

# Cost-effectiveness of scan-directed parathyroidectomy

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## Abstract

**Background** Concordant parathyroid localization with sestamibi and ultrasound scans allows minimally invasive parathyroidectomy (MIP) to be performed in patients with non-familial primary hyperparathyroidism (PHPT).

**Aim** To investigate the financial implications of scan-directed parathyroid surgery.

**Methods** Analysis of hospital records for a cohort of consecutive unselected patients treated in a tertiary referral centre.

**Results** Two hundred patients (138F:62M, age 18–91years) were operated for non-familial PHPT between Jan 2003 and Oct 2007. MIP was performed in 129 patients, with a mean operative time was  $35 \pm 18$ min. Some 75 patients were discharged the same day and the others had a total of 72 in-patient days. Bilateral neck exploration (BNE) was performed in 71 patients with negative/non-concordant scans. Mean operative time was  $58 \pm 25$ min. Only nine patients were discharged the same day and a total of 93 in-patient days were used ( $\approx 1.3$ days/patient). The estimat-

ed total costs incurred were £215,035 ( $\approx 290,000$ €). These costs would have been covered by the National Tariff (£2,170 per parathyroidectomy) but were higher than those possibly incurred if all 200 patients would have undergone BNE without any radiological investigations (£166,000  $\approx$  224,100€).

**Conclusion** Shorter operative time and day-case admission for MIP generate costs savings that compensate only partially for the additional costs associated with parathyroid imaging studies.

**Keywords** Primary hyperparathyroidism · Cost · Parathyroidectomy · Sestamibi scanning

## Introduction

Two decades after unilateral cervical exploration was first proposed as a safe surgical approach for patients with sporadic primary hyperparathyroidism (PHPT) [1, 2] scan-directed parathyroidectomy is well-established as the treatment of choice for such patients. Concordant Tc<sup>99m</sup>-sestamibi scanning and neck ultrasound secure accurate localisation of the parathyroid adenomas with a 95–98% accuracy rate [3]. This allows a minimally invasive parathyroidectomy (MIP) to be offered to majority of patients with PHPT. The approach favoured by most endocrine surgeons is the MIP technique based on a focused lateral approach [4]. This is perceived to be a far less invasive procedure compared with the gold-standard bilateral neck exploration and has been performed under LA and sedation in some series [5]. It is certain that the availability of MIP has lowered the endocrinologists' referral threshold for PHPT and more patients are being operated on than previously [6].

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Surgeons who first embraced scan-directed MIP have used it in conjunction with intraoperative PTH monitoring (ioPTH) to confirm excision of all the overactive parathyroid tissue. The argument in favour of ioPTH is that multigland disease is present in up to 10% of patients with PHPT and such patients can only be identified and cured if all four parathyroid glands are visualised during the operation [7–9]. Results have been published by several retrospective series [10–12] and confirmed in randomised trials [13]. However, ioPTH can fail to identify patients with multigland disease [14]. In a study of 69 patients who underwent conventional bilateral cervical exploration with ioPTH, the existence of multiple gland disease would have been missed in 75% of cases if one would have relied on the threshold of at least 50% from the preoperative baseline PTH value at 10min after excision of the first visualised enlarged gland [15]. Similarly, ioPTH results did not identify multiglandular disease in 11 of 423 patients undergoing focused parathyroidectomy [16]. The debate about the benefits of routine ioPTH remains unsettled even though a recent analysis of series of MIP with ioPTH failed to support its use [17].

Arguably, the expense associated with radiological studies and intraoperative biochemical assessments in patients undergoing MIP cannot add much to the cure rate provided by the “gold standard” bilateral cervical exploration whose success rate is expected to be in excess of 95% [18]. The patients’ desire to be offered a less invasive operation and the surgeons’ willingness to rise to the challenge has made MIP a very attractive operation. For the last 5 years, we have performed MIP without intraoperative PTH monitoring with similar long-term results to those seen with BNE [19]. Omitting ioPTH leads to saving the cost of processing multiple PTH samples taken intraoperatively, it avoids delays whilst results are obtained and can shorten the operation time by 30min allowing the completion of a greater number of cases within a 4-h theatre session. We reported a 97% cure rate using this approach [19]. However, in the current climate of financial reform within the National Healthcare System in the United Kingdom, it is becoming increasingly important to assess if this strategy is financially viable.

The aim of this study was to estimate the costs of scan-directed parathyroidectomy in a cohort of patients operated on for PHPT and to compare this to the potential costs incurred if the same patients would have undergone BNE without preoperative neck imaging.

## Materials and methods

A prospective database maintained in our unit provided clinical and operative data on patients undergoing parathyroidectomy in the last 5 years. Computerised hospital

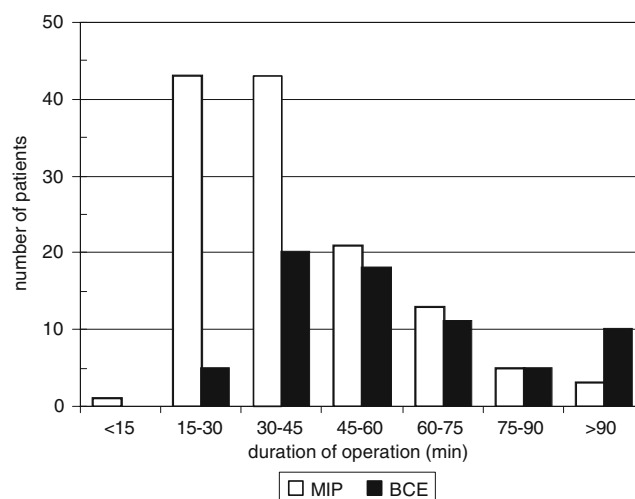
records were used to determine the operative times and duration of hospital admission from contemporaneous data logged in by the nurses directly involved in the care of individual patients.

All patients with biochemical diagnosis of PHPT underwent localisation studies with technetium  $Tc^{99m}$ -sestamibi and neck ultrasound scans as previously described [19]. If both scans were positive and concordant, minimally invasive parathyroidectomy was performed through a lateral approach. Patients with non-concordant or negative scans underwent bilateral cervical exploration.

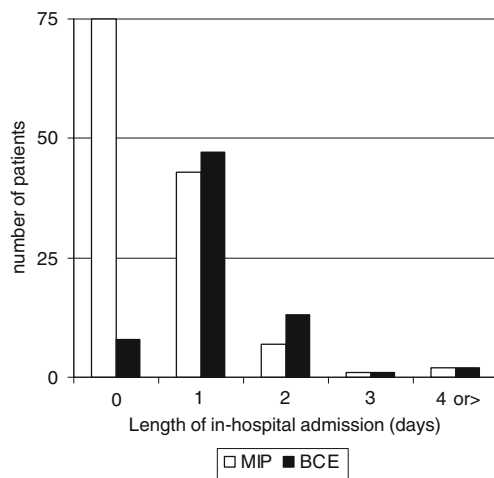
Patients were admitted on the morning of their operation to the Day-Surgery Unit. Those due to have a MIP were scheduled for repeat USS and neck marking. Superficial cervical blocks were performed on the site of the MIP or bilaterally. Anaesthetic technique was similar, with emphasis on avoiding opioid analgesia. If patients were not deemed fit for discharge in the evening of their operation, an over-night admission was organised and patients were transferred from the Day-Surgery Unit.

All financial calculations were cross-checked with the hospital’s Finance Department. Radiological costs were calculated at £357/patient, preoperative ultrasound at £65/patient, operating theatre time at £550/h, admission to the Day-case Unit at £175/patient and in-patient admissions at £225/day. The overall costs were compared with the 2007–2008 National Tariff published by the Department of Health (<http://www.dh.gov.uk/en/publications> and [statistics/publications](http://www.dh.gov.uk/en/publications)) which quotes £2,170 for parathyroidectomy (K02 healthcare resource group).

Data are presented as mean  $\pm$  std. deviation and Students *t* test was used to compare parametric data, with  $p < 0.05$  considered significant.



**Fig. 1** Surgical time for minimally invasive parathyroidectomy and bilateral cervical exploration



**Fig. 2** Length of hospital admission after surgical treatment for primary hyperparathyroidism

## Results

Costs incurred in a cohort of 200 patients undergoing scan-directed parathyroidectomy

Between Jan 2003 and Oct 2007, a total of 200 patients (138F:62M, age 18–91years) underwent first-time surgery for non-familial PHPT. There were 80 men and 120 women (18–92years).

Minimally invasive parathyroidectomy was performed in 129 patients. Mean operative time was  $35 \pm 18$ min (range 10–95min, median 25min). The majority of patients were discharged the same day ( $n = 75$ , 59%) or within 23h ( $n = 43$ , 34%), with a total of 72 in-patient days (average 0.5days/patient).

Bilateral neck exploration (BNE) was performed in 71 patients. Mean operative time was  $60 \pm 25$ min (range 25–120min, median 55min). Eight patients were discharged on the same day and 47 patients (66%) within 23h, with a total of 93 in-patient days (average 1.3days/patient).

Anaesthetic time was similar between patients undergoing MIP or BNE ( $19 \pm 8$ min vs.  $21 \pm 9$ min,  $p = \text{NS}$ ). Operative time and length of hospital admission were significantly shorter for MIP compared with BNE (Figs. 1 and 2).

The estimated costs incurred by the first operation in this cohort of 200 patients are detailed in Table 1. These costs

would have been covered by the National Tariff, which reimburses hospitals £2,170 per parathyroidectomy.

## Outcome of first operation

Of the 129 patients undergoing MIP, four had persistent PHPT (hypercalcaemia identified within less than 12months after operation) and one patient had recurrent PHPT (hypercalcaemia at >12months after first operation). These five patients were cured after a second operation. Arguably, none of the four patients with persistent PHPT would have had a different outcome if BNE would have been their first operation because small thyroid nodules were interpreted as enlarged parathyroid glands, a potential mistake even if a larger exposure would have been used.

Three patients had persistent PHPT after BNE. Two were cured after a mediastinal parathyroid adenoma was excised and one patient is pending further investigations.

## Costs incurred if 200 patients would have undergone bilateral neck exploration

If no preoperative localisation studies were performed, all patients would have undergone bilateral neck exploration. Extrapolating from the above data, some 200h operating time were needed, 22 patients might have been operated as day-case and 178 patients would have used a total of 261 in-hospital days. The costs associated were estimated  $\approx$ £166,000 (Table 1). The cure rate would have been similar.

## Discussion

This study analyses the use of hospital resources in a cohort of 200 patients with non-familial PHPT operated within 5years in a tertiary referral centre in the United Kingdom. The cure rate was 97% after the first operation and 98% per total. The cost associated with radiological localisation studies was only partially offset by the savings generated by a shortened admission time in patients undergoing scan-directed minimally invasive parathyroidectomy (MIP).

Despite a growing interest in monitoring and controlling the costs associated with care within the National Health Service (NHS) in the United Kingdom, it remains difficult

**Table 1** Costs associated with the operative management of a cohort of 200 patients with primary hyperparathyroidism

	Localisation studies	Preoperative ultrasound	Operating theatre	Day-case unit	In-patient admissions	Total
200 patients (historical group)	$200 \times \text{£}357 = \text{£}71,400$	$129 \times \text{£}65 = \text{£}8385$	$152\text{h} \times \text{£}550 = \text{£}83,600$	$83 \times \text{£}175 = \text{£}14,525$	$165 \times \text{£}225 = \text{£}37,125$	£215,035
Hypothetical group	None	None	$200\text{h} \times \text{£}550 = \text{£}110,000$	$22 \times \text{£}175 = \text{£}3,850$	$261 \times \text{£}225 = \text{£}52,065$	£165,915

to generate precise figures. To simplify the analysis performed in this study we assumed that costs related to preoperative and postoperative outpatient visits, anaesthetic times and recovery times are similar and hence could be omitted from a comparative analysis between scan-directed MIP and bilateral cervical exploration without preoperative localisation.

It was anticipated that short admission after MIP will generate cost savings that could offset the expense incurred with radiological tests. Unexpectedly, there was a minimal difference between the costs quoted for a 6–8-h admission on the Day-Surgery Unit compared with an over-night in-patient admission (£175 vs. £225). Based on these figures, treatment of this cohort of 200 patients was more expensive than it would have been if localisation studies had not been performed. However, the total costs were well within the NHS Tariff ([http://www.dh.gov.uk/en/Managingyourorganisation/Financeandplanning/NHSFinancialReforms/DH\\_081226](http://www.dh.gov.uk/en/Managingyourorganisation/Financeandplanning/NHSFinancialReforms/DH_081226), accessed 16 April 2008).

Two thirds of patients were considered suitable for MIP. This proportion is similar to the one reported in the last national audit of the *British Association of Endocrine and Thyroid Surgeons* (BAETS). Overall mean length of in-hospital admission was 1.5 days and it was significantly shorter in patients who underwent MIP than bilateral cervical exploration. These figures compare favourably with the 2.4 days average stay reported in the BAETS audit [20].

This is the first study to estimate the financial consequences of parathyroidectomy for PHPT in the United Kingdom. When the same topic was previously explored in the United States, MIP was found to be cost-effective. For example, in a study from Yale University, New York comparing the results obtained using conventional ( $n=401$ ) and MIP ( $n=255$ ) surgery, MIP was associated with a 50% reduction in operating time, a seven-fold reduction in length of hospital stay, and a mean cost savings of \$2,693 per case [21]. Similar financial benefits were highlighted in the analysis of the first 100 consecutive MIP performed by same authors, in which the mean hospital charge for MIP was less than 40% of that associated with traditional exploration [11]. In an analytic model comparing the cost of different strategies of management for asymptomatic PHPT in France, it was estimated that scan-directed unilateral neck exploration would cost 3,766€ while BNE without would cost 3,537€, with the incremental costs for quality-adjusted life expectancy in favour of minimally invasive surgery [22]. In contrast with these studies, we found that the expense of radiological tests was not off-set by the savings on the length of hospital admission. Even though many more patients were treated as day-case/ambulatory base, this led to no financial benefits since the quoted prices for day-case and in-patient were similar (£175 vs. £225/day)

In summary, these data do not support the use of scan-directed MIP purely on cost grounds. It is likely that patients undergoing MIP have reduced postoperative pain, better cosmesis and a quicker return to normal function, and that this may justify the increased cost of preoperative localisation studies. When performed in centres with appropriate radiological and surgical expertise, scan-directed parathyroidectomy is a financially-sustainable treatment strategy for patients with non-familial PHPT.

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