

Clinical Venous Thromboembolism in Spinal Trauma with and Without Spinal Cord Injury: A 3-Year Experience of Midlands Centre for Spinal Injuries, Oswestry, UK

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Abstract

Background and Aims: This study aimed to determine the incidence of deep-vein thrombosis (DVT) and pulmonary embolism (PE) among patients admitted acutely to a regional spinal injury center, following spinal trauma; to compare its occurrence between those with spinal cord injury (SCI) and those without; and to assess the effect of various factors such as age, gender, neurological impairment, and duration of prophylaxis on the incidence observed. **Patients and Methods:** We retrospectively reviewed the charts of 374 consecutive patients who sustained traumatic spinal injury and were admitted acutely to the Midlands Centre for Spinal Injuries, Oswestry (UK), over a 3-year period. A total of 159 patients had spinal trauma with SCI and 215 were neurologically intact. The majority of these patients were treated nonsurgically and received the same thromboprophylactic regimen started within a median of 2 days postinjury. The incidence of clinical VTE (DVT and PE) was determined and some risk factors were assessed. Ethical approval was obtained through the Audit Office Committee of the Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry. **Results:** Among the neurologically intact group, one patient developed clinical PE (0.5%). Out of 159 patients with SCI, 23 developed clinically evident VTE (14.5%), 15 had DVT (11.9%), 4 had PE (5%), and 4 had both DVT and PE. There was no fatality. Complete SCI lesions were associated with higher incidence of VTE compared to incomplete lesions, 17.6% and 11%, respectively ($P < 0.001$). There were two peaks of thromboembolic episodes: the first during the first 2 weeks after injury (30% of cases) and the second was after the 8th week postinjury (38% of cases). A higher incidence of VTE was recorded in males than females (14.3% and 7.9%, respectively). Also, the incidence of VTE is slightly higher in the age group between 40 and 60 years, but these differences were not statistically significant. **Conclusions:** SCI is associated with high risk of venous thromboembolism, and the risk increases with the severity of cord insult. While spinal column injury is shown to be associated with much lower risk. The risk is reduced with strict adherence to thromboprophylactic regimen which we suggest to continue for at least 12 weeks for SCI patients.

Keywords: Deep-vein thrombosis, pulmonary embolism, spinal cord injury, spinal injury, thromboprophylaxis, venous thromboembolism

INTRODUCTION

For several decades, the potential fatal outcome from venous thromboembolism (VTE) in spinal cord injuries (SCIs) was realized. Tribe in 1963^[1,2] showed pulmonary embolism (PE) to be the cause of death of 37% of those dying within 3 months of SCI (without prophylaxis). Green *et al.* reported 4% mortality due to PE with thromboprophylaxis.^[3,4] DeVivo *et al.*^[5] reported PE as the cause of death in 9.7% of 496 SCI patients in the 1st year after injury.

Waters *et al.*^[6] reported an incidence of 14% clinically evident deep-vein thrombosis (DVT) in 909 patients with acute SCI, and they noted no difference between the surgically and

nonsurgically treated groups (13% vs. 15%, respectively). The incidence of PE was equal for both the groups at 5%.

In the present study center, a thromboprophylaxis regimen of a combination of pharmacological anticoagulants and

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mechanical means is implemented on all patients with spinal injuries with or without neurological deficit. We evaluate the results of this regimen and discuss variations in incidence by age groups, gender, level, and presence or absence of neurological deficit and its severity.

PATIENTS AND METHODS

Subjects

We reviewed the clinical notes and the center database system of all newly admitted patients at the Midlands Centre for Spinal Injuries, Oswestry (UK), over a 3-year period. The total number of new patients admitted to the center during the period of study was 467 patients. We included patients who sustained trauma to the spine, were admitted within 2 weeks from injury, and were commenced on anticoagulation prophylaxis within 72 h ($n = 374$). Ninety-three patients were excluded as they did not fulfill the above criteria (34 were nontraumatic and 59 were traumatic but admitted late or did not complete treatment).

There were 215 patients of spinal column injury and no neurological deficit (American Spinal Injury Association [ASIA] E) and 159 patients with SCI resulting in either complete (ASIA A) or incomplete (ASIA B, C, or D) paralysis, according to the ASIA Impairment Scale.^[7]

Prophylactic measures

All patients were commenced on low-molecular-weight heparin (LMWH) (tinzaparin) within 72 h of injury. Patients were subsequently started on warfarin (anticoagulation with antivitamin K) once they were able to take oral medication. The international normalized ratio (INR) was regularly monitored to maintain adequate prophylactic levels (target INR level of 2.0, range: 2–3). Warfarin was discontinued after an average period of 6 weeks from injury, and patients were monitored for evidence of VTE until discharge. Passive exercises by physiotherapy and nursing staff were carried out daily; elasticated compression stockings were applied from the day of admission unless there was a contraindication.

Patients were monitored for clinical evidence of VTE daily. If suspected, the diagnosis was confirmed or refuted by ultrasound/ipsilateral venography for DVT and ventilation–perfusion (V/Q) lung scan for PE. Postmortem examination was carried out for all causes of death (as per the hospital and national policy for inpatients of trauma).

Statistical analysis

The data were analyzed using Excel spreadsheet and SPSS statistical package (Microsoft Excel 365/2021 and IBM SPSS Statistics (Statistical Package for Social Science), version 23.0.0.0 USA; the Chi-square test was used for measuring the independence of variables.

RESULTS

The neurologically intact group

A total of 215 patients fulfilled the criteria for inclusion; there

were 141 (67%) males and 74 (33%) females; the mean age was 38.6 (standard deviation [STD] \pm 19.9) years, with an average period of in-hospital stay of 34 (STD \pm 24) days. One patient, aged 70 years, developed symptoms and signs of PE, confirmed by a V/Q lung scan, 11 days postinjury. He had fracture L1 vertebra treated by surgical stabilization. None of the patients in this group developed clinically detectable DVT [Table 1].

The spinal cord injury group

The median time to admission to the center after injury was 2 days. There were 73 cervical, 60 thoracic, and 26 lumbar vertebral injuries with an injury to the spinal cord or cauda equina. The mean age was 40.7 years (range: 14–88 years); there were 121 (76%) males and 38 (24%) females. Sixty-eight (43%) patients had complete injuries and 91 (57%) had incomplete neurological loss [Table 2].

Nineteen patients developed clinically manifest DVT, confirmed by venography, a prevalence of 11.9%. Four of these patients developed signs of PE confirmed with V/Q lung scan. Four other patients had confirmed clinical PE without clinical signs of DVT. The total prevalence of PE was 5% [Table 3]. No fatal PE occurred in the treated patients. There were eight deaths during the study period; all underwent a postmortem examination.

Table 1: Prevalence of deep-vein thrombosis and pulmonary embolism in the study groups

Neurology	Number of patients	DVT (%)	PE (%)
Complete tetraplegic	21	3 (14.3)	0
Complete paraplegic	47	7 (14.9)	5 (10.6)
Incomplete tetraplegic	52	9 (17.3)	2 (3.8)
Incomplete paraplegic	39	0	1 (2.6)
Total SCI group	159	19 (11.9)	8 (5.0)
Intact neurology group	215	0	1 (0.47)

DVT: Deep-vein thrombosis, PE: Pulmonary embolism, SCI: Spinal cord injury

Table 2: Spinal cord injury population gender and neurological status

	Complete (%)	Incomplete (%)	Total (%)
Males	51 (42.1)	70 (57.9)	121 (76.1)
Females	17 (44.7)	21 (55.3)	38 (23.9)
Tetraplegic	21 (13.2)	52 (32.7)	73 (46)
Paraplegic	47 (29.6)	39 (24.5)	86 (54)
Total	68 (43)	91 (57)	

Table 3: Occurrence of venous thromboembolism among patients with complete and incomplete lesions

	Complete lesions (percent of group)	Incomplete lesions (percent of group)
Tetraplegia	3 (14.3)	9 (17.3)
Paraplegia	10 (21.3)	1 (2.6)
Total	13 (17.7)	10 (11)

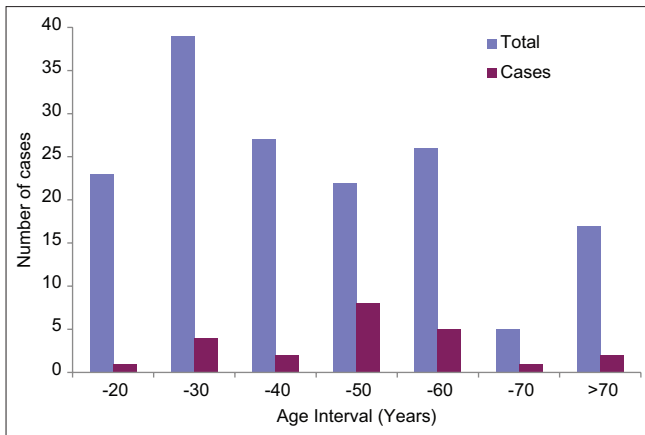


Figure 1: Incidence of thromboembolic complications among age groups

When analyzed by age, the prevalence of VTE was found to be higher in the age group between 40 and 60 years. There was, however, no statistically significant correlation between age and incidence of VTE [Figure 1].

When analyzed by gender, it was noted that DVT occurred more commonly in males (13.2%) than females (7.9%) while PE occurred in equal frequency in both sexes. Overall, there was no statistically significant difference in incidence of VTE between males and females.

Patients with complete lesions had a higher occurrence of VTE (17.7%) than those with incomplete lesions (11%). The difference was statistically significant ($P < 0.001$); the highest occurrence of PE was in the complete paraplegia group (21.3%) [Table 2].

Two peaks of thromboembolic episodes were noticed, the first during the first 2 weeks after injury (30% of cases) and the second after the 8th week postinjury (38% of cases) [Figure 2], after discontinuing thromboprophylaxis.

DISCUSSION

Regimens instituted for thromboprophylaxis still vary widely from simple Thrombo Embolic Deterrent (TED) stockings to the insertion of vena cava filters. Data from the model system in North America report fatal PE to be the third most common cause of death in the 1st year after SCI.^[1] Green *et al.* also reported fatal PE in 2 of 41 (5%) and 2 of 48 (4%) SCI patients.^[3,4] The consortium for spinal cord medicine guidelines stated that combination treatment prophylactically is more efficient than a single method.^[8]

LMWHs are the most commonly prescribed chemical thromboprophylactic agents, alone or in combination with mechanical means. Oral anti-Vitamin K (warfarin) is still being used in some spinal injuries' centers in the UK, especially for long-term prophylaxis. Thumbikat *et al.*^[9] suggested that it remains a safer option than enoxaparin in the SCI population.

In our experience, a combination regimen of LMWH/warfarin with mechanical means was effective in preventing fatal PE and in reducing VTE morbidity.

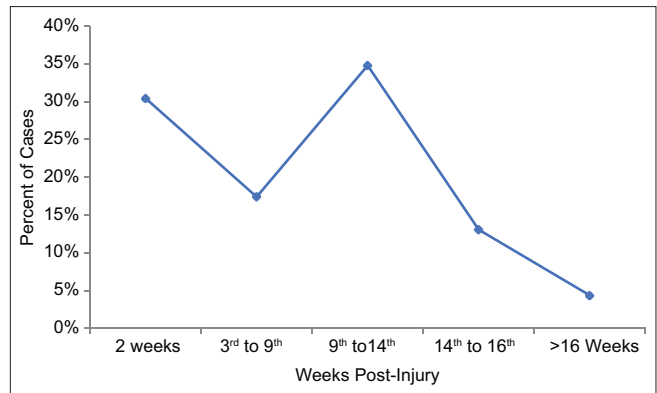


Figure 2: Time of peak incidence of thromboembolic complications

It is shown that the incidence of VTE peaks within the first 2 weeks of injury and then peaks again after the 8th week, following discontinuation of thromboprophylaxis in this series. This is similar to the finding by Thumbikat *et al.*,^[9] and Green *et al.*^[3] also reported one fatal PE out of 33 patients, 2 weeks after discontinuation of thromboprophylaxis. We, therefore, suggest that thromboprophylaxis continues for at least 12 weeks postinjury or until discharge in high-risk patients (vide infra). This recommendation was also made in 2004 by the seventh American College of Chest Physicians (ACCP) conference on antithrombotic and thrombolytic therapy.^[10]

We have shown that the prevalence of VTE was highest among the complete paraplegic patients (21.3%) and lowest among the incomplete or minimal deficit patients (2.6%). Our findings confirm earlier reports by Chen *et al.*^[11] and Ragnarsson *et al.*^[12]

The great majority of patients without neurological deficit were treated with bed rest for a period of 4–6 weeks in this series. There was only one out of 215 patients in this group who developed PE a few days after surgical stabilization. We have found no other reports in the English literature about the incidence of thromboembolism in neurologically intact patients treated conservatively with 4–6 weeks of bed rest. The significant statistical difference in incidence between the neurologically intact and the neurologically impaired ($P < 0.01$) suggests that the effects of the neurological impairment such as paralysis, and possibly also the neurological impairment itself, are the major risk factors for the development of VTE. Bed rest alone with adequate prophylaxis against VTE does not seem to increase the risk of VTE in patients with spinal injuries with and without neurological impairment.

We have shown that SCI is associated with high risk of VTE and the risk increases with the severity of cord insult. While spinal column injuries is shown to be associated with much lower risk. Strict adherence to thromboprophylactic regimen and its early commencement postinjury may prevent VTE complications in many patients.

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Conflicts of interest

There are no conflicts of interest.

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