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ORIGINAL ARTICLE

Incidence of thromboembolic complications in lumbar spinal surgery in 1,111 patients

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Abstract Deep venous thrombosis (DVT) and pulmonary embolism (PE) cause significant morbidity and mortality in orthopaedic surgical practice, although the incidence following surgery to the lumbosacral spine is less than following lower limb surgery. Our objective was to compare our rate of thromboembolic complications with those published elsewhere and investigate whether the adoption of additional pharmacological measures reduced the incidence of clinically evident DVT and PE. This retrospective study was undertaken to investigate the incidence of DVT/PE during the 10 years from 1 January 1985 to 31 December 1994, and then to assess the effectiveness of an anticoagulant policy introduced during 1995 using low dose aspirin or LMH in high risk cases. All records for spinal operations were reviewed for thrombo-embolic complications by reference to the Scottish Morbidity Record form SMR1. To ensure that all patients were compliant with the policy, data for the whole of 1995 was omitted and the period 1 January 1996 to 31 December 2003 was taken to assess its effectiveness. Surgery was done with the patient in the kneeling, seated prone position which leaves the abdomen free and avoids venous kinking in the legs. Records of a total of 1,111 lumbar spine operations were performed from 1 January 1985 to 31 December 2004 were reviewed. The overall incidence of thrombo-embolic complications was 0.29%. A total of 697 operations were performed from 1 January 1985 to 31 December 1994 with two cases of DVT and no cases of PE giving thromboembolic complication rate of 0.29%. During the period 1 January 1996 to 31 December 2003, 414 operations resulted in one case of DVT and no cases of PE, a rate of 0.24%. The incidence of symptomatic thromboembolic complications in lumbar spinal surgery is low in the kneeling, seated prone operating position, whether or not anticoagulation is used.

Keywords Deep venous thrombosis · Pulmonary embolism · Lumbar spine surgery · Kneeling seated prone operating position · DVT prophylaxis · Aspirin

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Introduction

As the complexity of spinal surgery increased, so too has the incidence of deep venous thrombosis (DVT) and pulmonary embolism (PE) [3, 11, 17, 20, 22, 40, 42, 46]. These events occur in up to 14.0% [46] and 2.9% [40] respectively of orthopaedic operations in general with the incidence being highest in surgery of the lower limb. Although prophylactic methods such as aspirin, low dose Heparin, elastic stockings and intermittent pneumatic calf compression have been used widely, a review of the literature suggests that thromboembolic disease is still a significant complication following spinal surgery [1, 4–10, 12, 14–16, 24, 25, 27, 28, 30, 32–34]. In surgery of the lumbosacral spine, the lowest quoted rates are 0.6% for DVT and 0.3% for PE [40]. Most studies reviewing the rates of DVT and PE did not make specific mention of the

operating position. We believe this may be a factor in the prevention of these complications.

Ideally, the surgeon and assistants must have uninhibited access to the operation site and the anaesthetist must be easily able to monitor the patient and administer inhalation and intravenous agents needed throughout the operation. There must be no restriction of ventilation or impairment of the arterial supply to—and venous return from—the lower limbs. This is particularly important since impairment of venous return from the legs is a major risk factor for the development of DVT and PE. Finally, the patient must be safe and not suffer from undue pressure on any one part of the body.

History

In 1937 Love and Camp [31] reported the prone position with pillows under the abdomen for surgery for lumbar disc protrusion. Subsequent authors emphasised the importance of adequate ventilation [21, 26, 29]. Smith et al. [39] in 1944 described a special table with the patient positioned with the hips flexed at 90° with pressure removed from the abdomen. Similar tables using lateral bolsters [2, 26, 36] have been described. Ecker [19] in 1949 and Lipton [29] in 1950 described knee–chest positions with the aim being to remove pressure from the abdomen with the chest being supported by a sling (Ecker) or by pillows (Lipton). These carried the danger of vascular impairment below the knees either due to venous kinking in the popliteal fossa or to compression of the deep veins within the calf. In 1950 Moore et al. [35] described a light-weight frame used in conjunction with a standard operating table.

In 1956 Taylor et al. [44] emphasised the need to minimise extradural bleeding by avoiding abdominal compression by means of an adjustable prop which could be used on any conventional operating table. Smith et al. [41] in 1961 described the "Georgia Prone Position" using fixed props beneath the pelvic crests. The thighs were flexed at right angles and the knees supported some of the patient's weight. Young et al. [47] in 1982 described the use of an "evacuatable" mattress (Evac M) for the operations of the lumbosacral spine to spread body pressure.

Another major advance in positioning was made in 1967 by Tarlov [43] with a "seated prone" position in which the patient is placed with the hips and knees flexed to ~90° and the operating table tilted to about 45°. The abdomen is left free and so there is no pressure on either the viscera or the inferior vena cava. Also the vessels in the groin and popliteal fossa are not at risk of compression from excessive flexion as they are with some other methods of support (Table 1).

Table 1 Breakdown of results by procedure and thromboprophylaxis

	Cases	DVT	PE	Calf comp	Stockings	Aspirin[a]
Non-fusion 1985–1994	554	0	0	208	23	0
Fusion 1985–1994	143	2	0	99	37	0
Non-fusion 1996–2003	272	1	0	272	272	272
Fusion 1996–2003	142	0	0	142	142	142
Totals	1,111	3	0	721	484	414

[a] Including those on low molecular weight heparin

Materials and methods

We carried out a retrospective review of patients who had spinal surgery in our unit from 1 January 1985 until 31 December 2003. From 1985 to 1995, the operations were performed without any pharmacological antithombotic prophylaxis. During 1995 an anticoagulant policy was introduced, in which patients were given aspirin 150 mg daily from the first post operative day, unless specifically contraindicated, in which case they were given low molecular weight heparin. In addition, after 1995 all patients had intermittent calf compression intra operatively and thrombosis embolic deterrent (TED) compression stockings post operatively. It took time for the policy to be established and so we excluded the data from 1st January 1995 to 31st December 1995 to ensure that all patients were compliant.

We found all those patients who had suffered a symptomatic thromboembolic event (DVT or PE) by utilising the Scottish Morbidity Record Scheme forms (SMR1) returned for each patient. The SMR1 is episode-based and relates to all patients admitted and discharged from Scottish Hospitals except psychiatric and obstetric cases. The national data set includes demographic information on the patient, administrative details including consultant in charge, and clinical details on diagnosis. SMR 1 data was provided by the Common Services Agency's Information and Statistics Division, Trinity Park House, Edinburgh, from their Scottish Linked Database.

We examined the case notes of all patients re-admitted to hospital for any cause within 3 months of spinal surgery, as well as those patients with a prolonged hospital stay. The SMR1 readmission data was used only to identify patients; diagnosis for readmission was ascertained from the case notes and not from the SMR1 forms. There were no in hospital deaths within three months of surgery, and no other deaths we were aware of.

During the 10-year-period of 1st January 1985 to 31st December 1995, and then the 8 years 1st January 1996 to 31st December 2003, we carried out 1,111 lumbar spinal

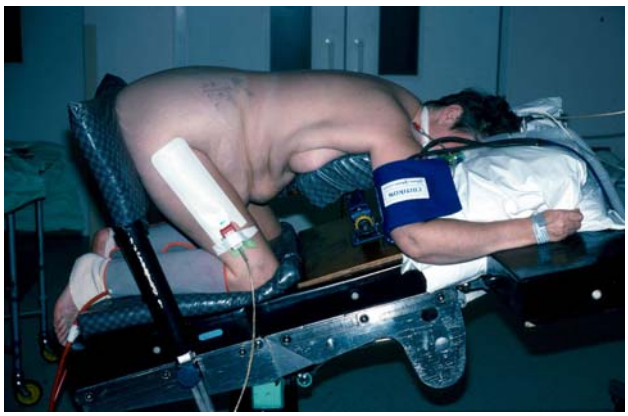

Fig. 1 The kneeling seated prone position with the operating table tipped to ~30°. The chest was supported by an adjustable raised pad. The hip and knee joints were flexed to about 110° and the thighs abducted to between 10 and 20° away from the midline. When used, the intermittent pneumatic compression was applied to both calves with a cycle time of between 30 and 40 s

operations in our unit. Data was checked by retrospective review of operating theatre records and case notes.

The indications for operation were leg pain in about four fifths and low back pain in about one fifth of cases. The operations consisted of laminotomy, laminectomy, disc enucleation, and spinal fusion with or without internal fixation. Accurate records of each operative procedure were kept and reviewed.

All cases were performed with the patient in a kneeling, seated prone position with the operating table tipped to approximately 30°. The chest was supported by a raised, adjustable pad, resting on the operation table. The hip and knee joints were flexed to about 110° and the thighs abducted between 10 and 20° away from the midline (Fig. 1). The majority of operations were performed under general anaesthesia with a few being done under epidural anaesthesia plus sedation.

The patients were mobilised on the second post-operative day following decompression and/or disc enucleation, on the fifth day after spinal fusion with internal fixation and on the twenty-second day after spinal fusion without instrumentation.

Results

In the first 10 years, from 1st January 1985 to 31st December 1994 there were 697 procedures, 554 of these were described as laminotomy, decompression and disc enucleation, and on average had an operating time of around 49 min, defined as the time the patient spent in the operating position. None of these patients had any form of prophylactic anticoagulation, but 128 had intermittent calf compression during surgery and 33 had compression stockings during the first 6 weeks post operatively in addition.

The remaining 143 had posterolateral spinal fusion, with or without decompression or pedicular fixation, with the overall operating time averaging 128 min. None had prophylactic anticoagulation, 109 had intermittent calf compression during surgery and 23 also had post operative compression stockings. During this time period there were two cases of DVT, on the 20th and 58th post-operative days respectively, and no cases of PE giving an overall thromboembolic complication rate of 0.29%. The first had exploration of L5/S1 and had an interbody fusion of L4/5 without intermittent calf compression. On the 20th post-operative day, developed a DVT in the left leg from the popliteal to iliac vein confirmed by venography. Operating time was 105 min. The second had fusion of L5 to S1 using Steffee plates with intermittent calf compression during surgery. The patient developed a popliteal vein thrombosis in the left leg confirmed by duplex ultrasound scan. The operating time was 90 min. Neither patient had compression stockings postoperatively.

From 1st January 1996 to 31st December 2003, there were 414 procedures. 272 of these were non-fusion, as described above, with the remaining 142 involving fusion. All 414 patients were given aspirin 150 mg daily from the first post operative day, unless specifically contraindicated, in which case they were given low molecular weight heparin. In addition, all patients had intermittent calf compression intra operatively and compression stockings post operatively. During this time period there was one case of DVT and no cases of PE giving an overall thromboembolic complication rate of 0.24%. The patient, a female was found to have a right ileo-femoral confirmed on Doppler ultrasound. She was had a revision decompression at L4/5 and L5–S1. The operation lasted 75 min. She was readmitted 34 days after surgery with a DVT. Intermittent calf compression had been used intra operatively and she was on Aspirin 150 mg once per day and had compression stockings post operatively.

The mother of one patient had had a DVT following hip arthroplasty, and another had a sister and father with DVTs. We could find no other major risk factors. The first two were managed with a standard regime of intravenous Heparin infusion, the third was given low molecular weight heparin, all were anticoagulated with oral Warfarin therapy with regular blood monitoring and made a complete recovery. There were no cases of fatal pulmonary embolism during the study.

Discussion

This is a retrospective study of 1,111 patients with an overall rate of clinically evident thrombotic complications

of 0.27%. The rate during the period without pharmacological DVT prophylaxis was thus 0.29%. During the second period, with additional pharmacological prophylaxis, the rate was 0.24%. DVT and PE are well-known complications of orthopaedic surgery, and although we accept that this is a retrospective study, as far as the patient is concerned, it is clinical DVT or pulmonary embolism that is important. We can make no comment as to the incidence of subclinical DVT.

The incidence in spinal surgery is lower than for that for orthopaedic operations in general, and there are a number of published reports with differing rates of the two conditions in spinal surgery [3, 11, 17, 20, 22, 37, 40, 42, 46]. The rate varies in some small series from 12% when operating in the prone position [46] to 1.6% for DVT and 05–3% for PE [22, 23, 40] with varying antithrombotic regimens. Rokito [37] reported only one case of DVT in a group of 329 cases (0.3%) of cervical, thoracic and lumbar surgery including anterior and posterior procedures. Posterior procedures were performed with the patients positioned prone with various antithrombotic prophylaxes. Eie [20] carried out a review of thrombotic complications in 2690 patients undergoing lumbar disc surgery in the knee-elbow position over 30 years and found 38 cases of DVT (4%) and 14 cases of PE (1.5%). The incidence was 10% in the 1950s when spinal fusion was performed in all their disc surgery patients, reduced to 4% from the 1960s onward and was 0% in the 1970s when only simple removal of the disc herniation was performed.

In our study the overall incidence of thrombotic complications was only 0.27% (0.29% prior to DVT prophylaxis, 0.24% since.) This is, evidently, much less than in many previously quoted studies. The operating position may be an important factor in the rate of thrombo-embolic complications, since there was no difference in the rates of thrombosis in the group of patients who had had additional prophylactic measures such as aspirin and compression stockings from those who did not.

It is interesting to note that two of the three patients who did have a thromboembolic complication had a positive family history for the condition.

With the patient in the kneeling, seated prone position and the table tipped 30° head-up, the patient is effectively sitting against the board which is placed under the buttocks with the rest of their weight being distributed through the knees and upper chest. Ventilation, as noted by our anaesthetic colleagues, is not significantly restricted and the blood vessels in the groin and popliteal fossa are not compressed.

Tarlov, describing his kneeling, seated prone position [43] commented that central venous pressure (0–2 cm of water) was not significantly changed from normal. This was confirmed by Cook [13] in a study of 12 patients. Distephano [18] gave a comparison of inferior vena cava pressures measured during surgery of the lumbosacral spine with different operating positions and, again, concluded that the Tarlov position is superior in this respect. In prone position with the pressure-free abdomen, ventilation is enhanced without any change in regional perfusion [38] and that will definitely improve the safety of the operation. Tarlov reported two minor post-operative cases of DVT out of 300 cases (0.6%) and attributed these to excessive flexion of the hips and knees at the time of surgery. In a fifteen year survey undertaken by Wayne [45] the authors reported favourably of this position with only one case of DVT occurring in 253 cases (0.4%). The lack of pressure on the abdomen is particularly welcome to the surgeon as there is no venous congestion and therefore a more blood-free operative field.

Conclusions

In this retrospective study, the addition of pharmacological DVT prophylaxis has not been demonstrated to reduce the incidence of symptomatic DVT and PE which is the lowest so far published in the literature. We suggest that this may be attributable to the operative positioning which has remained constant throughout the study.

This study does not allow us to rule out other factors, as yet unknown, that contribute to the low levels of symptomatic DVTs and PEs, and our findings may not be broadly applicable to other patient populations.

We feel this merits further investigation.

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