Cost-effective prevention of pulmonary embolus in high-risk trauma patients

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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Screening with twice-weekly duplex ultrasound (US), or prophylactic placement of an inferior vena cava filter (VCF) to prevent pulmonary embolus (PE) in high-risk trauma patients receiving DVT prophylaxis with either subcutaneous unfractionated heparin (SUH) or sequential compression devices (SCD).

Type of intervention
Screening, secondary prevention and treatment.

Economic study type
Cost-effectiveness analysis.

Study population
High-risk trauma patients receiving DVT prophylaxis with either SUH or SCD.

Setting
Hospital. The economic study was carried out in the USA.

Dates to which data relate
Clinical probabilities were obtained from studies published between 1979 and 1996. The data on the baseline length of stay (LOS) were based on patients admitted to the study institution from 1 July 1991 to 30 June 1995. The dates for other elements of resource use were not reported. The price year was not explicitly specified.

Source of effectiveness data
Effectiveness data were derived from a review of the literature and assumptions made by the authors.

Modelling
A decision tree was constructed to represent all eventualities following three different strategies and to estimate costs and effects associated with each strategy.

Outcomes assessed in the review
The following outcomes were assessed from a review of studies: total DVT incidence, DVT incidence (asymptomatic), PE incidence without DVT, recurrent PE (after filter placement), DVT progression to PE (treated), DVT progression to PE (untreated), PE fatality (treated), and PE fatality (untreated).

Study designs and other criteria for inclusion in the review
Data from series restricted to trauma populations were used in establishing the values for the DVT incidence, DVT incidence (asymptomatic), PE incidence without DVT, and recurrent PE (after filter placement). To establish the values for progression of DVT to PE and the PE mortality rates, data from series with unrestricted populations (including trauma and non-trauma patients) were used. Other criteria employed in the selection of restricted series were DVT being diagnosed by some type of screening method, and either SUH or SCD being used as DVT prophylaxis in all patients.

Sources searched to identify primary studies
Not reported.

Criteria used to ensure the validity of primary studies
Not reported.

Methods used to judge relevance and validity, and for extracting data
Not reported.

Number of primary studies included
A total of 18 studies were used.

Methods of combining primary studies
In calculating the baseline incidence of DVT and PE, a weighted average of all restricted series was used. No further details were given.

Investigation of differences between primary studies
Not reported.

Results of the review
The results (baseline probabilities and range of values used in sensitivity analysis) were as follows:

- total DVT incidence, 0.07 (range: 0.028 - 0.175);
- DVT incidence (asymptomatic), 0.35 (range: 0 - 0.57);
- PE incidence without DVT, 0.018 (range: 0.007 - 0.035);
- recurrent PE (after filter placement), 0.010 (range: 0 - 0.045);
- DVT progression to PE (treated), 0.013 (range: 0 - 0.025);
- DVT progression to PE (untreated), 0.500 (range: 0.33 - 0.66);
- PE fatality (treated), 0.080 (range: 0.06 - 0.10);
- PE fatality (untreated), 0.320 (range: 0.20 - 0.50).

Methods used to derive estimates of effectiveness
Assumptions about effectiveness were made by the authors.
Estimates of effectiveness and key assumptions
It was assumed that the methods of prophylaxis used were not associated with immediate fatal complications. Complications considered were those occurring within 30 days of initial trauma, and were assumed to have no effect on efficacy.

Measure of benefits used in the economic analysis
The number of PE prevented (incidence of PE with each method).

Direct costs
Costs were not discounted, but it is not possible to stated whether this was appropriate as the time frame of the model was not explicitly specified. Some quantities were reported separately from the costs. Cost items were not reported separately. Cost analysis covered the costs of exam and fee for ICU for US; filter, minor case cart, OR time (if VCF placed in OR), RS time (if VCF placed in radiology suite), anaesthetist’s/anaesthesiologist’s fee, surgeon’s fee, fluoroscopy, and abdominal flat plate for VCF placement; heparin, warfarin sodium, and prothrombin time (PT)/partial thromboplastin time (PTT)/international normalised ratio (INR) for anticoagulation for PE. The perspective adopted in the cost analysis was not explicitly specified. The cost analysis was based on true costs (such as hospital acquisition costs) rather than hospital charges. The source of hourly professional fees was the American Association of Medical Colleges guidelines (1995). A cost-to-charge ratio specific to the study institution was used to evaluate 31% of resources for which costs were not available. The date of the price data was not explicitly specified. The cost analysis did not cover the costs of DVT prophylaxis with SCD or SUH since these were common to all three strategies.

Indirect Costs
Not considered.

Currency
US dollars ($).

Sensitivity analysis
A set of one-way and two-way sensitivity analyses was performed on all parameters of the model. Threshold values were identified for the sensitive parameters.

Estimated benefits used in the economic analysis
The incidence of PE was 0.04 for the no intervention strategy versus 0.02 for US screening and 0.01 for VCF placement.

Cost results
The average cost was $45 for the no intervention strategy versus $971 for US screening and $2,856 for VCF placement.

Synthesis of costs and benefits
The cost per PE prevented was calculated as the measure of cost-effectiveness, resulting in a cost of $46,300 for US relative to the no intervention strategy versus $93,700 for VCF placement. The sensitivity analysis established that location of VCF placement and anticipated LOS were the two main sensitive parameters of the model. US and VCF were equally cost-effective when VCF were placed in RS by either surgeons or radiologists; and when the anticipated LOS was 2 weeks or longer, beyond which VCF placed in RS was more cost-effective.

Authors’ conclusions
Ultrasound is the most cost-effective approach for pulmonary embolus prevention in high-risk trauma patients. VCF should be reserved for patients with an anticipated length of stay of 2 weeks or longer, and those who can safely have a filter placed in the radiology suite.

CRD COMMENTARY - Selection of comparators
The reason for the choice of the comparator is clear.

Validity of estimate of measure of benefit
The internal validity of the estimate of benefit can not be objectively assessed due to a lack of reported detail regarding the inclusiveness of the review, and how quality assessment of the primary studies was undertaken. The study did not cover long-term effects such as long-term morbidity and mortality resulting from both anticoagulation and filter placement. The authors suggested that these would not affect the number of PE which was the main measure of benefit adopted in the study.

Validity of estimate of costs
Some quantities were reported separately from the costs and adequate details of the methods of cost estimation were given. Price dates were not clearly reported.

Other issues
As acknowledged by the authors, caution should be exercised with respect to the study results as the cost-effective analysis was based on practice patterns in the study institution and was applied only to patients who could receive both anticoagulation and VCF for PE prevention. The issue of generalisability should be considered in the light of both the extensive sensitivity analyses performed and the limitations of the study results reported above. Appropriate comparisons were made with other studies.

Implications of the study
This analysis cannot be used for those patients with contraindications for mechanical and pharmacologic prophylaxis (such as those with head injury, fractures, or recent surgery). Proper application of this analysis, however, can help to identify situations in which VCF and not US is the most cost-effective approach for PE prevention.

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