

Use of Prophylactic Inferior *Vena Cava* Filters in Trauma

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الاستخدام الوقائي لمرشحات الوريد الأجوف السفلي في حالات الصدمة

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ABSTRACT: Venous thromboembolisms, specifically pulmonary embolisms (PEs), represent a significant burden on healthcare systems worldwide, particularly within the setting of trauma. According to the literature, PEs are the most common cause of in-hospital death; however, this condition can be prevented with a variety of prophylactic and therapeutic measures. This article aimed to examine current evidence on the use, indications for prophylaxis, outcomes and complications of prophylactic inferior *vena cava* filters in trauma patients.

Keywords: Inferior Vena Cava Filters; Trauma; Veins; Thromboembolisms.

المخلص: تمثل الإنصمامات الوريدية، خاصة الإنصمامات الرئوية، عبئا كبيرا على نظم الرعاية الصحية في جميع أنحاء العالم، وبصورة خاصة في حالات الصدمة وبحسب ما جاء في الأدبيات العالمية، فإن الإنصمامات الرئوية هي من أهم الأسباب الشائعة لموت المرضى المقيمين بالمستشفى. غير أن هذه الحالة يمكن منع حدوثها بطرق وقائية وعلاجية عديدة. ويهدف هذا المقال لبحث الدليل الحالي فيما يخص استخدام مرشحات الوريد الأجوف السفلي عند المصابين بالصدمة واستطبابتها الوقائية، ونتائج استخدامها، والمضاعفات التي قد تحدث عند استخدامها.

مفتاح الكلمات: الوريد الأجوف السفلي؛ الصدمة؛ الأوردة؛ الإنصمامات الخثارية.

DESPITE RECENT OUTSTANDING BREAK-throughs in thrombosis research, venous thromboembolisms (VTEs)—notably pulmonary embolisms (PEs)—continue to be a major health concern around the world. Possibly due to its abrupt onset, non-specific symptoms and relatively difficult diagnosis, PE is the most common cause of in-hospital death worldwide.¹ In addition, it is a major cause of preventable mortality in hospitalised trauma patients.² Although PEs are preventable through a variety of prophylactic and therapeutic measures, data from the USA suggests that PE is the cause of 50,000–100,000 deaths each year.³

In 1961, Sevitt *et al.* reported an incidence of 65% and 20.3% of deep venous thrombosis (DVT) and PE, respectively, among a cohort of trauma and burn patients.⁴ Moreover, a study published in 1990 by Shackford *et al.* found a VTE incidence of 7% among trauma patients, despite the use of mechanical or pharmacological prophylactic measures.⁵ However, more recent data have suggested lower incidences of VTE. A cohort study from the UK of acute trauma patients admitted between 2010–2011 found the incidence of PE to be 0.8%; most of these patients had lower limb fractures.⁶ Ho *et al.* found that fatal PEs accounted for 11.9% of all deaths among 971

consecutive trauma patients.⁷ One reason for the variability in reported VTE incidences could be differences in the techniques used to confirm or diagnose the condition, while another explanation could be under-reporting, perhaps due to a reluctance to perform autopsies in cases of sudden death.⁸ Several studies have attempted to identify risk factors for VTEs following trauma.^{9,10} In 1994, a comprehensive prospective study of 349 patients by Geerts *et al.* showed various associations between developing VTE and older age, scores on the Abbreviated Injury Scale, lower limb orthopaedic injuries and fractures, spinal cord injuries, blood transfusions within 24 hours of admission and surgical interventions.⁹ Similar factors were associated with the risk of developing VTE in a study by Kudsk *et al.* in 1989, including spinal, pelvic or lower limb fractures, age (>45 years old), bed rest (>3 days) and previous venous repairs.¹⁰

Inferior *vena cava* (IVC) filters interrupt the *vena cava* flow and the migration of a potential *thrombus*. Trauma patients usually present with multiple injuries involving organs such as the brain or spinal cord which leaves them at risk of fatal bleeding if pharmacological anticoagulation is attempted. In addition, to further complicate matters, extremity injuries in trauma are often severe enough to render the use of mechanical

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pneumatic compression devices unsuitable.⁵ Two types of IVC filter exist: permanent and non-permanent. Permanent filters are designed to function indefinitely while non-permanent filters are subdivided into temporary filters which must be removed or retrievable filters that can either be removed or left in place as a permanent implant, depending on the patient's clinical condition.⁶ Since the introduction of percutaneously-inserted IVC filters approximately 30 years ago, there has been extensive development of filter designs aiming to improve success rates and lower complication rates.¹¹

This article aimed to examine the available published literature on the use of prophylactic IVC filters in trauma patients and their effect on reducing morbidity and mortality. Articles were identified through a search on the MEDLINE and Cochrane Central Register of Controlled Trials databases using the following keywords: "inferior"; "vena"; "cava"; "filter"; and "trauma".

Choice of Placement

The placement of IVC filters is usually done in an angiography suite by an interventional radiologist or in an operating room by a vascular surgeon. Venous access is gained via the femoral or internal jugular vein.¹² The ideal position for the placement of an IVC filter depends on the extent of the *thrombus* within the inferior *vena cava*; deployment at an infrarenal position is often chosen to protect against renal vein thrombosis in the event of an IVC occlusion. Another approach involves using intravascular ultrasound probes.¹² This technique offers some advantages as it can be performed at the patient's bedside and avoids exposing trauma patients to the effects of an iodinated contrast injection; however, this approach is relatively expensive.¹²

Indications for Prophylaxis

Considerable controversy exists regarding the use of IVC filters in VTE prevention, despite a reported VTE prevention rate of 98%.¹³ In 2002, the Eastern Association for the Surgery of Trauma (EAST) recommended that insertion of a prophylactic IVC filter should be considered only in extremely high-risk trauma patients who were unable to receive anticoagulation treatment because of their increased risk of bleeding.¹⁴ In addition, eligible patients included those who would remain immobile for prolonged periods of time, potentially due to one of the following: severe closed head injuries (Glasgow Coma Scale score <8);

incomplete spinal cord injuries with paraplegia or quadriplegia; complex pelvic fractures with associated long bone fractures; or multiple long bone fractures.¹⁴ In addition, the EAST guidelines also state that patients at high risk for bleeding complications for 5–10 days after injury have an increased need for prophylactic IVC filters, particularly those with intracranial haemorrhage, ocular injuries with associated haemorrhage, solid intra-abdominal organ injuries and/or pelvic or retroperitoneal haematomas requiring transfusion.¹⁴ In contrast, the American College of Chest Physicians recommended against the use of prophylactic IVC filters regardless of VTE risk in 2012.¹⁵ This recommendation was based on low-quality evidence (grade 2C) suggesting frequent complications with IVC filters and unclear long-term benefits.¹⁵ These conflicting recommendations, which were issued 10 years apart, exist due to the continuing absence of high-quality evidence to either support or refute the prophylactic use of IVC filters. As a result, the final decision as to IVC filter insertion in a critical trauma patient remains with the treating physician.

Outcomes

There are very limited data in the form of randomised controlled trials to ascertain the outcomes of the prophylactic use of IVC filters to prevent PEs. To date, the only evidence available is in the form of observational studies, the majority of which were conducted before 2010.¹⁶ Since then, the use of low-molecular-weight heparin has become a widely accepted method of thromboprophylaxis against DVTs and PEs.¹⁵ A meta-analysis of seven observational studies on the prophylactic use of IVC filters in trauma patients reported that the pooled odds ratio of developing a PE was significantly lower (OR = 0.21; 95% CI = 0.09–0.49) among patients who received an IVC filter in comparison to matched control subjects.¹⁶ In contrast, a clinical trial observed an increase in the odds of DVT with IVC filter placement, reaching up to 87%.¹⁷ In weighing these outcomes, the absolute risk reduction of PE is compared to the absolute increased risk of DVT. Such reported outcomes further contribute to the controversy regarding IVC filter use.¹⁸

Complications

Early and late complications can occur at various stages during and after the placement of IVC filters. Access-site thrombosis is an early complication which has been found to occur in 1–3% of cases with low-profile filter delivery systems.¹⁹ Delivery system complications, such as sheath kinking or air embol-

isms, penetration of the IVC filter into neighbouring organs and post-procedural bleeding are other early complications.^{20–22} Late complications include filter fracture, migration, IVC occlusion, venous stasis, chronic venous insufficiency and PE recurrence.^{23–25} The risk of fracture rises the longer a filter is in place; research shows a 40% risk of filter fracture after 5.5 years.²³ The incidence of migration varies with the type of filter used. For one of the most extensively used filters, the Greenfield™ filter (Boston Scientific Corp., Marlborough, Massachusetts, USA), the migration rate is 8–15%.²⁴ Recurrence of PE has been reported to be as high as 4%.²⁴ An increased risk of IVC occlusion and distant embolism despite IVC filter use has also been previously reported.²⁵

Conclusion

Trauma is a major risk factor for VTE. Trauma patients usually present with multiple injuries that preclude the use of pharmacological or mechanical thromboprophylaxis. Thus, IVC filters are sometimes used to prevent the occurrence of a fatal PE in high-risk trauma patients. However, there is a lack of high-quality evidence available to standardise protocols for IVC filter use. In addition, there remain concerns over the long-term benefits of IVC filters. The final decision as to whether IVC filter insertion is suitable for a severely injured trauma patient remains a decision best guided by clinical judgment and available evidence.

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CME Quiz Questions

1. How is venous access for an IVC filter gained?

- a. Basilic vein
- b. Femoral veins
- c. Internal jugular veins
- d. Femoral or internal jugular veins
- e. All of the above

2. What are possible indications for prophylactic use of IVC filters in trauma patients?

- a. Severe closed head injury
- b. Incomplete spinal cord injury with paraplegia or quadriplegia
- c. Complex pelvic fractures with associated long bone fractures
- d. Multiple long bone fractures
- e. All of the above
- f. None of the above

3. What are potential short-term complications of IVC filter use? Check all correct answers.

- a. Migration
- b. Thrombosis
- c. Air embolisms
- d. Post-procedure bleeding
- e. Chronic venous insufficiency

4. What are potential long-term complications of IVC filter use? Check all correct answers.

- a. Fracture
- b. Solid intra-abdominal organ injury
- c. Migration
- d. Lower limb venous *stasis*
- e. Chronic venous insufficiency

5. What is the risk of IVC occlusion and distant embolism despite IVC filter use?

- a. Decreased
- b. Increased
- c. The same

IVC = *inferior vena cava*.

Answers: 1: d; 2: e; 3: b, c, d; 4: a, c, d, e; 5: b.