorial

24–48 hour preoperative “surveillance” lower extremity venous Doppler’s: Aren’t they worthwhile prior to spine surgery?

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Abstract


Background: Most previous studies focused on the utility of Doppler surveillance to determine the incidence of deep venous thrombosis (DVT) following spine surgery. Here, we utilized Doppler surveillance to assess the frequency of DVT prior to spine surgery.

Methods: We asked, how often do patients exhibit preoperative DVT? To answer this, for over a 7-month period, bilateral lower extremity venous Doppler’s were prospectively obtained 24–48 hours prior to a variety of spinal operations among 45 patients. This did not include an analysis of postoperative venous Doppler’s/ incidence of pulmonary embolism for these patients.

Results: Of the 45 patients, 3 (6.7%) exhibited preoperative positive/abnormal venous duplex studies (unilaterally) that led to cancellation of spinal surgery. One patient, a 56-year-old female, with a C6-C7 cervical disc, demonstrated a proximal right lower extremity DVT; she required full-dose anticoagulation and her surgery was cancelled. In two cases, a 42-year-old female and a 55-year-old male, exhibited DVT in the right posterior tibial and left peroneal veins respectively; both operations were cancelled, and they were placed on anticoagulants by their internists.

Conclusions: Over a 7-month period, prospective “surveillance Dopplers” of both lower extremities obtained 24–48 hours prior to spinal surgery documented 3 (6.7%) positive studies out of a series of 45 patients. One instance of DVT was proximal (e.g. femoral in local) whereas 2 were distal. These data showed that preoperative surveillance Doppler of both lower extremities was “worthwhile.” However, performing these studies earlier than 24-48 hrs prior to surgery would help avoid last minute cancellations.

Key Words: Deep venous thrombosis, distal, positive studies, preoperative, proximal, spine surgery, surveillance lower extremity Dopplers

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The incidence of lower extremity deep venous thrombosis (DVT) prior to spine surgery is not well documented. For years, we have been seeing patients with positive “surveillance” venous Doppler studies of both lower extremities and/or even positive computed tomography angiography-pulmonary embolism (CTA-PE) protocols on days 1 and 2 following spinal surgery. Although we suspected that at least some of these patients had preoperatively

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undiagnosed DVT and even pulmonary embolism (PE), particularly in those with preoperative neurological deficits (e.g. foot drop), we had no clear documentation for this hypothesis. This prompted the development of a prospective protocol that required all of the author’s patients who were to undergo spine surgery (since March 2016 with Rankin Scores of 3 or more indicating varying degrees of paresis) to undergo preoperative bilateral lower extremity “surveillance” Doppler studies 24–48 hours prior to surgery [Tables 1 and 2]. Here, we present our findings, and briefly summarize select postoperative DVT surveillance studies from the literature [Table 3].

6.7% incidence of positive “surveillance” bilateral lower extremity Dopplers prior to spine surgery in patients with Rankin scores of 3 or greater

Of the 45 patients scheduled for spine surgery since March 2016, 3 (6.7%) exhibited preoperative positive unilateral venous duplex studies that led to cancellation of surgery [Table 2]. In one instance, a 56-year-old female smoker with a C6-C7 cervical disc (myelopathy/radiculopathy right greater than left), the patient demonstrated a proximal right lower extremity femoral vein DVT that required cancellation of the case, and full-dose anticoagulation. In two instances, a 42-year-old female and 55-year-old male, the patients exhibited DVT in the left popliteal (side of the disc herniation) and right posterior tibial (side opposite the disc herniation)

veins respectively; both cases were cancelled, and their internists placed them on anticoagulants.

SEQUENTIAL HISTORY OF UTILITY OF SURVEILLANCE DOPPLERS FOLLOWING SPINE SURGERY

Review of risks/benefits of different regimens of prophylaxis for deep venous thrombosis and pulmonary embolism in Neurosurgery (2005)

In a review of the DVT/PE literature regarding spinal surgery, Epstein noted (2005) that approximately 2 million people in the US develop DVT, whereas approximately 100,000 have fatal PE/year [Table 3]. Prophylaxis regimens primarily include intermittent pneumatic compression stockings (PCS) vs. low-dose unfractionated heparin (5000 U every 8–12 hours) or low molecular-weight heparin (e.g., enoxaparin and dalteparin). As anticipated, the incidence of DVT was higher for cranial (7.7%) vs. spinal procedures (1.5%). Although PCS were relatively effective in reducing these risks, low-dose heparin-based prophylaxis for both was more effective. However, the use of chemoprophylaxis poses the risks of minor or major hemorrhages in 2-4% of cranial, and up to 0.7% of spinal surgery. The conclusion of this paper was that PCS provided effective prophylaxis against DVT/PE in many studies, but “the added efficacy of low-dose heparin regimens has to be weighed against the risks of major postoperative hemorrhages and their neurological sequelae.”^[1]

Efficacy of alternating pneumatic compression stocking prophylaxis alone against deep vein thrombosis in cervical and lumbar spine surgery (2005–2006)

Citing a 2–4% risk of major perioperative hematomas attributed to mini-heparin/low-dose heparin prophylaxis in cranial and 0.7% in spine surgery, Epstein evaluated the efficacy of PCS alone without chemical prophylaxis in cervical and lumbar surgery [Table 3].^[2,3] The first study in 2005 prospectively evaluated the efficacy of PCS for preventing DVT/PE in 100 patients undergoing one-level

Table 1: Rankin scale

0	No symptoms
1	No significant disability, despite symptoms; able to perform all usual duties and activities
2	Slight disability; unable to perform all previous activities but able to look after own affairs without assistance
3	Moderate disability; requires some help but able to walk without assistance
4	Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
5	Severe disability: bedridden; incontinent; and requires constant nursing care and attention
6	Death

Table 2: Clinical data summary of 3 patients with DVT on preoperative Doppler of both lower extremities

Patient #	Age	Sex	Height Weight	Planned Spine Surgery	Location of DVT	DVT in Paretic Leg Comorbidities
1	55	M	5'11" 221	Laminectomy L3-S1 Stenosis: Left L45 Disc	Right Posterior Tibial Vein DVT	No Contralateral but with stenosis None
2	56	F	5'7" 152	Anterior Cervical Discectomy Fusion C67	Right Femoral Vein	Yes (Right sided disc/myelopathy) Smoker
3	42	F	5'9" 164	Lumbar Laminectomy L4-S1 Stenosis; Left Disc L5S1	Left Peroneal Vein DVT	Yes Yes; Birth Control Pills

Table 3: Deep venous thrombosis “surveillance” of bilateral lower extremities following spine surgery

Author Reference Year	Number of Patients	Surgery	Incidence of Positive Doppler's	Findings Conclusions
Piper ^[6] 2016	22434 NSQIP Incidence of postoperative venous thromboembolism (VTE)	Multiple Spine Operations Risk of VTE overall 1.1% PE 0.4% DVT 0.7%	Major Risk Factors Paralysis Cancer Inpatient Hypertension TIA	Others: African American Surgery >4 h Emergencies ASA Class III-IV Postoperative sepsis
Epstein ^[5] 2015	2 morbidly obese patients 69 and 68 years old	BMI 40/37.5 Both HTN/DM	Prophylactic IVC Filters No DVT No PE	Removal of Filters <3 Postoperative Months
Epstein ^[4] 2011	Spine Surgery: 75 Cervical Laminectomy/ Fusion 165 Lumbar Laminectomy/ Non instrumented fusion DVT Prophylaxis: PCS	Screening Doppler's for DVT 1-2 Days After Surgery Select CTA/PE Protocols	Negative Doppler's Positive CTA 1-21 Days Postoperatively 5 (6.7%) Cervical surgery 6 (3.6%) Lumbar Surgery	All 11 had IVC filters 5 (45%) had Hypercoagulation syndromes
Epstein ^[3] 2006	138 Lumbar Laminectomy (3.8 levels) Instrumented fusions (average 1.4 levels)	Prospective Doppler's Postoperative Day 2	2-6 Days After Surgery 4 (2.8%) DVT PE 1 (0.7%)	All received IVC Filters
Epstein ^[2] 2005	100 Single level ACDF 100 Circumferential Cervical Surgery (3 or > Corpectomy/Fusion C2T2)	Prospective Doppler's Postoperative Day 2	1 (1%) of Single Level ACDF Developed DVT Positive for Factor V Leiden Mutation	7 (7%) of Multilevel ACF/PF Developed DVT
Epstein ^[1] 2005	Literature Review DVT/PT Spine Surgery	2 Million DVT/Year 100,000 fatal PE DVT Cranial Surgery 7.7% DVT Spinal Surgery 1.5%	Prophylaxis Pneumatic Compression Stockings (PCS) Low-Dose Heparin or Unfractionated Heparin (5000 U q 8-12 h)	Risk of chemo- prophylaxis hematoma 2-4% Cranial 0.7% Spinal

NSQIP: National Surgical Quality Improvement Project database, TIA: Transient Ischemic Attacks, ASA: American Society of Anesthesiologists Classification, CTA: Computed Tomography Angiography (Pulmonary Embolism Protocol), IVC: Inferior Vena Cava Filter, PCS: Pneumatic Compression Stockings Alone, HTN: Hypertension, DM: Diabetes, DVT: Deep Venous Thrombosis, PE: Pulmonary Embolism, ACDF: Anterior Cervical Discectomy/Fusion, ACF: Anterior Cervical Corpectomy/Fusion, PCS: Pneumatic Compression Stockings

anterior cervical corpectomy/fusion and in an additional 100 patients having circumferential surgery (e.g., three or more anterior corpectomy/fusion with posterior fusion C2-T2).^[2] Doppler “surveillance” of both lower extremities was performed on postoperative day 2. Only one patient (1%) undergoing a single-level ACF developed DVT/PE 6 days postoperatively; she tested positive for Factor V Leiden mutation (hypercoagulability syndrome). Notably, 7 (7%) of 100 patients undergoing circumferential cervical surgery developed DVT 2–14 days postoperatively (mean, 7.15 days); only two clots in the iliac veins resulted in PEs (days 10 and 14 postoperatively). Epstein concluded that PCS's were as effective for prophylaxis against DVT/PE for 200 patients undergoing cervical surgery while avoiding the risk of hemorrhage attributed to chemoprophylaxis. In 2006, Epstein assessed the efficacy of PCS in preventing DVT in 138 lumbar laminectomy (average 3.8 level) patients undergoing instrumented fusions (average 1.4 levels).^[3] Routine Doppler screening for DVT was performed 2 days postoperatively; if clinically indicated, subsequent lower

extremity Dopplers were repeated, and CTA-PE protocols were performed where indicated. Four (2.8%) patients developed DVT 2–6 days postoperatively; they all received inferior vena cava (IVC) filters. Therefore, “pneumatic compression stocking prophylaxis effectively reduced the incidence of DVT (2.8%) and PE (0.7%) in 139 patients undergoing multilevel lumbar laminectomies with instrumented fusions.” Notably, these “rates compared favorably with those reported in spinal series employing low dose heparin (LDH) prophylaxis.”

Study confirms value of postoperative computed tomographic angiography-pulmonary embolism protocol in diagnosing pulmonary embolism despite negative lower extremity “surveillance” Dopplers (2011)

Epstein *et al.* (2011) evaluated the frequency of positive CTA-PE protocols despite negative bilateral lower extremity postoperative “surveillance Dopplers” performed in 240 patients undergoing spinal surgery all of whom received PCS prophylaxis alone [Table 3].^[4] Five (6.7%)

of 75 patients undergoing cervical laminectomy/fusion, and 6 (3.6%) of 165 undergoing lumbar laminectomy/noninstrumented fusion exhibited negative Dopplers but positive CTA-PE protocols on postoperative days 1 to 21. All received IVC (inferior vena cava) filters (2 permanent and 9 retrievable). Of interest, 5 patients (45%) tested positive for hypercoagulation syndromes. The conclusion was we should have a “low threshold” for requesting postoperative CTA-PE protocols even when bilateral lower extremity Dopplers are negative for DVT. Factors contributing to the decision to obtain CTA-PE protocols included; persistent low-grade temperature, mildly elevated white blood cell count, and low grade unexplained tachycardia (unresponsive to hydration).

Safety/efficacy of prophylactic inferior vena cava filter placement for two morbidly obese patients prior to lumbar surgery

In 2015, Epstein evaluated the safety/efficacy of preoperative placement of prophylactic IVC filters in two morbidly obese patients [criteria body mass index (BMI) >40 or >35 with 2 major comorbid factors] about to undergo L1-S1 multilevel decompressive lumbar laminectomies [Table 3].^[5] In one patient, 69 years of age, the BIM was 40, while in the other patient, a 68 year-old, the BMI was 37.5; both, however, had two major comorbidities (e.g., hypertension/diabetes). Both patients received prophylactic IVC filters prior to surgery; they also received alternating compression stocking prophylaxis intraoperatively/postoperatively. Furthermore, both received subcutaneous heparin 5000 U 12–48 h after surgery, starting on postoperative day 2, until discharge. Neither patient developed DVT or PE, and both filters were uneventfully removed within 3 postoperative months. Here, a review of the spinal surgical and some general surgery literature revealed that the placement of IVC filters was supported for patients with the following major risk factors; obesity (BMI > 40), a history of DVT/PE, cancer, fusions, hypercoagulation syndromes, pulmonary/circulatory disorders, preoperative/postoperative immobility, staged procedures (five spinal levels), combined anterior–posterior surgery, ilio caval manipulation, age >80, and prolonged surgery (e.g., >261 min vs. >8 h). Although the safety and efficacy of prophylactic IVC filters for spine surgery in patients with morbidly obesity were well-substantiated, those for bariatric patients were less clear.

More recent study confirms value of postoperative bilateral lower extremity “surveillance” Dopplers in patient undergoing spinal surgery

A recent study by Piper *et al.* documented the value of performing bilateral lower extremity “surveillance” Doppler’s of both lower extremities [Table 3].^[6] They used the American College of Surgeons National Surgical Quality Improvement Project (NSQIP) database to

assess how various clinical factors/multiple comorbidities in 22434 patients impacted the risk for developing preoperative venous thromboembolism (VTE). The risk of VTE overall was 1.1%: PE 0.4%, and DVT 0.8% respectively. Multiple major comorbid factors that contributed to the risk of VTE included paralysis, metastatic cancer, inpatient status, hypertension, transient ischemic attacks, sepsis, African American status, operative time over 4 hours, emergency surgery, American Society of Anesthesiologists Class III-IV, and postoperative sepsis. Combining these risk factors led to an overall risk score for VTE in patients undergoing spinal surgery.

RELEVANCE OF PRESENT STUDY

“Worthwhile” preoperative surveillance Dopplers of both lower extremities prior to spine surgery: Present study

Utilizing “surveillance preoperative Doppler” of the lower extremities prospectively performed in 45 patients 24–48 hours prior to spinal surgery, we encountered 3 (6.7%) positive studies: One proximal DVT and two distal DVTs [Table 2]. With this high frequency, surveillance Doppler performed within 24–48 hours prior to surgery would appear “worthwhile.” However, because these were performed just the day or two prior to surgery, they led to the abrupt cancellation of surgery that was traumatic for the patient and problematic for the surgeon/operating room scheduling. Perhaps, obtaining studies just a few days earlier (e.g., at least 48 hours preoperatively) would enable both parties to optimally manage the DVT while maximizing patient safety (e.g., what if the surgeon/staff was not alerted on time) and hospital resources (what if a patient comes in for surgery, it is cancelled, and the packs/instruments are already opened and “wasted”). Of interest, Medicare apparently “covers” the cost of these studies only when performed within 23–48 hours prior to surgery. Notably, several other insurance companies are following suit. Nevertheless, modifying the “schedule” for preoperative surveillance lower extremity Dopplers might be helpful to all involved.

Recommendations regarding preoperative “surveillance” lower extremity Dopplers prior to lumbar surgery

We would recommend utilizing surveillance venous Dopplers of both lower extremities prior to spine surgery, particularly for those with Rankin scale scores of 3 or greater (e.g., with a paretic leg/focal deficit) deficits. Of *Surgical Neurology International Spine* to comment further as to whether “surveillance” Doppler would promote the “safety” of spinal surgery in their institutions.

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Conflicts of interest

There are no conflicts of interest.

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