Cost-effectiveness of duplex ultrasound surveillance in spinal cord injury
Kadyan V, Clinchot D M, Colachis S C

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
The use of duplex ultrasound for the surveillance and screening of thromboembolic disease in individuals with acute traumatic spinal cord injury (SCI) on admission to a rehabilitation facility.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised individuals with traumatic SCI who had been admitted to a rehabilitation facility.

Setting
The setting was secondary care. The economic analysis was conducted in Columbus, Ohio.

Dates to which data relate
The effectiveness data were gathered between July 1988 and December 1998. The resource data were derived from studies published between 1991 and 1993. The price year was 2001 to 2002.

Source of effectiveness data
The effectiveness data were derived from a prospective single study, a published study and authors' assumptions.

Link between effectiveness and cost data
The costing was undertaken prospectively on the same group of patients as that used in the effectiveness study.

Study sample
No power calculations were reported. Eligible patients were all patients with traumatic SCI who had been admitted and discharged from the authors' facility after inpatient rehabilitation between July 1988 and December 1998. During the study period, 369 patients met the inclusion criteria. The inclusion criteria were a history of traumatic SCI, admission within 3 months of injury and duplex ultrasound on admission. The exclusion criteria were any history of thromboembolic disease and duplex ultrasound being carried out more than 3 days after admittance to rehabilitation. Of those who received a duplex ultrasound on admission, 78% were male and 22% were female. Their age ranged from 14 to 81 years. Fifty-one per cent were tetraplegic and 49% paraplegic, with 54% motor complete and 46% motor incomplete injuries.
Study design
The study was a retrospective, sequential case series study that was conducted in a single centre. The length of follow-up was unclear. No patients were lost to follow-up.

Analysis of effectiveness
All of the patients included in the initial study sample were considered in the analysis. The primary health outcome used was the detection rate of positive duplex ultrasound in detecting deep vein thrombosis (DVT), and the positive and negative predictive values.

Effectiveness results
The detection rate of positive duplex ultrasound at admission was 6.5%.

The positive and negative predictive values of duplex ultrasound at admission were 85.2% (positive) and 99.8% (negative), respectively.

Clinical conclusions
The authors did not report a clinical conclusion.

Modelling
A decision tree was constructed to determine the cost-effectiveness of duplex ultrasound surveillance. The model compared statistical outcomes and was based on published literature (Meythaler et al., see Other Publications of Related Interest) and assumptions.

Outcomes assessed in the review
Although it was not entirely clear, it appears that the authors have reported the estimated mortality from the study of Meythaler et al. (see Other Publications of Related Interest).

Study designs and other criteria for inclusion in the review
Not reported.

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
One study appears to have been used to estimate the mortality rate.

Methods of combining primary studies
Not applicable.
Investigation of differences between primary studies
Not applicable.

Results of the review
The total mortality from pulmonary embolism (PE) was 0.524%. The estimated mortality when performing duplex ultrasound at admission was 0.016%.

Methods used to derive estimates of effectiveness
The authors made three basic assumptions.

Estimates of effectiveness and key assumptions
The authors assumed that only 40% of all DVTs became clinically symptomatic while 60% remained asymptomatic. They also assumed that up to one half of all untreated DVT embolise, leading to PE. Of those, 24% are diagnosed and treated for PE and 30% lead to mortality.

Duplex ultrasound was assumed to have a sensitivity of 97% and a specificity of 99%.

Measure of benefits used in the economic analysis
The summary benefit measures used were the number of lives saved and the number of life-years saved. The benefits were not discounted. No discounting was performed. The costs and the quantities of resources used were not presented separately. The health services included in the economic evaluation were classified into four main categories. More specifically, screening or diagnostic, treatment of bleeding complications, treatment of DVT, and treatment of PE. Some costs were excluded (DVT prophylaxis, all complications of anticoagulation, and surgical or invasive management of DVT). The cost/resource boundary adopted in the study is likely to have been that of the hospital. It appears that the estimation of resource use and unit costs have been based on data from the authors’ setting. All the costs were expressed in 2001-2002 values.

Statistical analysis of costs
No statistical analyses of the costs were reported.

Indirect Costs
The indirect costs were not considered.

Currency
US dollars ($).

Sensitivity analysis
Sensitivity analyses were carried out. These assessed the impact of changes in the sensitivity and specificity of duplex ultrasound (60% and 97%, respectively, or both 100%), the detection rate for DVT, and the severity of injury and age at the time of injury. No justification for the ranges selected for the sensitivity and specificity of duplex ultrasound was provided.

Estimated benefits used in the economic analysis
The number of lives saved or life-years saved were not reported.
**Cost results**
The total cost per patient for the treatment of thromboembolic disease was $449.28 when performing admission duplex ultrasound and $136.29 when not performing admission duplex ultrasound. The estimated difference was $312.99.

**Synthesis of costs and benefits**
The cost for one life saved by performing duplex ultrasound at admission was $61,542.

The cost for each life-year saved by performing duplex ultrasound at admission ranged from $1,193 to $9,050, with higher costs for increased severity and older age at time of injury.

When the sensitivity and specificity of duplex ultrasound were changed to 60% and 97%, respectively, the cost of one life saved was $116,644, and the cost of one life-year saved ranged from $2,261 to $17,154.

When the sensitivity and specificity of duplex ultrasound were both assumed to be 100%, the cost of one life saved was $48,613.

When the detection rate for DVT was assumed to be 8.7%, the cost of one life saved was $34,622.

**Authors' conclusions**
Duplex ultrasound is a cost-effective tool for deep venous thrombosis (DVT) surveillance in individuals with acute traumatic spinal cord injury (SCI) who have been admitted to rehabilitation programmes.

**CRD COMMENTARY - Selection of comparators**
The rationale for the choice of the comparator (no screening) was clear. It allowed the effectiveness and cost-effectiveness of the intervention to be determined.

**Validity of estimate of measure of effectiveness**
The analysis of effectiveness was difficult to interpret. The authors used various sources of effectiveness estimates and the methodology used to derive the estimates was unclear. First, the use of a retrospective case series study was inappropriate for the study question, as it meant that no randomisation was performed and it was not possible to compare screened and unscreened patients. Second, the authors used data from published literature. However, a systematic review of the literature was not carried out, which means that selection bias may have been present in the estimates. Finally, the authors made strong assumptions about the sensitivity and specificity of duplex ultrasound without providing any justifications for their assumptions. Therefore, there is a good deal of uncertainty surrounding the effectiveness conclusions.

**Validity of estimate of measure of benefit**
The summary benefit measure was derived directly from the effectiveness study and had the same weaknesses as the effectiveness estimates. The authors did not report any benefit results. These factors greatly limited the interpretation and validity of the measure of benefits.

**Validity of estimate of costs**
The cost analysis also showed a number of weaknesses. No discounting was performed, although the period of follow-up was likely to have been more than 2 years. Only the overall categories of costs were reported, and the cost items were not listed in detail. This limits the possibility of replicating the study in other settings. The authors reported that some costs were excluded, but no reason for their exclusion was given. The costs were treated deterministically but no sensitivity analyses on the costs were performed. In addition, the costs were specific to the study setting. All these factors introduce uncertainty into the validity of the cost results.
Other issues
The authors compared their effectiveness results with those from other studies. However, where differences were observed, no explanations were proposed. The authors reported that these results were not generalisable to all rehabilitation facilities. They also discussed some of the main limitations to the validity of their analysis.

Implications of the study
The authors did not report any specific implications. The results of this study are subject to a number of weaknesses, as outlined already. Future research, based on relevant methodology, is needed to answer the question of the usefulness of duplex ultrasound surveillance for thromboembolic disease.

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Other publications of related interest

Indexing Status
Subject indexing assigned by NLM

MeSH
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