A cost-utility analysis of interventions for severe proliferative vitreoretinopathy


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
Two surgical treatments for patients with retinal detachment associated with severe proliferative vitreoretinopathy (PVR) were examined. The treatments were vitreoretinal surgery using expanding gases (perfluoropropane) or silicone oil therapy.

Type of intervention
Treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of patients with retinal detachment associated with severe PVR. The exclusion criteria included age less than 18 years, visual acuity of no light perception in the eye with PVR, blunt ocular trauma within 3 months before randomisation, and a history of penetrating ocular trauma. Further exclusion criteria were the presence of giant retinal tears of 90 degrees or more and the presence of proliferative diabetic retinopathy.

Setting
The setting was secondary care. The economic study was conducted in the USA.

Dates to which data relate
The effectiveness data came from studies published between 1978 and 2000. No dates for the resource use data were reported. The price year was 2000.

Source of effectiveness data
The effectiveness evidence was derived from a review of completed studies and authors' assumptions.

Modelling
A decision model based on a standard tree and a Markov process was used to assess the long-term benefits and costs of the two strategies for a hypothetical 64-year-old patient who had retinal detachment associated with severe PVR. The time horizon of the study was the patient's lifetime. The analysis was conducted on two different cohorts of patients, depending on whether they had previously undergone pars plana vitrectomy (PPV). The structure of the decision tree was reported, but no further information on the model was provided.

Outcomes assessed in the review
The outcomes estimated from the literature were:

- the life expectancy;
- the mean visual acuity values;
- the risk of developing a rhegmatogenous retinal detachment with severe PVR, or some other reason for severe visual loss in the contralateral eye; and
- the utility values for visual acuity of 20/400, 20/500, hand motions, and contralateral eyes.

Complications were also assessed but these were incorporated in the values already estimated.

**Study designs and other criteria for inclusion in the review**

A formal review of the literature was not undertaken. The study used as the main source of evidence was a randomised trial that involved 265 eyes (Silicone Study Group, see Other Publications of Related Interest). The utility values were derived from a sample of 325 patients with visual loss, using the time trade-off method. Survival data came from US Life Tables.

**Sources searched to identify primary studies**

Not stated.

**Criteria used to ensure the validity of primary studies**

Not stated.

**Methods used to judge relevance and validity, and for extracting data**

Not stated.

**Number of primary studies included**

The effectiveness evidence for the decision model was derived from 10 primary studies.

**Methods of combining primary studies**

Not stated.

**Investigation of differences between primary studies**

Not stated.

**Results of the review**

Life expectancy was 18 years (mean age of the hypothetical cohort that was entered in the model was 64).

The mean visual acuities after three years were 20/400 for patients receiving perfluoropropane, 20/300 in the silicone oil group for those with prior PPV, and 20/500 in both groups for those without prior PPV.

The mean postoperative visual acuities observed over a 3-year timeframe (trial length) were maintained long-term.

There was a 1% risk of developing a rhegmatogenous retinal detachment with severe PVR, or some other reason for severe visual loss in the contralateral eye, during the patient’s lifetime.
The utility values were 0.54 for visual acuity 20/400, 0.53 for visual acuity 20/500, 0.35 for hand motions, and 0.92 for contralateral eyes.

**Methods used to derive estimates of effectiveness**
The authors made some assumptions that were used in the decision model.

**Estimates of effectiveness and key assumptions**
The authors assumed the following:
- Retinal detachment had no effect on life expectancy;
- When retinal detachment or some other form of visual loss occurred in the second eye, it yielded the same visual result as the untreated natural course of retinal detachment in the first eye; and
- Contralateral eyes had 20/20 vision.

**Measure of benefits used in the economic analysis**
The summary benefit measure used was the quality-adjusted life-years (QALYs). These were derived from the decision model. The source of the utility values was reported and they were obtained using the time trade-off approach. The QALYs were discounted at an annual rate of 3%.

**Direct costs**
Discounting was relevant since some costs were incurred after the first year. A 3% annual discount rate was used. The unit costs were not presented separately from the quantities of resources used. However, a detailed breakdown of the cost categories was given. The health services included in the economic evaluation were vitrectomy surgery, medications, office consultations, anaesthesia, diagnostic tests and other procedures. Other procedures included, for example, the repair of a detached retina, the removal of silicone oil, vitrectomy with membrane stripping, the removal of an intraocular lens, and cataract surgery as separate procedure. Physician costs comprised physician work, practice expenses and malpractice expenses. The cost/resource boundary of the study appears to have been that of the third-party payer. The resource use data were mainly derived from the clinical trial and authors' assumptions. The costs were estimated from Medicare reimbursement rates and wholesale drug prices. The costs associated with the two procedures were compared with the alternative of no treatment, which was assumed to cost nothing. All the costs were presented in 2000 values.

**Statistical analysis of costs**
The costs were treated deterministically in the base-case.

**Indirect Costs**
The indirect costs were not considered.

**Currency**
US dollars ($).

**Sensitivity analysis**
One-way sensitivity analyses were conducted to address the issue of variability in the data. The model inputs varied were the discount rate, costs (+/- 10%), use of alternative Medicare billing, and 10% of fellow eye with severe visual loss.
Estimated benefits used in the economic analysis
The incremental estimated discounted QALYs relative to no treatment were 0.162 with perfluoropropane and 0.238 with silicone oil in patients with no previous PPV, and 0.154 with both interventions in patients with previous PPV.

Cost results
The total discounted costs per patient over no treatment were $7,602 with perfluoropropane and $9,580 with silicone oil in patients with no previous PPV, and $7,109 (perfluoropropane) and $9,607 (silicone oil), respectively, in patients with previous PPV.

Synthesis of costs and benefits
An incremental cost-effectiveness analysis was conducted to combine the costs and benefits of each strategy with those of no treatment.

The incremental cost per QALY was $46,926 with perfluoropropane and $40,252 with silicone oil in patients with no previous PPV, and $46,162 (perfluoropropane) and $62,383 (silicone oil), respectively, in patients with previous PPV.

The sensitivity analysis showed that the results were sensitive to the choice of the discount rate and the assumption on the fellow eyes.

The assumption that 10% of fellow eyes had either a retinal detachment that could not be repaired, or another ocular abnormality that brought the vision in the fellow eye to hand motions, resulted in a cost per QALY ranging from $13,347 to $20,749, depending on the patient and intervention sub-group.

Authors' conclusions
The use of silicone had a more favourable cost-effectiveness than perfluoropropane gas in patients with severe proliferative vitreoretinopathy (PVR). However, the differences were not dramatic and were likely to depend on some model assumptions. Both strategies had a cost-effectiveness ratio comparable to that of other commonly used health care interventions.

CRD COMMENTARY - Selection of comparators
The authors stated that the two comparators were selected because they represented the main procedures in the trial that was used as one of the sources of evidence. A third approach, based on sulphur hexafluoride, had been shown to be inferior to silicone oil in the same trial. It was thus excluded from the comparators considered in the current study. No treatment was selected as the basic comparator, but it was unclear whether this represented an actual alternative for patients with severe PVR. You should decide whether they were valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The basis of the effectiveness analysis was a review of completed studies, although a formal review of the literature was not undertaken. In addition, the studies appear to have been identified selectively. The main source of evidence was a randomised trial, which ensured the internal validity of the estimates. However, other data came from different studies, the designs of which were unclear. The methods used to combine the data were not stated. Some assumptions were also made, which introduced further uncertainty in the analysis. Only some of the model inputs were investigated in the sensitivity analysis.

Validity of estimate of measure of benefit
The use of QALYs as the summary benefit measure appears to have been appropriate to capture the impact of the interventions on quality of life, although the impact on survival was negligible. The QALYs were discounted due to the long timeframe of the analysis, and different rates were applied in the sensitivity analysis. The use of QALYs means
that comparisons can be made with the benefits of other health care interventions. The utility values were derived from a sample of patients and the authors discussed the reasons for their choice of such values.

**Validity of estimate of costs**
The perspective of the study was clear, although it was not explicitly stated. A breakdown of the cost items was reported, but the unit costs were not provided as the costs were presented as macro-categories. Information on resource use was unclear and appears to have been derived from trial data and authors’ assumptions. The price year was reported, which makes reflation exercises in other settings easy. The costs were treated deterministically and the total costs were varied within reasonable ranges in the sensitivity analysis. The source of the cost data was reported. The authors noted that the costs of screening for retinal detachment or productivity losses were not considered.

**Other issues**
The authors did not compare their findings with those from other studies. They also did not explicitly address the issue of the generalisability of the study results to other settings. Some sensitivity analyses were conducted on key variables, but uncertainty around some assumptions remains. The overall external validity of the analysis was low. The study involved patients undergoing surgery due to severe PVR and this was reflected in the conclusions of the analysis.

**Implications of the study**
The study results suggested that procedures for severe PVR are cost-effective treatments when compared with other widely accepted health care interventions across different medical specialties.

**Source of funding**
None stated.

**Bibliographic details**

**PubMedID**
11860974

**Other publications of related interest**


**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Computer Simulation; Cost-Benefit Analysis; Decision Trees; Fluorocarbons; Humans; Markov Chains; Medicare; Middle Aged; Models, Economic; Quality-Adjusted Life Years; Retinal Detachment /economics /etiology /surgery; Sensitivity and Specificity; Silicone Oils; United States; Visual Acuity; Vitrectomy /economics; Vitreoretinopathy, Proliferative /complications /economics /surgery

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