

Location of Parathyroid Adenomas: Chiang Mai University Hospital Experience

Kirati Watcharachan, MD*
Pongsak Mahanupab, MD†

*Department of Surgery, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand

†Department of Pathology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand

Abstract

Background and Objective: To identify common locations of parathyroid adenomas in patients with primary hyperparathyroidism seen at Chiang Mai University Hospital.

Material and Method: A retrospective medical record review was performed to identify the location of parathyroid adenomas in patients who underwent parathyroidectomy with pathology report confirmation at Chiang Mai University Hospital from January 2005 to December 2014. The adenomas were grouped according to their position, into right superior, right inferior, left superior and left inferior. Results of the MIBI scans in terms of the position of adenomas were also reviewed.

Results: The most common location of parathyroid adenomas was left inferior. In 23 patients, the left inferior location was seen in 12 patients (52%), the right inferior in 5 patients (22%), the left superior in 4 patients (17%) and the right superior in 2 patients (9%). According to MIBI scans, the left inferior was still the most common location of parathyroid adenomas (10/18 patients, 56%).

Conclusion: The most common location of parathyroid adenomas was the left inferior. This may help the surgeon identify an adenoma in primary hyperparathyroidism by providing a starting point, and perhaps decrease unnecessary neck exploration in patients with negative imaging studies.

Keywords: Location, parathyroid adenoma, primary hyperparathyroidism

INTRODUCTION

Primary hyperparathyroidism is a hypercalcemic condition resulting from autonomous overproduction of parathyroid hormone by one or more parathyroid glands. The most common cause of primary hyperparathyroidism is a single adenoma (88.9%). Less common are multiple gland hyperplasia (5.7%),

double adenoma (4.1%) and parathyroid carcinoma (0.7%)¹. The diagnosis of primary hyperparathyroidism is made by finding elevated parathyroid hormone in the hypercalcemic patient.

Parathyroidectomy is a definitive treatment of primary hyperparathyroidism and a minimally invasive parathyroidectomy is the preferred procedure².

Correspondence address: Kirati Watcharachan, MD, Department of Surgery, Faculty of Medicine, Chiang Mai University, 110 Intravaroros Road, Sripoom, Muang, Chiang Mai 50200, Thailand; E-mail: kvatchara@gmail.com

Performance of minimally invasive parathyroidectomy depends on correct preoperative imaging that can localize the parathyroid adenoma and direct the surgeon to its location. MIBI scan and ultrasound are the preferred localizing imaging studies. The range of sensitivity as regards MIBI scan and ultrasound for parathyroid adenoma localization is 92% to 98%^{3,4} and 77% to 87%^{5,6}, respectively. Bilateral neck exploration is required for patients with negative imaging studies⁷. In such patients, a single adenoma is still the most common intraoperative finding (62% to 77%)^{8,9}.

The location information of the parathyroid adenoma may help the surgeon with a starting point when imaging failed to localize the position of the parathyroid adenoma. When the potential adenoma location is identified early, operating time and unnecessary neck exploration will be reduced. In one study the most common position of parathyroid adenoma was the left inferior (41.3%). The remaining distributions of parathyroid adenomas were right inferior (33.1%), left superior (15.7%) and right superior (8.3%)¹⁰.

At Chiang Mai University Hospital, specific information on the common location of parathyroid adenomas is not available. The objective of our study was to determine the common location of parathyroid adenomas in patients seen at Chiang Mai University Hospital.

PATIENTS AND METHODS

This is a retrospective observational study. Records of patients diagnosed with hyperparathyroidism who underwent a parathyroidectomy, with available pathology report, at Chiang Mai University Hospital from January 2005 to December 2014 were reviewed. This study was approved by the Institutional Review Board. The diagnosis of hyperparathyroidism was made by an endocrinologist. Patients who had indications for surgery underwent neck ultrasonography and/or MIBI scan for preoperative localization.

Primary hyperparathyroidism patients underwent either a standard bilateral neck exploration or a minimally invasive parathyroidectomy. For patients with secondary hyperparathyroidism either a subtotal parathyroidectomy or total parathyroidectomy with autotransplantation was performed. Patient who had concomitant thyroid disease underwent parathyroi-

dectomy and thyroidectomy. Operations were performed by head and neck surgeons.

Biopsy and intraoperative frozen section was used to confirm the presence of parathyroid gland, and all specimens were subsequently sent for permanent section examination. Pathology reports were reviewed and pre and postoperative calcium levels and parathyroid hormone levels were recorded. The locations of the parathyroid adenomas were reviewed from the operative notes. These locations were grouped into right superior, right inferior, left superior and left inferior. Patient characteristics, type of operation, operative time and results of MIBI scan were recorded. Categorical data were summarized as proportions and percentages, and continuous data were summarized as mean $\pm$ SD. Fisher's exact probability test was used to compare categorical variables, and the Student t-test was used to compare continuous variables. Statistical significance was defined as a *p*-value of 0.05 or less.

RESULTS

The characteristics of patient who underwent parathyroidectomy with pathology confirmation of adenoma are summarized in Table 1. The majority of patients were female (89%) with a mean age of 54.5 years. The diagnosis was primary hyperparathyroidism in 23 patients (82%) and secondary hyperparathyroidism in 5 patients (18%). A preoperative MIBI scan was performed in 20 patients, with negative results in 2 patients. All patients with negative MIBI scans had secondary hyperparathyroidism.

Table 1 Patient Characteristics

Characteristics	N (%) or Mean $\pm$ SD
Gender	
Female	25 (89)
Male	3 (11)
Diagnosis	
Primary Hyperparathyroidism	23 (82)
Secondary Hyperparathyroidism	5 (18)
Age (years)	54.5 $\pm$ 15.0 (range, 14 to 73)
Preoperative MIBI Scan	
No Scan	8 (29)
Negative MIBI Scan	2 (7)
Positive MIBI Scan	18 (64)

Operations and operative times are listed in Table 2. We performed bilateral neck exploration in 14 patients (61%), minimally invasive parathyroidectomy in 6 patients (26%) and parathyroidectomy with thyroidectomy in 3 patients (13%). The mean operative time of minimally invasive parathyroidectomy was significantly lower than that of standard bilateral neck exploration (p -value = 0.009). The most common location of a parathyroid adenoma was left inferior. Of 23 patients, the left inferior location was seen in 12 patients (52%), the right inferior in 5 patients (22%),

the left superior in 4 patients (17%) and the right superior in 2 patients (9%) as shown in Table 3.

Eighteen patients diagnosed with primary hyperparathyroidism had an MIBI scan performed. Preoperative MIBI scans revealed the location of adenomas as shown in Table 4. The locations were left inferior in 10 patients (56%), left superior in 4 patients (22%), and right inferior in 4 patients (22%). Pre and postoperative parathyroid hormone and serum calcium levels are shown in Table 5. The mean $\pm$ SD of preoperative and postoperative parathyroid hormone was 348.9 ± 2.9 and 27.7 ± 3.2 , respectively (p -value < 0.001). The mean preoperative serum calcium was 11.7 and postoperative was 8.9 (p -value < 0.001).

Table 2 Operative Finding and Operation in Primary Hyperparathyroidism (N=23)

Operation	N (%)	Operative Time (min) Mean $\pm$ SD
Bilateral Neck Exploration	14 (61)	92.7 ± 25.4 (range, 55 to 135)
Minimally Invasive Parathyroidectomy	6 (26)	55.5 ± 27.4 (range, 30 to 100)*
Parathyroidectomy with Thyroidectomy	3 (13)	121.7 ± 31.8 (range, 85 to 140)

* p -value = 0.009 (bilateral neck exploration versus minimally invasive parathyroidectomy)

DISCUSSION

Table 3 Location of Parathyroid Adenoma in Primary Hyperparathyroidism (N = 23)

Location of Adenoma	N (%)
Right Superior	2 (9)
Right Inferior	5 (22)
Left Superior	4 (17)
Left Inferior	12 (52)

Table 4 Preoperative MIBI Scan and Location of Adenoma in Primary Hyperparathyroidism (N = 23)

MIBI scan	Right Superior	Right Inferior	Left Superior	Left Inferior	Total
No scan	2(40%)	1(20%)	0	2(40%)	5
Positive scan	0	4(22%)	4(22%)	10(56%)	18

Table 5 Pre- and Postoperative Parathyroid Hormone and Serum Calcium in Primary Hyperparathyroidism

Variables	Preoperative Value	Postoperative Value	P-Value
Parathyroid Hormone (pg/mL)	$348.9 \pm 2.9^*$ (range, 72.3 to 3126)	$27.6 \pm 3.2^*$ (Range, 1.14 to 199.5)	<0.001
Serum calcium	11.7 ± 1.3	8.9 ± 1.5	<0.001

*Geometric Mean $\pm$ SD

Table 6 Review of Adenoma Locations Reported in Surgical Studies Using the "Perrier" Nomenclature

Year	Study	No. of patients	Superior*(%)	Inferior*(%)
2011	Moreno et al.14	271	29.8	51.6
2012	Mazeh et al.13	108	47.0	49.0

*Superior = type A + type B, Inferior = type C + type D + type E

The most common location of parathyroid adenomas in the present study was the left inferior gland (52%) which was similar to the study by Mazouki et al. (left inferior 41%)^{10, 11}, but different from the study of Yazici et al. (right inferior 37.7%)¹¹. From both studies, however, the most common location was in the inferior glands, i.e., Mazouki et al., 73% (right 33%, left 41%) and Yazici et al., 70.7% (right 37.7%, left 33%). The superior parathyroid gland usually falls posteriorly in the tracheocephalic groove and may lie as low as the level of inferior pole of the thyroid gland ("type C" parathyroid according to the "Perrier" nomenclature¹²). Thus the glands that are near the lower pole of thyroid gland might be composed of most of the inferior parathyroid glands and a type C superior parathyroid gland. We reviewed the studies that use the "Perrier" nomenclature to classify the location of parathyroid adenomas and the majority was at the inferior location (types C, D and E) as shown in Table 6^{13,14}.

Since 2011 most parathyroid adenomas at Chiang Mai University Hospital were treated with minimally invasive parathyroidectomy (6 of 7 cases) and the mean operative time was significantly lower than that of bilateral neck exploration. We prefer this operation if technically feasible.

The main limitation of our study was the sample size. In Western countries primary hyperparathyroidism is a common disease¹⁵ and the diagnosis is made from routine screening in asymptomatic adults¹⁶. In Thailand, however, it is a rare disease and most patients are symptomatic¹⁷ and there is no routine screening program. Another limitation was that intraoperative parathyroid hormone measurement is not available in our hospital.

Many centers use intraoperative parathyroid hormone to confirm the success of a parathyroidectomy¹⁸. If the intraoperative parathyroid hormone level decreases to less than 50% of the preoperative level, the operation is considered successful. We use only frozen section to confirm the successful removal of a parathyroid gland. Thus we missed a double adenoma in one patient. The parathyroid hormone of that particular patient was still high postoperatively, requiring a reoperation.

In conclusion we recommend using the location near the lower pole of the left side of the thyroid as a starting point of a parathyroidectomy in patients with

primary hyperparathyroidism, in whom imaging studies results are negative, and to use intraoperative parathyroid hormone measurement if possible. This approach may help the surgeon reduce unnecessary neck exploration and lower the risk of complications.

CONCLUSION

A knowledge of the common location of parathyroid adenomas may help the surgeon identify an adenoma in primary hyperparathyroidism more quickly and precisely, and obviate unnecessary neck explorations in patients with negative imaging studies.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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บทคัดย่อ ตำแหน่งที่พบบ่อยของ parathyroid adenomas รายงานจากโรงพยาบาลมหารชนครเชียงใหม่
กิริติ วัชรชัย*, พงษ์ศักดิ์ มหานุภาพ†

*ภาควิชาศัลยศาสตร์, †ภาควิชาพยาธิวิทยา คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่

วัตถุประสงค์ของการวิจัย: การศึกษารั้งนี้เป็นการศึกษาจากหาตำแหน่งของ parathyroid adenomas ในผู้ป่วย primary hyperparathyroidism ในโรงพยาบาลมหารชนครเชียงใหม่

วิธีดำเนินการวิจัย: เป็นการศึกษาจากเวชระเบียนย้อนหลังเพื่อดูตำแหน่งของ parathyroid adenomas ในผู้ป่วยที่ได้รับการผ่าตัด parathyroidectomy และผลทางพยาธิเพื่อยืนยันว่าเป็น parathyroid adenomas ในโรงพยาบาลมหารชนครเชียงใหม่ตั้งแต่เดือนมกราคม 2005 ถึงเดือนธันวาคม 2014 โดย adenomas จะถูกแบ่งตามตำแหน่งเป็น ขวบน ขวาล่าง ซ้ายบนและซ้ายล่าง และมีการบันทึกความสัมพันธ์ระหว่าง MIBI scan และตำแหน่งของ adenomas

ผลการวิจัย: ตำแหน่งที่พบบ่อยที่สุดของ parathyroid adenoma คือซ้ายล่าง ในผู้ป่วยที่ศึกษาจำนวนทั้งหมด 23 ราย พบตำแหน่งซ้ายล่างจำนวน 12 ราย (52.2%) ขวาล่างจำนวน 5 ราย (21.7%) ซ้ายบนจำนวน 4 ราย (17.4%) และขวบนจำนวน 2 ราย (8.7%) และความสัมพันธ์กับ MIBI scan พบว่าตำแหน่งซ้ายล่างก็ยังเป็นตำแหน่งที่พบบ่อยสุดของ parathyroid adenoma (10ใน18 ราย, 55.5%)

สรุป: ตำแหน่งที่พบบ่อยของ parathyroid adenomas อาจจะช่วยคัดแยกแพทย์โดยใช้เป็นจุดเริ่มต้นในการหา adenoma และช่วยลดการทำ neck exploration โดยไม่จำเป็นได้ในผู้ป่วย primary hyperparathyroidism ที่ไม่สามารถระบุตำแหน่ง adenomas ได้จากการตรวจทางรังสี