JOURNAL OF TRAUMA MANAGEMENT & OUTCOMES

REVIEW Open Access

Complications related to deep venous thrombosis prophylaxis in trauma: a systematic review of the literature

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Abstract

Deep venous thrombosis prophylaxis is essential to the appropriate management of multisystem trauma patients. Without thromboprophylaxis, the rate of venous thrombosis and subsequent pulmonary embolism is substantial. Three prophylactic modalities are common: pharmacologic anticoagulation, mechanical compression devices, and inferior vena cava filtration. A systematic review was completed using PRISMA guidelines to evaluate the potential complications of DVT prophylactic options. Level one evidence currently supports the use of low molecular weight heparins for thromboprophylaxis in the trauma patient. Unfortunately, multiple techniques are not infrequently required for complex multisystem trauma patients. Each modality has potential complications. The risks of heparin include bleeding and heparin induced thrombocytopenia. Mechanical compression devices can result in local soft tissue injury, bleeding and patient non-compliance. Inferior vena cava filters migrate, cause inferior vena cava occlusion, and penetrate the vessel wall. While the use of these techniques can be life saving, they must be appropriately utilized.

Introduction

Multisystem traumatic injury is a significant risk factor for the development of a deep venous thrombosis (DVT). Without thromboprophylaxis, overall DVT rates exceed 50% [1-3]. Although DVT alone is not life-threatening, a resulting pulmonary embolism (PE) carries potentially significant morbidity and mortality. PE is estimated to be the third leading cause of death in injured patients who survive beyond the first day of admission [2,4-6]. Trauma patients at the highest risk have been identified as those with a lower extremity or pelvic fracture, spinal cord injury, brain injury (Glasgow Coma Score < 8), increased age, surgical intervention, femoral central venous catheter, and prolonged immobilization [2,3,7-9].

Modalities available for trauma patient thromboprophylaxis are classified into pharmacologic anticoagulation, mechanical compression devices, and inferior vena cava (IVC) filtration. Although the options are numerous, level one evidence currently supports the use of pharmacologic anticoagulation with low molecular weight heparins (LMWHs) as the primary DVT prophylactic agent [10]. Other modalities such as mechanical compression devices and IVC filters are not used for primary thromboprophylaxis, but may be helpful when LMWHs are contraindicated. This systematic review describes the potential complications associated with LMWHs, mechanical compression devices, and IVC filters.

Methods

All scientific publications discussing the use of biochemical, mechanical, and IVC filter prophylaxis for the prevention of DVT after trauma were identified using PubMed, EMBASE, and Medline. Search terms included: "DVT", "deep venous thrombosis", "complications", "trauma", "injury", "DVT prophylaxis", "low molecular weight heparin", "heparin", "chemical", "mechanical", "IVC filter" and/or "heparin-induced thrombocytopenia." The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) was employed. Only English language publications were included. Once identified, manuscripts were reviewed for relevance to the topic of DVT prophylaxis, and sorted according to their prophylactic mode of choice. This review included all

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mas. This was the only study to experience insertion related complications, however all filters were placed at the bedside under ultrasound guidance.

There is poor long-term follow-up data for trauma patients with retrievable filters that were not removed. In studies involving non-trauma patients with permanent retrievable filters, filter migration occurred between 3% and 8%, and IVC occlusion rates were reported between 4% and 15% [72-75,77,78]. Of the four studies analyzing retrievable filters in injured patients, none reported filter migration or IVC occlusion rates. One patient did have a symptomatic IVC penetration for a calculated rate of 0.4% however.

Failed filter retrieval does not carry an immediate complication to the patient, but it does expose the patient to the long-term complications of a permanent filter. Failed retrieval rates in trauma patients are reported between 0% and 4% with a calculated rate of 2.8% (Table 6).

Conclusion

Pharmacologic anticoagulation using LMWHs is the recommended primary thromboprophylaxis modality in trauma patients. In this review we calculated the risk of bleeding and HIT to be 3.9% and 0.7% respectively. These values are slightly higher than the previously published rates of 3.1% and 0.4% [9]. Mechanical compression device thromboprophylaxis should not be used as an initial choice, however evidence supports its role in trauma patients when LMWHs are contraindicated. Mechanical devices have a generally safe profile, however they must be used with caution in patients with peripheral vascular disease and peripheral neuropathy for risks of soft tissue injury and ulceration. Although the mechanism that predisposes patients to bleeding while using mechanical devices is unclear, the calculated risk of bleeding is 2.6%. This may reflect the general risk of bleeding in a trauma patient. Patient compliance is poor but may be improved with adequate patient and staff education regarding the benefits of mechanical thromboprophylaxis. When LMWH and mechanical device thromboprophylaxis are contraindicated, retrievable IVC filters should be considered in high-risk trauma patients [79]. Current high risk features include: spinal cord injury with paraplegia or tetraplegia, severe brain injury (Glascow Coma Score <8), multiple long bone fractures and complex pelvic fractures [8]. Future studies are needed to identify the trauma populations that will benefit from prophylactic IVC filtration. Retrievable IVC filters have the benefit of providing protection from PE in the early, high-risk period while consequently being removed to prevent the long-term complications of permanent IVC filtration. Although retrievable filters are removed in the majority of patients, they may also be left in place for permanent filtration if necessary. The versatility of the retrievable filter has virtually eliminated the use of permanent filters. Long-term follow-up studies of permanent IVC filtration using retrievable filters are required. The risk of insertion related complications, such as arterial puncture, hematoma, infection, and pneumothorax is calculated to be 2.6%. There were no reported filter migration or IVC occlusion events in the short-term. Although a failed retrieval is not a direct complication, it results in permanent IVC filtration and places the patient at risk for future complications. The failed retrieval rate is calculated to be 2.8%. While the essential nature of thromboprophylaxis in the management of multi-system trauma patients can not be understated, understanding their potential complications is an absolute requirement for both patient counselling and clinical care.

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Authors' contributions
ID - Study design, data analysis, manuscript writing & editing.
CGB - Data analysis, manuscript writing & editing.
LRR - Data analysis & manuscript writing.
SMH - Data analysis, manuscript writing & editing.
JBK - Study design, data analysis, manuscript writing & editing.
All authors read and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

Received: 2 June 2009
Accepted: 6 January 2010 Published: 6 January 2010

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doi:10.1186/1752-2897-4-1
Cite this article as: Datta *et al.*: Complications related to deep venous thrombosis prophylaxis in trauma: a systematic review of the literature. *Journal of Trauma Management & Outcomes* 2010 **4**:1.