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Short Communication

Venous Thromboembolism and Pressure Ulcers in Acute Spinal Cord Injury: A Retrospective Review

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Abstract

Patients with acute spinal cord injury (SCI) are at high risk of development of complications such as venous thromboembolism (VTE) and pressure ulcers. Clinical guidelines recommend certain preventative and prophylactic strategies in order to reduce the risk of such complications. We aimed to assess the incidence of VTE and pressure ulcers in patients with SCI presenting to a level I trauma center and to evaluate potential factors that might be associated with their occurrence. Utilizing a prospective centralized trauma database, we identified 94 patients with acute SCI; of these 33% had completed SCI (American Spinal Injury Association Impairment Scale (AIS) grade A). VTE occurred at a rate of 11.7% with all affected patients being in the surgical group. Low Molecular Weight Heparin (LMWH) was administered in 72.1% of patients, with 26.9% of these patients developing VTE compared to 75% of patients treated with un fractionated heparin (UFH) ($X2=3.6$, $P = 0.058$). The incidence of pressure was 16.0%, with 30% of complete cord injuries being affected ($P = 0.022$). Development of pressure ulcers was associated with a delayed transfer to neurorehabilitation ($P = 0.037$). This study illustrates the experience of a level I trauma center in relation to development of specific SCI-related complications and emphasizes the role of certain parameters in reducing the rate of these complications.

ABBREVIATIONS

SCI: Spinal Cord Injury; DVT: Deep Vein Thrombosis; PE: Pulmonary Embolism; VTE: Venous Thrombo Embolism; ASIA: American Spine Injury Association (ASIA); AIS: ASIA Impairment Scale; LMWH: Low-Molecular Weight Heparin; UFH: Un-Fractionated Heparin

INTRODUCTION

The management of acute spinal cord injury (SCI) requires a multifaceted approach that integrates surgical and medical interventions in order to optimize neurologic recovery and reduce post-SCI complications. Patients with SCI are at high risk for complications associated with significant morbidity and mortality such as venous thromboembolism (VTE) and pressure ulcers [1-7]. Such complications are associated with The incidence of VTE in SCI has been reported to be as high as 74%, with pulmonary embolism (PE) being the most serious form of VTE [8,9]. Based on class II evidence, clinical guidelines favor early use of chemical and mechanical VTE prophylaxis in SCI postoperatively, and support the choice of low-molecular-weight heparin (LMWH) over unfractionated heparin (UFH) [10,11]. In addition, development of pressure ulcers was considered the most common complication associated with SCI in one series [12]. Pressure ulcers increase the risk of sepsis and may impede neurologic recovery by delaying neurorehabilitation, emphasizing the role of primary prevention of these complications post-injury. Although a number of complications could be associated with SCI including urinary tract infections, cardiac dysrhythmia and pneumonia, [4] we aimed to evaluate the incidence of specific avoidable complications such as VTE and pressure ulcers in a cohort of patients referred to a level I trauma centre.

MATERIALS AND METHODS

Study sample

All patients, in our province, with acute traumatic SCI are transferred to the Queen Elizabeth II Health Sciences Centre in Halifax, which is the only level I trauma center in Nova Scotia, Canada. Patients with acute traumatic SCI presenting between 2006 and 2010 were identified through a centralized trauma database. A retrospective chart review was completed in

order to obtain relevant historical data concerning severity of injury, occurrence of VTE, pressure ulcers and alcohol serum levels documented on admission. The American Spinal Injury Association (ASIA) Impairment Scale (AIS) was used as a standardized neurologic assessment to define the extent and severity of SCI, and monitor improvement [13].

Determination of VTE and pressure ulcers

The diagnosis of deep vein thrombosis (DVT) or pulmonary embolism (PE) was based on diagnostic imaging (Doppler ultrasound or CT pulmonary angiography, respectively) and was only performed upon clinical suspicion from the treating physician. Monitoring for pressure ulcers in our institution is performed according to a standardized screening protocol for pressure ulcers [14]. The presence of a pressure sore was identified on the basis of documentation in chart records as well as admission and discharge records from rehabilitations.

Statistical analysis

Data analysis was performed using SPSS version 21.0. Results were summarized as single proportions with 95% binomial confidence intervals, calculated using the score method for data with a binomial distribution. Differences of proportions of cases with SCI in study comparisons were assessed with the Pearson chi-squared test. Kolmogorov-Smirnov (for $n > 50$) or Shapiro-Wilk (for $n < 50$) tests were used to determine whether data were normally distributed. For normally distributed data, two-sample student's t-test for independent samples or one-way ANOVA was applied in comparing means between 2 or more groups, respectively. Alternatively, for non-normally distributed data, Kruskal-Wallis analysis of variance with post-hoc Mann-Whitney U test was used. All levels of significance were two-tailed and set at $p < 0.05$.

RESULTS AND DISCUSSION

We identified102 patients with suspected SCI and included 94 patients in the analysis after excluding 6 pre-hospital deaths and 2 patients with incomplete hospital records. Of those, there were 66 patients with cervical cord injury, among which 31 patients had complete SCI (AIS grade A injury). The mean age of patients was 47.6 ± 20.7 years, with male patients accounting for 74% of SCI cases. Radiographic investigations for suspected VTE were performed in 31 patients with SCI based on clinical suspicion. VTE occurred in 11 patients (11.7%) all of whom were in the surgically treated group. Isolated DVT was diagnosed in 2 cases, whereas PE occurred in 9 cases. Of those patients with PE, only one case had a Doppler ultrasound positive for DVT whereas the remainder was found to have isolated PE. DVT prophylaxis was administered in 96.7% of patients with SCI within 72 hours. In surgically treated patients, DVT prophylaxis was initiated within 24 hours postoperatively in 73% of cases with the remainder receiving prophylaxis ≥ 24 hours. Although a higher percentage of patients with delayed chemical prophylaxis (≥ 24 hours) developed VTE compared to early prophylaxis, this difference was not statistically significant ([44.4%] vs. [35%], respectively, $P = 0.62$). Of those cases receiving DVT prophylaxis, LMWH (5000 units once daily) was administered in 72.1%, UFH (5000 units twice daily) in 26.7% and warfarin (7 mg once daily) in 1.2%. DVT occurred in the only case treated with warfarin. In addition, a higher percentage of patients treated with UFH (75%) was diagnosed with VTE, compared to 26.9% of those treated with LMWH ($X2=3.6$, $P = 0.058$). There was no significant difference in age, gender or the rate of positive serum alcohol levels on presentation between patients with and without VTE ($P > 0.05$).

Pressure ulcers occurred in 16.0% of SCI patients, affecting the sacro-coccygeal area (n=10), calcaneal area (n=3), skin overlying the ischial tuberosity (n=1) and malleolus (n=1). Although the mean time of transportation from peripheral centers was longer in patients with SCI who developed pressure ulcers compared to those without ulcers, this difference did not reach statistical significance ([12.2 ± 28.9 h] vs. [8.3h ± 7.9 h], $P = 0.104$). Acute care hospital admission was significantly prolonged in patients with pressure ulcers compared to those without ([39.7 ± 22.4 days] vs. [24.8 ± 18.2 days], $P = 0.009$), as was the length of stay at neurorehabilitation ([118.2 ± 68.7 days] vs. [79.1 ± 55.4 days], respectively, $P = 0.037$). Pressure ulcers developed in 30% of complete SCI cases, compared to 10.5% of incomplete SCI ($X2 = 5.2$, $P = 0.022$). Patients with a complete injury had an odds ratio of 3.6 (95% CI, 1.2–11.5) of developing a pressure ulcer compared to incomplete injuries. A higher proportion of cases with cervical SCI (22.2%; 95% CI, 10.6–40.7%) were affected by pressure ulcers, compared to thoraco-lumbar SCI (14.5%; 95% CI, 7.8–25.3%) ($X2 = 0.8$, $P = 0.372$).

To our knowledge, the lowest reported rate of DVT in a traumatic SCI population is 7% [15,16]. We found a slightly higher but comparable rate of VTE in our study (11.7%), with no significant difference in the rate of VTE among patients started on prophylactic anticoagulation either within 24 hours or ≥ 24 hours. Indeed, the vast majority of patients in the late prophylaxis group were treated within 72 hours. These data suggest that the initiation of VTE prophylaxis in post-operative day 2 is associated with the same rate of VTE as in postoperative day 1. In addition, UFH was associated with a higher rate of VTE compared to LMWH ($P = 0.058$), which supports clinical trials indicating that LMWH be used due to lower incidence of VTE and hemorrhagic events, compared to warfarin and UFH [11,15-18]. All patients in our series who developed DVT or PE were receiving VTE prophylaxis which stresses the notion that all physicians caring for patients with SCI are required to exercise a high index of clinical suspicion for VTE even among those treated with DVT prophylaxis. There was no significant association between VTE and age or gender in this study population. However, a retrospective review of 16,240 adult and pediatric patients with spinal cord injury demonstrated that male gender, multiple co-morbidities especially metastatic cancer, chronic neurologic disease and obesity were found to be significant predictors of VTE, whereas patients aging less than 14 years had a significantly lower risk for VTE [19].

Pressure ulcers constitute a significant healthcare burden with potential septic complications and subsequent delay in SCI neuro rehabilitation programs [20,21]. In this study, about 1 in 6 patients developed a pressure ulcer, with a higher proportion of affected cases being complete injuries. The rate of pressure ulcer occurrence in SCI has been reported to reach as high as 49.2% with an estimated incidence of 2.2 per person per year [21]. Pressure ulcers are arguably a preventable complication.

Our results indicate that prolongation of the transport time to a trauma center whilst lying on a hard spinal board maybe associated with increased incidence of pressure ulcers. In all cases with pressure ulcers, the mean transport time was 12 hours with 30% of complete injuries developing a pressure ulcer. Such concern has been highlighted in the literature [22], and these findings call for an evaluation of health policies underlying the pre-hospital use of hard spinal boards and their potential association with adverse effects.

CONCLUSION

The incidence of VTE in our series of traumatic SCI was 11%, with a higher proportion of VTE events occurring in patients treated with UFH. In addition, the incidence of pressure ulcers was 16%, with patients affected by complete SCI being at a higher risk. Development of pressure ulcers in the context of SCI is an avoidable complication that was significantly associated with prolonged admission and delayed neurorehabilitation. Physicians are encouraged to exercise vigilance in monitoring for such potential life-threatening complications after SCI in order to optimize neurologic recovery post-SCI.

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