The Role for Preoperative Localisation Techniques in Surgery for Hyperparathyroidism

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Abstract

Preoperative localisation procedures in primary hyperparathyroidism have been associated with advantages like decreased operative dissection, shorter operating time and in some series, lower morbidity and mortality. However, successful identification of parathyroid glands exceeding 90% is achievable at surgery without preoperative localisation studies.

Sixty-nine patients who underwent parathyroidectomy at the Department of Surgery, Singapore General Hospital, between March 1990 and July 1996 were analysed to determine the role of preoperative localisation techniques. Preoperative localisation of parathyroid glands consisted of computed tomographic (CT) scan in 66.7% of patients, technetium[99] sestamibi scan in 23.2%, ultrasound in 15.9% and angiographic localisation in 4.3% of the patients.

In the 28 end stage renal failure patients who were operated for progressive renal osteodystrophy, 6 had preceding renal transplants. The success of identifying parathyroid glands at operation in these 28 patients was independent of CT scan findings. CT scan was correct in only 6% of patients while surgical exploration had a success rate of 100%. Of the 41 patients with primary hyperparathyroidism, the success of CT scan in identifying enlarged parathyroid glands was 41.4% compared to 91.6% via surgical exploration. Furthermore, CT scan was not able to discriminate between superior and inferior parathyroid glands. Preoperative Tc-99m sestamibi scan and ultrasound correctly localised pathologic parathyroid gland in 40% and 18.2% of the patients, respectively.

Therefore, the use of preoperative imaging to localise parathyroid glands before the intended exploration was found not to be useful in our series.

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Introduction

Hyperparathyroidism is well recognised as a clinical problem that has a myriad of presentation. The classical presenting symptoms of hypercalcaemia have been well documented but there is an even greater awareness that many non-specific symptoms like fatigue, depression and constipation are related to hypercalcaemia.[1]

When the diagnosis of hyperparathyroidism is established, there is often considerable controversy as to the role of preoperative localisation procedures. Many authors have advocated preoperative localisation procedures as they allow unilateral parathyroid dissection, hence may be associated with lower morbidity such as shortened operative time and lesser risk of recurrent laryngeal nerve injuries. Unilateral explorations also leave the undissected contralateral side free from fibrosis, hence lower risk of recurrent nerve injury in re-exploration of patients with recurrent hyperparathyroidism.[2-4]

Recent literature, however, suggested that preoperative localisation procedures in newly diagnosed hyperparathyroidism were unnecessary as they did not contribute to improvement in cure rates.[5,6] Some are invasive while radiation exposure and idiosyncratic reaction like anaphylaxis to intravenous contrast may occur. Furthermore, multiple series have indicated that cure rates of exceeding 90% may be achievable in patients operated without preoperative localisation studies.[7,8]

We reviewed the role of computed tomography, ultrasound and technetium-99m sestamibi pertechnetate scan as a preoperative localisation modality in patients who underwent parathyroidectomy.

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Materials and Methods

Sixty-nine consecutive patients who had parathyroid-ectomy at the Department of General Surgery, Singapore General Hospital, between March 1990 and July 1996 were included. None of the patients were operated for recurrent hyperparathyroidism.

Preoperative serum calcium, phosphate and parathyroid hormone assays confirmed hyperparathyroidism. Hypercalcaemia was defined as total serum calcium of more than 2.60 mmol/L. Serum parathyroid hormone beyond the normal range of 0.5 to 5.1 pmol/L, as measured by the intact parathyroid hormone level was considered diagnostic for hyperparathyroidism. Case records were reviewed for the type of preoperative localisation procedure, operation performed and location of pathologic parathyroid glands.

Preoperative localisation procedures included ultrasound scan in 11 patients (15.9%), technetium-99m sestamibi pertechnetate scan in 16 (23.2%), computerised tomographic (CT) scan in 46 patients (66.7%) and angiographic localisation in 3 patients (4.3%). No magnetic resonance imaging (MRI) studies were performed.

In non-end stage renal failure (ESRF) patients, unilateral exploration was performed if an overtly pathologic gland was found and the presence of a normal adjacent parathyroid gland was confirmed on frozen section. However, if no pathologic gland was found or frozen section of the identified gland suggested the possibility of hyperplastic disease, a complete bilateral exploration was undertaken. Bilateral explorations were routinely performed for patients with ESRF due to the high incidence of multiglandular parathyroid disease.

Parathyroid glands were explored systematically according to that described by Wang.[9] Visual inspection of the glands' position, shape, colour and consistency was used to identify the glands. Frozen section confirmation of parathyroid tissue was mandatory as similar size adipose tissue or lymph nodes may be mistaken for parathyroid tissue on gross inspection.

The location of parathyroid glands identified on the CT scan was compared to the intraoperative findings. Localisation was considered incorrect when the pathologic gland was wrongly lateralised on CT scan, or when a pathologically enlarged gland was identified at operation but the CT scan was reported as normal. Separate analyses were performed for ESRF and non-ESRF patients. Comparison of mean operating times was done with students' t-tests.

Results

Of the 69 patients, 33 (47.8%) were males and 36 (52.2%) were females. The mean age was 47 years (range 32 to 79 years). None of the patients had family history of similar parathyroid disorder or other associated en-docrine abnormality to suggest Multiple Endocrine Neoplasia syndrome. None of the patients had any palpable neck mass related to an enlarged parathyroid gland. The presenting problems were progressive renal osteodystrophy in 28 patients (40.6%), urolithiasis in 22 (31.9%), constipation, recurrent abdominal pain and pancreatitis in 6 (8.7%), musculoskeletal pain, osteoarthritis and lower limb deformity in5 (7.2%) while the remaining 8 (11.6%) were either asymptomatic or had non-specific complaints like depression. Twenty-eight patients (40.6%) had ESRF while the rest had normal renal function.

Preoperative median serum calcium level was 3.02 mmol/L (range 2.21 to 4.06 mmol/L). Median serum phosphate was 0.92 mmol/L (range 0.5 to 3.90 mmol/L) while preoperative median serum parathyroid hormone was 163.4 pmol/L (range 8.9 to 1427 mmol/L). Seven patients had serum parathyroid hormone exceeding 1500 pmol/L. Median serum alkaline phosphatase was 119.5 mmol/L (range 61 to 4589 mmol/L). None had any previous parathyroid surgery and 62 (89.9%) patients were operated by one surgeon (SKC) while the remainder was operated by 4 other consultants. Statistical comparison of mean operating times between the surgeons showed no significant differences.

Of the 28 patients operated for progressive renal osteodystrophy, 17 (60.7%) had preliminary CT scan localisation. Twelve patients were reported to have single or double gland enlargement labelled as parathyroid adenomas while 1 patient had 3 enlarged parathyroid glands. Three patients (17.6%) had normal CT scan findings while another was reported to have a thyroid cyst. Computerised tomographic scan correctly identified the pathologic glands in only 1 patient (5.9%) (Table I) but was unable to localise the lesions as superior or inferior parathyroid glands. At surgical exploration of these 17 ESRF patients, 67 parathyroid glands were found out of the expected 68 glands (98.5%). All the identified glands were hyperplastic confirmed on histology. This contrasted significantly with the number of glands identified on CT scans. Only 21 glands were identified out of the expected 68 (30.9%). In addition, 1 patient had a supernumerary gland which was not identified on the preliminary CT scan.

TABLE I: COMPARISON OF THE SUCCESS RATES OF LOCALISING PATHOLOGIC PARATHYROID GLANDS BETWEEN PREOPERATIVE CT SCAN AND DIRECT SURGICAL EXPLORATION

	With preop** CT scan	Without preop** CT	Total
ESRF*	1/17 patients (5.9%)	11/11 patients (100%)	28
Non ESRF	12/29 patients (41.4%)	11/12 patients (91.6%)	41

* End stage renal failure
** preoperative

In the remaining 11 ESRF patients who did not have preoperative localisation, all parathyroid glands were found intraoperatively (100%). A supernumerary parathyroid gland was similarly found in 1 of the patients. Of the 28 ESRF patients who underwent parathyroid exploration, 6 patients (21%) had prior renal transplants of which 5 were still functioning at the time of analysis.

The extent of parathyroidectomy performed was based on frozen section irrespective of the radiologic diagnosis. Near total or total parathyroidectomy with autotransplantation was performed for patients with hyperplastic disease while parathyroid adenomas were excised. Histologic examination of the excised parathyroid glands in the 28 ESRF patients showed majority had hyperplastic parathyroid glands, unlike that reported on CT scans. Only 2 patients had a total of 3 parathyroid adenomas giving an incidence of 2.7% parathyroid adenomas out of the 112 parathyroid glands in patients with ESRF.

There was no statistical difference in the mean operating times for ESRF patients with (97.1 minutes) or without (96.8 minutes) preoperative CT scan ($P = 0.98$).

Among the 41 non-ESRF patients, 29 had CT scan in which localisation was correct in 12 patients (41.4%) (Table I). Six patients had enlarged glands on CT scan but 2 were localised to the contralateral side while the number of glandular enlargement reported was incorrect in the other 4 patients. The other 11 patients had normal or unrelated CT findings but pathologic parathyroid glands were found at exploration. Histologic examination of all the pathologic glands from these 29 non-ESRF patients without preoperative CT scan showed that majority were parathyroid adenomas (72.4%, 21 patients) while hyperplastic parathyroid glands were found in 17.1% patients.

This contrasted with the remaining 12 non-ESRF patients without preoperative CT scan where a total of 41 out of 46 (89.1%) glands were surgically identified in 11 patients (91.6%) (Table I). The last patient unexpectedly had normal parathyroid glands despite an adequate surgical exploration. He remained normocalcaemic and had normal serum parathyroid hormone levels as of his last follow-up, 1 year 3 months after surgery. There was no statistical difference in the mean operating times between patients with (108 minutes) and without (102 minutes) preoperative CT scan ($P = 0.68$).

Postoperative serum calcium level was 2.47 mmol/L (± 0.19) at a median follow-up of 15 months (range 3 to 43 months) while serum parathyroid hormone was 5 pmol/L at a median follow-up of 7 months (range 1 to 37 months).

Eleven patients underwent ultrasound determination of parathyroid gland. Ultrasound was correct in 2 out of 11 patients (18.2%) but in 6 (54.6%), no parathyroid abnormality was found. Instead, thyroid nodules were identified. The other 3 patients had hyperplastic parathyroid glands which required bilateral exploration.

Technetium[99] sestamibi scan was performed in 15 patients and pathologic glands were identified in 6 patients (40%). The remaining patients had technetium scan results that were inconsistent with the intraoperative findings.

Discussion

Clark and Duh[2] had concluded that 75% to 80% of all parathyroid tumours can be localised with ultrasound, thallium-technetium scanning, CT or MRI. Other authors have reported that Tc-99m sestamibi imaging has a sensitivity of 80% to 90%.[10,11] Success rates of up to 80% to 90% may be achieved with preoperative localisation procedures but these often require multiple techniques. This may increase radiation exposure and increase health cost.

McGarity and Bostwick[12] first discussed the possibility of parathyroid exploration without preoperative localisation in 1976. Our analysis similarly indicated that preoperative imaging for localising pathologic parathyroid glands is unnecessary.

Surgical exploration alone, without preliminary CT scan, identified all the pathologic parathyroid glands in the ESRF patients. Supernumerary glands identified at surgical exploration were not detected radiologically. Besides the low sensitivity of CT scan (5.9%) in identifying parathyroid glands in ESRF patients, radiologic differentiation between hyperplasia and adenoma was not possible.

In non-ESRF patients, CT scan correctly localised the pathologic parathyroid glands in 41.4% of patients. However, it was unable to differentiate the abnormal gland as the superior or inferior parathyroid gland. Many had normal radiologic findings (37.9%) despite pathologic glands at operation. In contrast, the success rate of identifying parathyroid glands at operation without preliminary imaging was 91.6%.

A significant factor in identifying the parathyroid glands at operation was the experience of the surgeons. In addition, several surgical techniques helped us locate and confirm the parathyroid glands prior to frozen section. Having identified the suspected gland through meticulous dissection as described by Wang,[9] incision of the suspected gland revealed fairly vascular tissue. The typical tanned yellow colour of the parathyroid glands facilitated visual identification and immersion in saline distinguished a fatty tissue that floats from a parathyroid gland that sinks. With these techniques, our surgical success rate in identifying parathyroid glands was comparable to other centres.

In conclusion, our experiences with the use of preoperative localisation have not been favourable as

they did not provide additional information, or altered our surgical management. We have shown that surgical exploration alone had a remarkable success rate of more than 90% in identifying parathyroid glands.

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