

## ORIGINAL ARTICLE

## MINIMALLY INVASIVE PARATHYROIDECTOMY: AN AUDIT OF A CHANGE IN CLINICAL PRACTICE

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**Background:** Minimally invasive parathyroidectomy (MIP) for primary hyperparathyroidism is gaining acceptance as a useful tool in the armamentarium of the endocrine surgeon.

**Methods:** We undertook an audit of 154 consecutive cases of parathyroidectomy carried out through bilateral neck exploration as well as a minimally invasive approach.

**Results:** Bilateral neck exploration had a 100% single operation cure rate. MIP had a 90% cure rate. Sestamibi localization had a positive predictive value of 99% for identifying an abnormal parathyroid gland. However, it performed poorly in the presence of multiglandular disease, resulting in these patients being at risk of having persistent hyperparathyroidism and therefore requiring a second operation.

**Conclusion:** Our results with bilateral neck exploration are favourable compared with other large series. However, we have reported a 10% reoperation rate with MIP. Although not ideal, we are confident that, as a result of improvements based on this audit and with increasing experience, the cure rate will improve to reach international benchmarks. As such we feel that this strategy is a pragmatic way to offer MIP to patients in our region.

**Key words:** minimally invasive parathyroidectomy, sestamibi scintigraphy.

Abbreviations: HPT, hyperparathyroidism; MIP, minimally invasive parathyroidectomy; PTH, parathyroid hormone level; SS, sestamibi scintigraphy; US, ultrasound.

### INTRODUCTION

Parathyroidectomy is the treatment of choice for primary hyperparathyroidism (HPT).<sup>1,2</sup> Bilateral neck exploration is the gold standard with published rates of cure of greater than 95% in experienced hands.<sup>3</sup> Minimally invasive parathyroidectomy (MIP) is challenging this standard and is carried out by many endocrine surgical units throughout the world.<sup>4</sup>

MIP requires accurate and reliable localization of the parathyroid adenoma. Preoperative localization techniques include sestamibi scintigraphy (SS) and ultrasound (US). Intraoperative localization with radioguided surgery or methylene blue have also been described. These techniques have been used either alone or in combination by various centres.<sup>5–9</sup>

SS was used at our institution and for patients from the private rooms for the localization of parathyroid adenoma for MIP from the year 2000.

We undertook an audit of parathyroidectomy for primary HPT carried out between January 1998 and June 2004.

The aim of our study was twofold.

- Audit the overall results of parathyroidectomy in this series against international benchmarks
- Assess the utility of SS and MIP

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### METHODS

A total of 154 consecutive cases of parathyroidectomy for primary HPT were carried out from January 1998 to June 2004. Surgery was carried out by, or under the supervision, of a single surgeon. Cases were obtained from the base hospital surgical database and also the surgeon's private rooms. All patient records, operative notes, serum biochemistry and pathology reports were interrogated.

Cases prior to the year 2000, all underwent bilateral neck exploration. From year 2000 onwards, patients who did not have a family history, or concurrent thyroid disease requiring thyroidectomy, underwent SS for localization. MIP through a short incision with a lateral approach was offered to patients in whom localization was successful.

Approximately half of the cases had SS carried out by the Nuclear Medicine Department at the Base hospital. The remaining cases had SS carried out at three other nuclear medicine facilities throughout metropolitan Perth. Approximately five different nuclear medicine/radiological facilities reported on these scans.

Preoperative examination of the parathyroid and thyroid glands with US was not routinely carried out.

Primary HPT was defined as elevated serum calcium in the presence of an inappropriate (normal or elevated) parathyroid hormone level (PTH). Urinary calcium excretion was carried out in selected cases to exclude familial hypocalcaemic hypercalcaemia.

Biochemical cure was defined as normalization of serum calcium at the last follow-up outpatient clinic, usually between 6 and 12 weeks postoperatively. Most of the pathology results were unable to distinguish between an adenomatous and hyperplastic gland.

Postoperative oral calcium supplementation was prescribed if patients developed hypocalcaemic symptoms or had osteoporosis.

## RESULTS

Patient demographics for the 154 cases are shown in Table 1. A total of 25% of the patients were asymptomatic. A total of 21% of the patients had renal calculi and 22% had osteoporosis and/or fractures. A small number of patients had high normal serum calcium levels but elevated PTH levels.

A total of 95% of the patients had no previous neck surgery. Six patients had previous thyroid or carotid surgery. One patient had two previous neck explorations for HPT carried out at another hospital.

The surgical course of all the patients is shown in Figure 1.

A total of 57 out of 154 patients did not undergo SS. The reasons for this have already been discussed. The remaining 97 patients underwent SS. A total of 79 out of 97 (81%) cases were reported as positive (probable or possible localization). A total of 18 out of 97 (19%) of the scintigrams were reported as negative, these patients underwent bilateral neck exploration.

Of the 79 patients who had positive scintigrams, 48 patients completed MIP. This represents 49% (48/97) of the patients who underwent SS. Of the remaining cases with positive SS, 19 had bilateral exploration, 11 had MIP converted to bilateral exploration and 1 had thoracoscopic excision of a mediastinal adenoma. The reasons for carrying out bilateral neck exploration from the outset were early experience with SS, vague scintigraphy image and one case had an US scan that was discordant with the SS. The reasons for conversion from MIP to bilateral exploration were either no adenoma or a small adenoma found on unilateral exploration.

Five patients from the whole series had persistent HPT. All these patients had multiglandular disease (two with double adenoma and three with hyperplasia) and had MIP as their first operation. Four of these patients were cured at the subsequent bilateral neck exploration. The remaining one patient has refused any further operative intervention. This represents a 10% (5/48) rate of persistent HPT or a cure rate of 90% for MIP.

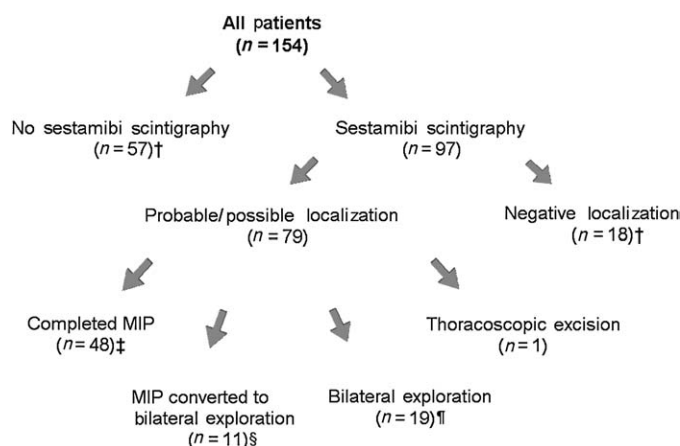
No cases of persistent HPT were observed in any of the cases that underwent bilateral neck exploration at any stage of treatment. This includes the 57 cases that did not have SS, 18 cases of negative SS, 19 cases of positive SS and 11 cases of MIP converted to bilateral exploration. This represents a 100% single operation cure rate with bilateral neck exploration.

SS had a sensitivity of 80% (78/97) and positive predictive value of 99% in identifying an abnormal parathyroid gland.

**Table 1.** Patient demographics and preoperative data

Median age (years) (range)	69 (21–90)
Female : male	128:26
Asymptomatic primary HPT	38 (25%)
Complications	
Renal calculi	32 (21%)
Osteoporosis/fractures	34 (22%)
Depression/bipolar	5 (3%)
Preoperative calcium	
Total median (range)	2.82 (2.39–4.76)
Ionised median (range)	1.43 (1.24–1.79)

HPT, hyperparathyroidism.



**Fig. 1.** Surgical course of the patients. †All underwent bilateral neck exploration. ‡Five of these cases had persistent HPT requiring reoperation. §Unsatisfactory unilateral exploration: either small or no adenoma found. ¶MIP not attempted: early phase, vague scintigram. HPT, hyperparathyroidism; MIP, minimally invasive parathyroidectomy.

Pathological results of these patients are shown in Table 2. Multiglandular disease represented 10% of this series.

Parathyroid gland weights are shown in Table 3.

Complications include hypocalcaemia requiring i.v. calcium (1%), temporary dysphonia (3%), permanent recurrent laryngeal nerve palsy (0%) and haematoma (2%).

## DISCUSSION

Parathyroidectomy is the treatment of choice for primary HPT. MIP, for carefully selected patients, is gaining acceptance as a valid and useful part of the endocrine surgeon's armamentarium.<sup>4,5</sup> Despite the added costs associated with localization studies, we may never see the return of bilateral neck exploration for all cases of primary HPT.

Currently, there are different ways that MIP is being carried out throughout the world. These include focused lateral MIP, endoscopic-assisted MIP and full endoscopic approach with gas insufflation.<sup>4</sup> Despite this, the key determinants of successful MIP are patient selection and excellent parathyroid localization techniques.

Apart from directing the surgeon to the parathyroid adenoma, the other aim of patient selection and parathyroid localization is to exclude patients at higher risk of harbouring multiglandular disease. Therefore, patients with multiple endocrine neoplasia syndromes and family histories with HPT tend to be excluded. Discordant localization studies and localization that emphasize multiglandular abnormalities are also excluded from MIP.<sup>5</sup>

In our study, the single operation cure rate was 90% for MIP and 100% for bilateral neck exploration. Of note, all the cases of

**Table 2.** Final pathology

Single adenoma	136 (88%)
Double adenoma	11 (7%)
Hyperplasia	5 (3%)
Carcinoma	1
Unknown	1

**Table 3.** Parathyroid gland weights

Maximum gland weight (g)	73 (Parathyroid carcinoma)
Median gland weight (mg)	550
Minimum gland weight (mg)	100

persistent HPT had multiglandular disease where SS localized only one of the abnormal glands.

Our results for MIP are poor compared with other large series; however, we are confident that the cure rate will improve to reach international benchmarks as a result of improvements based on this audit and with increasing experience. Only 44% (43/97) of those patients undergoing SS ultimately had curative MIP. This was partially explainable by the low threshold for conversion to bilateral exploration during the initial experience with SS and MIP. With the realization that SS has a PPV of 99%, we are learning to trust the report and the threshold for conversion from MIP to bilateral exploration will be raised. The tendency to commence the operation as a bilateral exploration because we cannot convince ourselves of the localization will also be less. These two measures should increase the proportion of patients completing MIP.

Of significant concern is the (~10%) rate persistent HPT requiring reoperative parathyroidectomy. Although SS is very good at localizing an abnormal parathyroid, it is clearly unable to alert us to the presence of multiglandular disease. This limitation of SS has been shown in previous studies.<sup>10</sup> The combination of US and SS should provide better results as shown by the Royal North Shore series,<sup>5</sup> however, our local anecdotal experience of parathyroid US to date has been disappointing. The answer probably lies in being able to localize a dedicated parathyroid radiologist. This was alluded to in a recent publication in this Journal.<sup>11</sup>

We do not use intraoperative/quick parathyroid hormone assay with MIP. This is because of the costs incurred and the significant rate of unnecessary bilateral explorations<sup>12</sup> as a result of false-negative drops in PTH. This allows for better planning of operative time. Instead, we prefer a same day PTH/Calcium or a morning after postoperative PTH and calcium level.

## CONCLUSIONS

In this series, we achieved a single operation cure rate of 100% for primary HPT using bilateral neck exploration. This compares favourably with other major series.

Ability to achieve good results with MIP requires dedicated professionals in nuclear medicine and radiology to direct us to the solitary abnormal gland. We have found that SS alone is good at detecting an abnormal parathyroid gland but clearly unable to alert us to the presence of multiglandular disease. We have shown that MIP in our hands has a 90% cure rate and correspondingly a 10% reoperation rate.

Although not ideal, we are confident that as a result of improvements based on this audit and with increasing experience, the cure rate will improve to reach international benchmarks. As such, we feel that this strategy is a pragmatic way to offer MIP to patients in our region.

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