Deep Vein Thrombosis Following Posterior Lumbar Spinal Surgery

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Deep vein thrombosis and pulmonary embolus are known complications of orthopaedic procedures, particularly about the hip and knee. Spinal surgery has been associated with few thrombotic complications historically. Widespread use of instrumentation in adult patients has lead to a rise in complexity of adult spinal surgery. Length of operative procedures, level of difficulty, and bulk of instrumentation have all increased. We have noted an occasional pulmonary embolus in our center, as well as a small incidence of pulmonary embolus in recent reports of adult spine instrumented cases. A consensus conference through the National Institute of Health has estimated that between 300,000 and 600,000 hospitalized patients develop deep vein thrombosis each year with as many as 50,000 deaths per year occurring secondary to pulmonary embolus. The incidence of thromboembolic disease appears to increase with age as well as with immobilization.[1] Prolonged rest and prone positioning on frames with compression of femoral veins and iliac veins have been indicated as possible risk factors during spinal surgery.[2,3]

A review of orthopaedic and neurosurgical literature reveals a wide variation of the incidence of thromboembolic disease in spinal surgery. Valladares and Hankinson reported deep vein thrombosis in 6 of 29 or 20% of patients undergoing spinal surgery.[4] Kozak reported 69 patients with anterior/posterior fusion for disabling low back pain with 3 cases of deep vein thrombosis and 2 non-fatal pulmonary emboli reported.[5] Stolke reported 412 primary and 69 reoperated surgical cases for herniated lumbar disc and 1 death secondary to pulmonary embolus for a death rate of .2% secondary to thromboembolic complications.[6] Johnson reported 44 consecutive cases undergoing treatment for isthmic spondylolisthesis with 1 case of thrombophlebitis requiring heparinization.[7] Byrd reported 1 of 27 patients expired secondary to pulmonary embolus following anterior/posterior spinal fusion.[8]

Review of neurosurgical literature reveals a variable deep vein thrombosis rate following laminectomy without prophylaxis of 6% to 70%.[9] Ferree reported a 5% incidence of postoperative calf deep vein thrombosis following laminotomy and laminectomy in patients using compression stockings as prophylaxis. Ferree also reported postoperative duplex scans on 195 patients undergoing posterior surgery in order to diagnose thromboembolic disease. One hundred one patients had spinal fusions and 84 laminectomy. One hundred eleven of the patients were assigned to an intermittent pneumatic compression group with 74 patients being placed in

elastic compression hose. A total of four patients developed deep vein thrombosis postoperatively, all of which were in the elastic compression group. No patient in the intermittent pneumatic compression group developed deep vein thrombosis. The conclusion of the study was that intermittent pneumatic compression significantly reduced the incidence of acute deep vein thrombosis.[2] Bell undertook a three part study to determine the incidence of deep vein thrombosis and the effect of prophylaxis using pneumatic compression hose. Surgery included hemilaminectomy, bilateral laminectomy, and fusion. Phase I of the study included 31 patients undergoing laminectomy and hemilaminectomy without prophylaxis. Venograms were done at days 2 and 3 postoperatively to determine the incidence of deep vein thrombosis. Fourteen patients had spinal anesthetic and 17 patients underwent general anesthetic. Results showed a 25% incidence of deep vein thrombosis in 8 of 31 patients. Five of 14 patients had deep vein thrombosis using spinal anesthetic and 3 of 17 patients had deep vein thrombosis using general anesthetic with a higher incidence of deep vein thrombosis in bilateral laminectomy versus unilateral. Phase II of the study evaluated the efficacy of pneumatic compression stockings. One hundred ninety-four patients were randomized to a pneumatic compression stocking group versus a control group. Ninety-nine patients were placed in a pneumatic compression stocking group and 95 patients in the control group. Surgical patients included both laminectomy and fusion patients. Again all patients were studied by venography. Results showed that 7% or 7 of 99 patients in the pneumatic compression stocking group developed deep vein thrombosis with 21% or 20 of 95 patients in the control group demonstrating a deep vein thrombosis. All 7 patients in the pneumatic compression stocking group developed calf thrombi, whereas 2 of the 20 patients in the control group developed proximal thrombi. Two patients in the control group developed bilateral calf thrombi.

When further analyzed according to type of anesthesia, results showed that 9 of the 51 spinal anesthesia patients with pneumatic compression stockings developed deep vein thrombosis while 14 of 51 or 27% of patients without pneumatic compression stockings developed thrombi ($p < .001$). For patients receiving general anesthesia, 7 of 48 or 14% of patients in the pneumatic compression stocking group developed deep vein thrombosis while 6 of 44 or 13% of patients in the control group developed deep vein thrombosis. This difference was not statistically significant. The third phase of the study again shows that the prophylactic effect of pneumatic compression stockings was dramatic for patients undergoing spinal anesthesia. The general anesthetic group demonstrated a decrease in the rate of deep vein thrombosis using pneumatic compression stockings from 13.6% to 8.1%. All phases of the study showed a significant incidence of deep vein thrombosis in spinal surgery.[10]

Smith performed a prospective study of 317 patients in an effort to attempt to determine the prevalence of deep vein thrombosis after reconstructive spinal surgery. One hundred twenty-six of the 317 patients were examined with Duplex ultrasound assessment, and all patients had sequential pneumatic compression hose used on the lower extremities. Of the group of patients who were screened, no positive tests were noted for deep vein thrombosis. Following screening, however, one patient in each group developed deep vein thrombosis as well as an additional patient who developed a fatal pulmonary embolus. Overall clinical prevalence with thrombotic complications was 1%.[11]

In 1992 the authors reported 41 patients undergoing adult reconstructive spinal surgery using either pedicular or segmental instrumentation. One day before discharge all patients underwent noninvasive testing using color duplex Doppler imaging to rule out deep vein thrombosis. Six patients were noted to have results compatible with deep vein thrombosis for an overall deep vein thrombosis rate of 14%. Several of these patients had spinal trauma with complete paraplegia. A 9.8% incidence of deep vein thrombosis was noted in patients without paraplegia. Intermittent pneumatic compression hose during this study was used prophylactically but applied postoperatively in the recovery room and not during the surgery.[12] Ferree et al.[2] reported a significant difference in their 2% versus 9.8% incidence of deep vein thrombosis. They felt a significant difference in the two patient populations was secondary to the fact that patients in their study did not include trauma and paraplegia and did not undergo anterior spinal surgery. Ferree also noted that pneumatic compression hose was applied preoperatively during his study versus postoperatively in the 1992 study.[2]

To resolve this issue, an additional 41 patients were studied prospectively, again using color duplex Doppler imaging. All patients had pneumatic compression hose applied preoperatively.

Doppler imaging, ultrasonography, and plethysmography have been found to be accurate in the evaluation in the thigh vein system; and iodine labeled fibrinogen testing is sensitive to thrombus formation in the calf.[13] Use of real-time ultrasonography seems to improve diagnostic ability in both the calf and the thigh. Recent incorporation of Doppler and ultrasound technology has lead to the duplex Doppler imaging and color Doppler imaging. These systems function by following frequency variation, called the Doppler shift, which is proportioned to the velocity of the blood flow. The Doppler imaging combines real-time ultrasound with semiquantitative color encoding of the Doppler information. Conventionally, arterial flow is displayed in a red color and venous flow on the blue scale. Slower flow has a deeper hue saturation and faster flow a lighter saturation. Most patients can be accurately evaluated in the thigh by use of the duplex Doppler image. Color Doppler imaging increases the sensitivity of duplex Doppler imaging in detecting deep vein thrombosis in the calf as well.[14] Although it has been argued that rarely does calf deep vein thrombosis cause pulmonary embolus, it has been noted that propagation of calf deep vein thrombosis into the popliteal area and femoral system does occur.

MATERIALS AND METHODS

Forty-one patients were studied prospectively. Adult patients undergoing major posterior surgery using pedicular or segmental instrumentation were included in the study. Acute trauma, paralytic, and anterior surgery patients were excluded. All patients underwent surgery using chest rolls with slight flexion of the operating table. Operating technique involving hypotensive anesthesia and spinal cord monitoring was indicated. Lower extremities were not wrapped. Intermittent sequential pneumatic compression hose was applied preoperatively in the operating theater. Sequential compression hose was continued postoperatively in the recovery room and once the patient was transferred to the floor. Sequential compression hose was allowed to be removed for 1 hour twice daily. Hose was kept in place until the patient was ambulating well and

approaching the time of discharge.

One day prior to discharge patients underwent noninvasive testing to rule out deep vein thrombosis of the lower extremities. Scanning involved the use of previously described color duplex imaging. Positive results were reviewed by a vascular surgeon. When Doppler studies confirmed deep vein thrombosis, patient's discharge was cancelled, intravenous heparin was administered, and later the patient was converted to oral Coumadin. The patients were discharged while receiving Coumadin.

RESULTS

Forty-one patients underwent noninvasive testing. The average age of the patient was 41 years of age. Diagnosis included 21 patients with spondylolisthesis including 9 patients with isthmic spondylolisthesis and 12 patients with degenerative spine disease. Seven patients had adult scoliosis and 13 patients had degenerative problems other than spondylolisthesis; most involved recurrent herniation. Of the 41 patients, 1 patient in the group was noted to have results compatible with deep vein thrombosis and underwent anticoagulation resulting in a 2.4% incidence of deep vein thrombosis. This patient did not have problems regarding wound hematoma or anticoagulation.

DISCUSSION

The incidence of 2.4% deep vein thrombosis appears compatible with Ferree's incidence of 2% deep vein thrombosis following posterior lumbar surgery, but higher than the 0% found in Ferree's intermittent pneumatic compression group. The incidence of 2% is higher than the .9% complication rate (3 out of 317 patients) noted by Smith. One of the three complications in Smith's study was a fatal pulmonary embolus. Finally, our 2.4% incidence is lower than the 7% incidence in the randomized pneumatic compression group noted by Bell. All patients in Bell's study were diagnosed by venography, considered the gold standard.

It appears, based on this study, that the application of sequential hose in the preoperative period significantly decreases the incidence of deep vein thrombosis in the postoperative spinal patient. This is supported be Ferree's study. The incidence of deep vein thrombosis following spinal surgery appears significant as manifested by the death in Smith's study. General anesthesia alone is noted to increase the incidence of deep vein thrombosis.[15,16]

The reported incidence following laminotomy and laminectomy would in and of itself appear to require some consideration for prophylaxis. Since the incidence would be expected to increase in the spinal deformity patient, further attention toward therapeutic regimens to decrease the incidence may be necessary. The ideal method for prevention of deep vein thrombosis remains controversial. While anticoagulation is an acceptable method for total arthroplasty patients, the potential complication of epidural hematoma and subsequent cauda equina syndrome makes its use in spinal surgery patients unacceptable. Our attempt at using low molecular weight heparin was abandoned after two patients developed wound complications secondary to hematoma.

CONCLUSION

Compressive methods of prophylaxis using intermittent pneumatic compression hose appear to be reasonably efficacious based on the above reviews. Several studies demonstrate their ability to decrease the overall incidence of deep vein thrombosis and subsequent incidence of pulmonary embolism. Use of intermittent compression hose appears to provide a reasonable level of primary prevention. The efficacy of routine screening in the postoperative period for spinal surgery patients remains controversial. Efficacy can only be determined by weighing the cost of noninvasive scanning versus the burden of an occasional death secondary to pulmonary embolus. In our hospital, the cost of noninvasive testing is $289.

Certain patients will be at an increased risk for developing deep vein thrombosis. Risk factors include prolonged immobility or paralysis, prior venous thromboembolism, cancer, obesity, varicose veins, congestive heart failure, or oral contraceptive use.[17] These patients are at a significant risk even with pneumatic devices in place. In this group perhaps secondary prophylaxis could be added and the patients considered for serial postoperative screening with duplex ultrasound to further screen and diagnose the incidence of deep vein thrombosis. At the present time, no data appears to support the use of anticoagulation as prophylaxis in the spinal surgery patient. STI

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