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# The high-risk polytrauma patient and inferior vena cava filter use

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ABSTRACT

*Objectives:* The aim of this study was to assess the impact on practice of vena cava filter insertion guidelines (Eastern Association for the Surgery of Trauma: practice management guidelines).
*Design:* The study was performed at a level 1 trauma centre with data from the 'Trauma Audit and Research Network' cross-referenced to hospital data.
*Results:* A total of 1138 specific 'high-risk' major trauma patients were identified over a 6-year period. The mean age was 46 years (18–102) and the male to female ratio was 3.3:1. The average Injury Severity Score was 23.6 (4–75). The overall DVT rate was 2.6% and the PE rate was 1.8%. A retrievable IVC filter was inserted in 42 cases (3.8%). The filter retrieval rate was 23.8% at a mean of 68.5 days (4–107). Only one complication was reported of a breakthrough PE despite filter. Applying the EAST guidelines to this cohort would have suggested filter insertion in 279 (24.6%) cases. The kappa concordance value between observed practice and the 'EAST filter group' was 0.103 (poor). The PE rate in the 'EAST filter group' was 2.2% vs 1.6% in the 'no filter group' ($p = 0.601$, no statistical difference) and the observed odds ratio was 0.814 (95% CI 0.413, 1.602).
*Conclusion:* The EAST guidelines are useful but may be overestimating the need for filter insertion.


## Introduction

The high-risk trauma patient cohort poses many medical challenges, one of which is the increased risk of venous thromboembolism (VTE). The quoted incidence of deep vein thrombosis (DVT) and pulmonary embolism (PE) in this patient group is 11.8% for deep vein thrombosis and 1.5% for pulmonary emboli [1]. Chemical and mechanical prophylactic approaches to prevent VTE are well established [2,3].

These modalities however are contraindicated in a small proportion of trauma patients. Owing typically to an increased bleeding risk from injuries preventing administration of chemical prophylaxis or lower extremity fractures preventing mechanical prophylaxis.

The use of inferior vena cava (IVC) filters has a role in such patients. Debate in the literature on the efficacy of IVC filters in this cohort is ongoing. Several guidelines exist with conflicting recommendations. The Eastern Association for the Surgery of Trauma Practice management guideline promotes IVC filters in certain patients [2]. However, guidelines from the American College of Chest Physicians (ACCP) advise against the use of IVC filters for primary prevention in patients even despite contraindication to both chemical and mechanical thromboprophylaxis [3]. In addition to the above consensus statements, there are several other society guidelines available including the 'Society of Interventional Radiology Standards of Practice Committee' [4], the 'Cardiovascular and Interventional Radiological Society of Europe' [5], the 'Inflammation and the Host Response to Injury Collaborative Research Project Investigators' [6], the 'Society of Interventional Radiology Multidisciplinary Consensus Conference' [7], all supporting filter placement in trauma patients. Finally, several well conducted reviews such as from Giannoudis et al. [8], and *meta*-analyses by Velmahos et al. [1] and Haut et al. [9] provide support for the use of IVC filters.

The aim of this study was to assess the theoretical impact of international IVC filter insertion guidelines on PE rates in high-risk trauma patients. A further aim was to determine the local PE and DVT rates in this cohort of trauma patients.

## Patients and methods

The patients under investigation were trauma patients presenting to the emergency department of a level 1 trauma centre in the London region. Cases for this study were obtained from the 'Trauma Audit and Research Network' (TARN) database.

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The inclusion criteria in this study were designed to capture all high-risk polytrauma patients and were based on the EAST Practice management guidelines [2]. These suggest insertion of a prophylactic IVC filter in trauma patients who cannot receive anticoagulation and who have injury patterns rendering them immobilised for a period of time. The specific details of the EAST Practice management criteria are listed in Table 1 [2].

A TARN request for data was placed for any emergency department episode fulfilling the following criteria; severe head injury (GCS < 8), spinal cord injury, pelvis fracture and any long bone fracture, >1 long bone fracture, intra-cranial haemorrhage, liver, kidney or spleen injury, and finally, aorta or iliac vessel injury.

The age range for inclusion in the study was any patient over the age of 18 years. The date range for this study was January 2007 till December 2013. Data collection was till December 2013, therefore providing at least one-year follow-up for all patients. Patients were excluded if they had an existing IVC filter.

The following patient demographics were collected including age, date and time of admission, injury mechanism, detailed injury type, and 30-day mortality rates. The commonly used 'Injury Severity Score' was also obtained [10].

Subsequently, the TARN dataset was cross-referenced with patient hospital records to assess DVT and PE rates. The hospital radiology database was cross-referenced to identify cases that had an IVC filter insertion from this cohort. The date of insertion, whether the filter was inserted prophylactically or therapeutically, and filter removal rates were determined. The patients that had a filter inserted were reviewed more closely to assess for whether any similarities existed between patients such as the pattern of injury sustained.

A retrospective sample size was calculated using the standard method for a comparative study. The chosen significance level in this study was 0.05. The chosen power of the study was 80%. The expected reduction in pulmonary embolus rates was 1.5% to 0.2% following IVC filter insertion. This is based on the findings from Velmahos et al. [11]. The sample size calculation suggested approximately 99 patients were required in each group.

The main form of statistical analysis was using the Chi-squared test (or Fischer's exact test) for non-parametric data. The outcome of interest was the impact of IVC filter insertion on PE prevention with the EAST guidelines applied to the data. The two groups for comparison were (a) EAST filter patient group and (b) No filter group. The working null hypothesis for this study was that insertion of an IVC filter according to the EAST guidelines would have no effect on preventing a pulmonary embolus in trauma patients. The chosen test significance value was 95%. Analyses were performed using SPSS statistics software version 22.0 (IBM, Armonk, New York).

Approval from the local research governance and ethics committee was obtained for this study.

**Table 2**
'High-risk' trauma patient cohort demographics.

| | Number | Range | SD |
|---|---|---|---|
| Gender M:F | 3.3: 1 | | |
| Average age (years) | 46 | 18–102 | 20.70 |
| ISS | 23.55 | 4–75 | 11.49 |
| 30 day mortality | 11.5% | | |
| Mechanism of injury | | | |
| Penetrating | 8.9% | | |
| Blunt | 91.1% | | |
| PE | 20 (1.8%) | | |
| DVT | 30 (2.6%) | | |
| IVC filter | 42 (3.8%) | | |
| Prophylactic | 38 | | |
| Therapeutic | 4 | | |

*ISS: Injury severity score; GCS: Glasgow coma scale; SD: standard deviation.

## Results

The TARN data request produced 1138 cases for the study period January 2007 till December 2013. The demographics for the cohort of patients are shown in Table 2. The sustained mechanism of injury is illustrated in Table 3.

The overall pulmonary embolism rate in this cohort of patients was 1.8% (20 patients). A pulmonary embolism was diagnosed on average 7.7 (range: 0–23) days after the injury. The deep vein thrombosis rate was 2.6%. An IVC filter was inserted in 42 cases. Filter insertion was prophylactic in 38 and therapeutic following a diagnosis of PE in 4 cases. The filter insertion rates over time did not demonstrate any particular trend (Fig. 1). All filters were of the retrievable type, either BARD (Covington, GA) or Cook (Bloomington, IN) types. There was one case of break-through pulmonary embolism despite a filter being placed. No other filter related complications were observed. In 35 of the filter cases, patients possessed an increased bleed risk with accompanying second high – VTE risk factor. The VTE risk factor was multiple in 22 of the 42 cases (Appendix). In the remaining 7 filter cases without a bleed risk, a pelvic fracture with or without accompanying long bone fracture was present in 6 cases and more than one long bone fracture in 1 case. The filters were removed in only 10 cases and therefore the filter removal rate was 23.8%. The filter could not be removed in one case because of persisting clot sitting beneath the filter. The filters were removed on average 68.5 days after insertion (range: 4-107 days). There were 7 deaths before filter removal.

The total cohort of patients (n = 1138) was analysed to calculate the number of patients who would qualify for a filter if the EAST practice management guidelines were adhered to [2]. The variables suggesting filter insertion are summarised in Table 2. Each case was retrospectively reviewed to determine if any of these variables existed. This analysis identified 279 (24.6%) cases that

**Table 1**
EAST Practice management guidelines for IVC filter insertion in trauma patients [2].

Insertion of a "prophylactic" VCF should be considered in very-high-risk trauma patients:

- Who cannot receive anticoagulation because of increased bleeding risk, and
- Have injury patterns rendering them immobilized for a prolonged period of time, including the following:
- Severe closed head injury (GCS score <8).
- Incomplete spinal cord injury with paraplegia or quadriplegia.
- Complex pelvic fractures with associated long bone fractures.
- Multiple long bone fractures.

Key: VCF – Vena cava filter; GCS – Glasgow coma scale.

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