Anticoagulation prophylaxis in orthopedic surgery: an efficiency frontier approach
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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.

CRD summary
The aim was to assess the relative cost-effectiveness of new anticoagulants for preventing venous thromboembolism in patients undergoing elective total hip or knee arthroplasty in the UK. The authors concluded that the efficiency of apixaban for hip surgery was very good, but the risk-benefit for rivaroxaban was less clear; dabigatran and enoxaparin were not good value for money. The study was not well reported, making it hard to assess the authors’ conclusions.

Type of economic evaluation
Cost-effectiveness analysis, cost-utility analysis

Study objective
The objective was to assess the relative cost-effectiveness of new anticoagulants, for preventing venous thromboembolism, in patients undergoing elective total hip or knee arthroplasty in the UK.

Interventions
The three oral anticoagulants were apixaban 2.5mg twice daily, rivaroxaban 10mg once daily, and dabigatran 220mg once daily. These were compared with enoxaparin 40mg daily.

Location/setting
UK/secondary care.

Methods
Analytical approach:
The authors developed a decision-tree model, for the 90 days following surgery (covering prophylaxis and non-fatal bleeding events), and a Markov model, for the five years following 90 days. The authors stated the perspective was that of the UK NHS.

Effectiveness data:
The clinical effectiveness evidence came from published studies or assumptions made by the authors. The main sources were three trials of apixaban versus enoxaparin, and a meta-analysis of the other comparators. The main clinical estimates were the rates of venous thromboembolism, non-fatal bleeding events, and deaths.

Monetary benefit and utility valuations:
The utility values were estimates from published literature.

Measure of benefit:
Quality-adjusted life-years (QALYs) and life-years gained were the summary benefit measures. Future benefits were discounted at a rate of 3.5% per year.

Cost data:
The cost categories were the drugs and their administration, the treatment of venous thromboembolisms and other adverse events, and the long-term care for patients after an adverse event during surgery. The sources for the resource use and prices were the British National Formulary and personal communications for the drugs; UK National Reference Costs and published literature for in-patient stays, episodes, and events; and assumptions made by the authors. All costs were presented in UK £ and future costs were discounted at a rate of 3.5% per year.
Analysis of uncertainty:
The authors conducted univariate sensitivity analysis on the main model inputs.

Results
For 1,000 patients undergoing hip replacement, apixaban resulted in 3,556.1 discounted QALYs, compared with 3,556.6 QALYs with rivaroxaban, 3,551.1 with dabigatran, and 3,550.1 with enoxaparin. For 1,000 patients undergoing knee replacement, apixaban resulted in 3,520.8 discounted QALYs, compared with 3,524.9 QALYs with rivaroxaban, 3,508.1 with dabigatran, and 3,506.8 with enoxaparin.

For hip replacement, the cost was £199,650 with apixaban, £234,710 with rivaroxaban, £262,381 with dabigatran, and £430,892 with enoxaparin. For knee replacement, the cost was £251,162 with apixaban, £242,676 with rivaroxaban, £339,230 with dabigatran, and £462,912 with enoxaparin.

The treatment alternatives ranked differently according to QALYs, life years gained, total venous thromboembolisms and total bleeding events, with apixaban or rivaroxaban being the preferred options. Apixaban avoided more bleeding events, but rivaroxaban avoided more venous thromboembolisms.

Authors' conclusions
The authors concluded that the efficiency of apixaban for hip surgery was very good, but the risk-benefit for rivaroxaban was less clear; dabigatran and enoxaparin were not good value for money.

CRD commentary
Interventions:
The reporting of the interventions was sufficient and they appear to have been relevant to the setting, but it was unclear whether warfarin should have been included, as this was used in the UK.

Effectiveness/benefits:
The reporting of the clinical effectiveness estimates was poor. The source trials were not described; their setting, randomisation, participant numbers, follow-up period, and blinding were not reported, making it difficult to assess the likelihood of bias and confounding in the data. Their references were not given. The meta-analysis was not described, but its reference was provided. The methods used to identify and select the relevant studies were not described and it is unclear whether the best available estimates or those most applicable to the setting were used. The derivation of the utilities was not described and the estimation of QALYs cannot be assessed.

Costs:
The reporting of the cost data was generally appropriate. The sources were referenced, in a table, and they appear to have been appropriate for the setting. The costs were consistent with the stated perspective. Discounting of future costs was appropriate for the five-year study horizon. The authors did not explicitly state the price year; 2010 prices were used for the drugs, but other sources were from 2001 to 2009 and no cost adjustments were mentioned.

Analysis and results:
The authors did not undertake an incremental analysis, which makes it difficult to compare the alternatives. They presented an efficiency analysis which might have been appropriate, but the results were not well described. The impact of uncertainty in the inputs on results was not fully addressed in the sensitivity analysis. A multivariate and probabilistic sensitivity analysis could have better assessed the overall impact of uncertainty. The reporting was poor and this limits the generalisability of the results. The authors discussed some limitations to their analysis.

Concluding remarks:
The study was not well reported, making it hard to assess the authors’ conclusions.

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