The cost-effectiveness of sestamibi scanning compared to bilateral neck exploration for the treatment of primary hyperparathyroidism

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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
The use of preoperative radionuclide technetium-99m (99mTc) sestamibi scanning (SS) to detect solitary adenomas in patients with primary hyperparathyroidism (PHPT) was examined. The comparator was bilateral neck exploration (BNE), the routinely performed technique.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised hypothetical patients undergoing surgical treatment for PHPT.

Setting
The setting of the study was not explicitly reported, but it was likely to have been secondary care (a hospital). The economic study was carried out in the USA.

Dates to which data relate
The effectiveness data were derived from studies published between 1997 and 2002. The price year was 2001.

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

Modelling
A decision analytical model (decision tree) was used to determine the cost-effectiveness of SS and BNE. If the first choice was BNE, it was assumed that a routine unguided BNE was performed. The following options were considered in the model if SS was pursued.

(1) If the SS strategy detects the adenoma, the clinician can proceed with minimally invasive radioguided parathyroidectomy (MIRP) in the affected side or quadrant of the neck. If MIRP fails, the surgery is converted intraoperatively to a BNE.

(2) If the initial sestamibi scan is inconclusive, a high resolution ultrasound is subsequently used to detect the adenoma. If the adenoma is localised, a unilateral neck exploration in the affected part of the neck is performed. Intraoperative conversion to BNE is performed if the adenoma is not localised, or in the event of failure to achieve normalisation of an
intraoperative plasma parathyroid assay. If both high resolution ultrasound and SS are inconclusive a BNE is performed.

The time horizon of the model was not reported, but it appears to comprise the surgery time.

Outcomes assessed in the review
The review assessed the sensitivity of dual-phase 99mTc SS and high-resolution ultrasonography, and the probability of achieving curative normocalcemia using BNE, MIRP, or unilateral neck exploration. The authors stated that the specificity of dual-phase SS and high-resolution ultrasonography was also assessed, but these data were not reported in the article.

Study designs and other criteria for inclusion in the review
The design of the primary studies was not stated. Articles that reported data solely on PHPT resulting either from multiple-gland hyperplasia or multiple adenomas, or using any agent other than dual-phase 99mTc sestamibi were excluded from the review.

Sources searched to identify primary studies
MEDLINE was searched from 1997 to 2002 using combinations of the keywords "primary hyperparathyroidism", "solitary adenomas", "radionuclide imaging", "surgery", "parathyroidectomy", "ultrasonography", "minimally invasive radioguided parathyroidectomy", "unilateral neck exploration", "minimally invasive surgery", "costs" and "bilateral neck exploration".

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

Not reported.

Number of primary studies included
The effectiveness evidence used in the model was derived from 76 primary studies.

Methods of combining primary studies
A weighted average, according to the sample size of each study, was calculated for each parameter.

Investigation of differences between primary studies
Not reported.

Results of the review
The sensitivity of dual-phase SS was 86.8% and that of high-resolution ultrasonography was 79.2%.

The probability of achieving curative normocalcemia was 94.6% with BNE, 92.2% with MIRP, and 93.7% with unilateral neck exploration.

Methods used to derive estimates of effectiveness
The authors made a critical assumption in the model.

Estimates of effectiveness and key assumptions
It was assumed that the illness involved only a solitary adenoma. The authors did not justify this assumption.

**Measure of benefits used in the economic analysis**
The measure of benefits was the expected cure rate (postoperative normocalcemia). This measure was obtained through modelling, according to the data obtained from the literature.

**Direct costs**
The costs and the quantities of resource were not reported separately. Discounting was not applied, which was appropriate since the time horizon of the study was shorter than 2 years. The costs of health services were considered in the economic analysis. More specifically, dual-phase sestamibi, high-resolution ultrasonography, BNE, MIRP and unilateral neck exploration. The cost data were obtained from the literature and were adjusted to 2001 prices using the medical care component of the Consumer Price Index. The average costs per patient were reported.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
The indirect costs were not included in the economic evaluation.

**Currency**
US dollars ($).

**Sensitivity analysis**
One-way sensitivity analyses were conducted on the cost of SS, high-resolution ultrasound, BNE, MIRP, neck exploration conversion surgery and unilateral neck exploration. The probability of success using MIRP and unilateral neck exploration were also included in the one-way sensitivity analyses.

Two-way sensitivity analyses were carried out on the sensitivities of ultrasound rates and SS, the costs of MIRP and BNE, and the costs of unilateral neck exploration and BNE.

The sensitivity analyses computed the threshold at which the SS strategy lost its dominance. The ranges used in the sensitivity analysis appear to have been derived from the literature. The area of uncertainty investigated was variability in the data.

**Estimated benefits used in the economic analysis**
The expected cure rate was 0.995 with SS and 0.9457 with BNE.

**Cost results**
The estimated costs were $5,747.90 with SS and $7,153.20 with BNE.

**Synthesis of costs and benefits**
The costs and benefits were combined using an incremental cost-effectiveness ratio (ICER). The SS strategy was both less costly and more effective than the BNE strategy. Thus, SS was dominant over BNE. The expected saving per additional patient successfully treated by SS was $28,505.07.

The threshold analyses showed that the conditions that could lead to the SS strategy not being dominant were quite
unlikely. SS would no longer be dominant if the cost of a sestamibi scan or MIRP exceeded $2,310 ($570 in the base-case scenario) or $6,227 ($3,949 in the base-case scenario). The two-way sensitivity analyses showed that the SS strategy was dominant for relatively high sensitivities.

**Authors' conclusions**
The study supported the use of sestamibi scanning (SS) in the treatment of solitary adenomas associated with primary hyperparathyroidism (PHPT).

**CRD COMMENTARY - Selection of comparators**
The rationale for the selection of the comparator was clear. BNE was selected because it represented the standard clinical practice at the authors' setting. However, it would have been useful to have included other techniques of diagnosis in the analysis. You should decide if the alternatives analysed in this study are relevant to your own setting.

**Validity of estimate of measure of effectiveness**
The effectiveness analysis was based on data obtained from published studies. A systematic review of the literature was performed with searches conducted in MEDLINE. However, the design of the primary studies was not reported. The method used to combine the primary studies seems to have been appropriate. Also, one- and two-way sensitivity analyses were performed using the ranges observed in the literature. Although the validity of the primary studies was not assessed, it would appear that the effectiveness data used were quite accurate. However, the authors highlighted that the feasibility of the preoperative sestamibi strategy depended on the expertise of the radiologist, and this should be taken into consideration.

**Validity of estimate of measure of benefit**
The measure of benefit used in the economic evaluation was the cure rate (postoperative normocalcemia). This measure is specific to the illness evaluated. Thus, it decreases the possibility of comparisons with other studies. Moreover, the issue of quality of life was not addressed, although the authors reported that more limited surgery may minimise morbidity by the avoidance of an unnecessary procedure.

**Validity of estimate of costs**
It was unclear whether all the costs relevant to the perspective adopted were included in the analysis. It appears that only the costs of the procedures have actually been considered. The costs and the quantities of resource were not reported separately, and this would not enable the analysis to be easily reworked for other settings. Further details of the analysis (e.g. the composition of the costs, including unit costs) would enable the reader to better understand and interpret the results presented. The cost data were obtained from the literature and were appropriately adjusted to 2001 prices. The costs were treated deterministically, but sensitivity analyses were conducted to test variability in the data used.

**Other issues**
The authors did not compare their results with those from other studies. The issue of the generalisability of the study conclusion was not addressed. However, it would seem that the cost and effectiveness data used in the model are unlikely to be generalisable to other settings. The sensitivity analyses performed were very extensive and used reasonable ranges. The authors reported a number of limitations to their study. For instance, some parameters of the model were not well reported in the literature and may vary among institutions. Also, the radiologist's experience and skill influenced the surgeon's confidence and reliance upon the SS strategy as a cost-effective tool.

**Implications of the study**
The preoperative sestamibi strategy involving guided MIRP and focused unilateral neck exploration was found to be cost-effective for the treatment of solitary adenomas associated with PHPT. It dominated the BNE strategy.
The main limitation of this study was that it assumed that the illness involved only a solitary adenoma. The authors reported that the results may change if the model is modified to represent a wider spectrum of parathyroid disease. The authors stated that it would be important to validate the study results in a prospective clinical study.

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