Journal of Surgery
2025, Vol. 13, No. 5, pp. 126-133
https://doi.org/10.11648/j.js.20251305.12

Research Article

Role of Preoperative Localization Before Focused Parathyroidectomy in Case of Parathyroid Adenoma

Md. Nadim Uddin[1, *], Md. Aminul Islam Joarder[1], Ferdous Alam[1], Noor Mohal[2], Aktar-Uj-Jaman[1], Soniya Akter[3]

[1]Department of General Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[2]Department of Anesthesiology, Islami Bank Medical College, Rajshahi, Bangladesh
[3]Department of Casualty, Sir Salimullah Medical College & Mitford Hospital, Dhaka, Bangladesh

Abstract

Background: Commonly, primary hyperparathyroidism is caused by a single parathyroid adenoma; a smaller fraction are hyperplasia, or multigland disease. Prelocalization of the diseased parathyroid gland is key to effective parathyroidectomy. Focused parathyroidectomy has become the standard treatment for selected patients with primary hyperparathyroidism. The aim is to assess the role of preoperative localization before doing focused parathyroidectomy. *Methods:* From July 2022 to June 2023, this cross-sectional study was conducted at Bangabandhu Sheikh Mujib Medical University's general surgery department in Dhaka. 14 patients with primary hyperparathyroidism had focused parathyroidectomy. Statistical analysis of the results was obtained by using window-based computer software with IBM SPSS statistics (Version 22). *Results:* The male-to-female ratio was 2.5:1, and the mean age was 32.36 years (SD = 9.76). The sensitivity, specificity, and accuracy for the ultrasound's validity test were 75.0%, 50.0%, and 71.4%, respectively. The validity test for the Sestamibi scan has an accuracy of 85.7%, a specificity of 0.0%, and a sensitivity of 100.0%. The biochemical frozen section validity test's sensitivity, specificity, accuracy, and positive and negative predictive values were all 100%. The majority of individuals (85.7%) in the histopathology study investigation had parathyroid adenoma. The range of the postoperative hospital stay was 2 to 19 days, with an average of 8.2 ±6.26 days. Not all patients who underwent surgery had ugly scars. *Conclusion:* Preoperative localization enables patients to have focused parathyroidectomy, which is potentially cost effective, reduce postoperative complication, hospital stay with good cosmesis and patient satisfaction; ultimately improve postoperative outcome.

Keywords

Primary Hyperparathyroidism, Parathyroid Adenoma, Focused Parathyroidectomy

1. Introduction

In the vast majority of primary hyperparathyroidism (PHPT) patients, the condition occurs due to a solitary sporadic parathyroid adenoma [single gland disease (SGD); a smaller proportion is as a result of a double adenoma or hyperplasia [multi gland disease (MGD)] [1]. The inferior thyroidal artery supplies blood to superior and inferior parathyroid glands.

*Corresponding author: mdnadimuddin07437@gmail.com (Md. Nadim Uddin)

Received: 20 August 2025; **Accepted:** 3 September 2025; **Published:** 25 September 2025

Even though the exact locations of the glands may be different. In 77% of cases, the inferior parathyroid gland is found at the posterior aspect of the thyroid lobe in an area 2 cm in diameter, centered 1 cm around the junction of the inferior thyroid artery and the recurrent laryngeal nerve in strict proximity to the cricothyroid junction [2]. The majority of ectopic glands found in the mediastinum are in thymus [3]. Over the past two decades, unilateral focused parathyroidectomy has largely replaced traditional bilateral neck exploration (BNE) as the surgery of choice for parathyroidectomy [4, 5]. Compared to BNE, focused parathyroidectomy decreases complication rates, i.e., vocal cord paralysis, operating, and anesthesia time, while also improving cosmetic results and providing a similar surgical cure rate [1]. Today focused parathyroidectomy has become the standard treatment for selected primary hyperparathyroidism patients who have positive imaging. However, BNE is still the gold standard in the surgical treatment of PHPT [6]. In the last quarter of the last century, combinations of USG and sestamibi scan methods were the most commonly used techniques for initial imaging. Objectives of this study are to evaluate the role of preoperative localization by USG and sestamibi scan before doing focused parathyroidectomy. Specially to see the accuracy of preoperative localization by USG and Sestamibi with peroparative localization of disease gland and observe postoperative complications in focused parathyroidectomy, which enhance localization of adenoma, direct approach, low postoperative complications, good cosmetic result, and over all cost effectiveness in our hospital setting.

2. Methods

All diagnosed cases of PHPT due to single adenoma excluding MGD, recurrent HPT, intrathyroid parathyroid adenoma, ectopic parathyroid adenoma needing thoracotomy, and parathyroid adenoma with other neck pathology needing neck exploration were included in this study. The cross-sectional study was conducted in the Department of General Surgery, BSMMU, over a period of one year from July 2022 to June 2023. 14 patients diagnosed with PHPT due to solitary parathyroid adenoma who fulfilled selection criteria were included in this study. The interviewer administered structured questionnaires and collected data considering the variables: age, sex, clinical features, laboratory investigation, USG of neck findings, sestamibi scan, peroperative findings, biochemical frozen section, postoperative follow-up, and events (till hospital period and over the telephone during homestay).

Statistical Analysis

Data were processed and analyzed using IBM SPSS (Statistical Package for Social Sciences) statistics (Version 22) in accordance with the aims and objectives. The result was presented in tables. The statistical terms included in this study are mean, percentages, standard deviations, etc. Statistical analysis—a test of validity was performed.

3. Results

Table 1. *Distributions of the study patients by demographic profile and presenting and past complaints (N=14).*

Demographic Profile	Number	Percentage
Age (in years)		
11-20	3	21.4
21-30	3	21.4
31-40	5	35.6
41-50	3	21.4
Mean ±SD	32.36 ±9.76	
Range (min, max)	18, 45	
Gender		
Female	4	28.6
Male	10	71.4
Presenting Complaints		
Renal symptoms	9	64.3
Bone symptoms	5	35.7
Abdominal symptoms	5	35.7
Muscle weakness	4	28.6
Fatigue	4	28.6
Memory impairment	3	21.4
Past history		
Renal disease	5	35.7
HTN	3	21.4
Bone disease	3	21.4
DM	1	7.1
Chronic calculus cholecystitis and pancreatitis	1	7.1
No past history	3	21.4

In this study, we evaluated 14 patients with single parathyroid adenoma. In which female 4 and male 10 patients with mean age 32.36, SD = 9.76. About 64.35% of patients presented with renal symptoms; about 35.7% had a past history of chronic renal disease. Also, 35.75% of patients present with bone symptoms and abdominal symptoms (Table 1).

Table 2. *Distributions of the study patients by preoperative imaging findings and peropertive findings (N=14).*

	USG of neck (n=14)		Sestamibi (n=14)		Peroperative (n=14)	
	n	%	n	%	N	%
Left	4	28.6	-	-	-	-
Left lower	-	-	6	42.9	6	42.9
Left upper	-	-	1	7.1	1	7.1
Right	4	28.6	-	-	-	-
Right lower	-	-	4	28.6	3	21.4
Right upper	-	-	-	-	1	7.1
Right & left	1	7.1	-	-	-	-
Superior medistinal	-	-	3	21.4	3	21.4
Normal findings	4	28.6	-	-	-	-
Right (medial & lateral)	1	7.1	-	-	-	-

All 14 patients were evaluated by USG of neck, sestamibi scan, and correlated with peroperative findings of disease gland. It was noted that 28.6% of the patients had USG performed to assess their left side. It's interesting to note that in 42.9% cases for the left lower region and 7.1% cases for the left upper region, sestamibi scans and peroperative assessments produced the same diagnosis. Additionally, it was shown that more than a quarter (28.6%) of the patients had a right-side USG assessment. Sestamibi scans, however, showed that all four cases (28.6%) were present in the right lower area. The peroperative data, in contrast, showed that 7.1% was in the right upper region and 21.4% was in the right lower region. Similar to that, it was discovered that 7.1% of the patients in this study had adenoma on their right & left sides and right (medial & lateral), respectively, as evaluated by USG. It's interesting to note that sestamibi scans and peroperative evaluations agreed that 21.4% of the instances were in the superior medistinal region. Notably, despite the fact that USG classified 28.6% as normal, neither sestamibi scans nor postoperative assessments found any instances to be normal (Table 2).

Table 3. *Association between USG of neck with peroperative findings (N=14).*

USG of neck	Peroperative																					
	Left		Left lower		Left upper		Right		Right lower		Right upper		Superior medias-tinal		Right & left		Right (medial & lateral)		Normal		Total	
	-		(n=6)		(n=1)		-		(n=3)		(n=1)		(n=3)		-		-		-		(n=14)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Left	-	-	4	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	28.6
Left lower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Left upper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Right	-	-	-	-	-	-	-	-	2	66.7	1	100.0	1	33.3	-	-	-	-	-	-	4	28.6
Right lower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Right upper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

USG of neck	Peroperative																					
	Left		Left lower		Left upper		Right		Right lower		Right upper		Superior mediastinal		Right & left		Right (medial & lateral)		Normal		Total	
	-		(n=6)		(n=1)		-		(n=3)		(n=1)		(n=3)		-		-		-		(n=14)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Superior mediastinal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Right & left	-	-	1	16.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	7.1
Right (medial & lateral)	-	-	-	-	-	-	-	-	1	33.3	-	-	-	-	-	-	-	-	-	-	1	7.1
Normal	-	-	1	16.7	1	100.0	-	-	-	-	-	-	2	66.7	-	-	-	-	-	-	4	28.6

Table 3 shows the peroperative findings of 6 patients found in the left lower, out of which 16.7% had enlarged right & left parathyroid glands, 66.6% had enlarged parathyroid glands left, and 16.7% had normal parathyroid glands evaluated by USG of the neck. Similarly, peroperative findings 1 patient found in left upper, out of which 100.0% had normal parathyroid gland evaluated by USG of neck. Peroperative findings: 3 patients were found in the right lower, out of which 66.7% had an enlarged parathyroid gland right and 33.3% had an enlarged right medial & lateral parathyroid gland evaluated by USG of the neck. Peroperative findings: 1 patient found in the right upper, out of which 100.0% had an enlarged parathyroid gland right evaluated by USG of the neck. Peroperative findings: 3 patients were found in superior mediastinal, out of which 33.3% had an enlarged parathyroid gland right and 66.7% had a normal parathyroid gland evaluated by USG of the neck.

Table 4. *Association between sestamibi scan findings with peroperative findings (N=14).*

Sestamibi	Per-operative											
	Left lower		Left upper		Right lower		Right upper		Superior mediastinal		Total	
	(n=6)		(n=1)		(n=3)		(n=1)		(n=3)			
	n	%	n	%	n	%	n	%	n	%	n	%
Left lower	6	100.0	-	-	-	-	-	-	-	-	6	42.9
Left upper	-	-	1	100.0	-	-	-	-	-	-	1	7.1
Right lower	-	-	-	-	3	100.0	1	100.0	-	-	4	28.6
Right upper	-	-	-	-	-	-	-	-	-	-	-	-
Superior Mediastinal	-	-	-	-	-	-	-	-	3	100.0	3	21.4

It was observed that all 100.0% patients had left lower enlarged parathyroid gland in sestamibi scan, found in per-operative left lower; 100.0% patients had left upper in sestamibi scan, found in peroperative left upper; 100.0% patients had right lower sestamibi scan found in peroperative right lower; 100.0% in peroperative right upper; and 100.0% in superior mediastinal (Table 4).

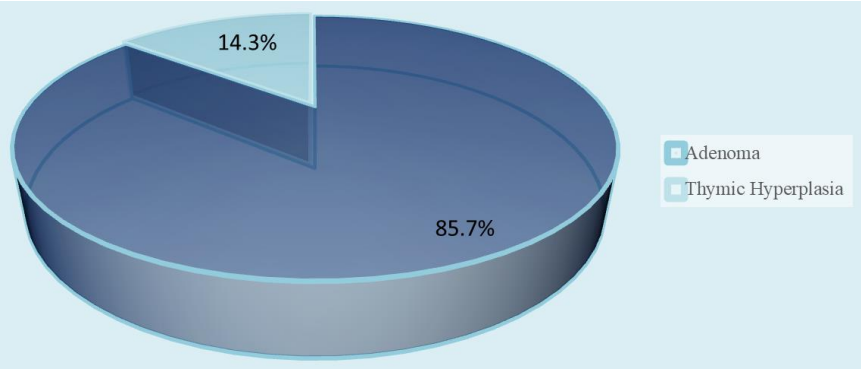

Figure 1. *Histopathological Diagnosis of patients (N=14).*

We found a significant reduction of parathormone after surgery, which is 85.7% (12), and after histology, in case 85.7% (12) had adenoma, 14.3% (2) had thymic hyperplasia.

Table 5. *Sensitivity, specificity, accuracy, positive and negative predictive values of USG, Sestamibi and Biochemical frozen section (N=14).*

Test of validity	USG	Sestamibi	Biochemical Frozen section
Sensitivity	75.0	100.0	100.0
Specificity	50.0	0.0	100.0
Accuracy	71.4	85.7	100.0
PPV	90.0	85.7	100.0
NPV	25.0	0.0	100.0

After comparison between histopathological diagnosis with imaging modalities and biochemical frozen section for evaluation of parathyroid adenoma (n = 14), USG of neck evaluation for parathyroid adenoma found true positive 9 cases, false positive 1 case, false negative 3 cases, and true negative 1 cases in identification by histopathological diagnosis. Sestamibi evaluation for parathyroid adenoma, true positive 12 cases, false positive 2 cases, false negative 0 cases, and true negative 0 cases in identification by histopathological diagnosis. Biochemical frozen section evaluation for parathyroid adenoma, true positive 12 cases, false positive 0 cases, false negative 0 cases, and true negative 2 cases in identification by histopathological diagnosis.

On the basis of the above data, Table 5 shows the validity test of USG has sensitivity 75.0%, specificity 50.0%, accuracy 71.4%, positive predictive value 90.0%, and negative predictive value 25.0%. The validity test of Sestamibi has sensitivity 100.0%, specificity 0.0%, accuracy 85.7%, positive predictive values 85.7%, and negative predictive values 0.0%. The validity test of the biochemical frozen section has sensitivity 100.0%, specificity 100.0%, accuracy 100.0%, positive predictive values 100.0%, and negative predictive values 100.0%.

Table 6. *Distributions of the study patients by postoperative outcome (N=14).*

Postoperative outcome	Number	Percentage
Complication (n=7)		
Bone pain	4	57.1
Circumoral paresthesia	4	57.1
Carpopedal spasm	1	14.3
Digital paresthesia	3	42.9
Cosmesis (n=14)		
Poor	0	0.0
Good	14	100.0
Postoperative hospital stay in days (n=14)	8.2±6.26	
Range (min, max)	2, 19	

Table 6 shows the distributions of the study patients by postoperative outcome. It was observed that more than half (57.1%) patients had bone pain and circumoral paresthesia, followed by 3 (42.9%) digital paresthesia and 1 (14.3%) carpopedal spasm, respectively. All (100.0%) patients had good cosmesis. The mean postoperative hospital stay was 8.2±6.26 days, which ranged from 2 to 19 days.

4. Discussions

According to the study findings, a sizable portion (35.6%) of the patients undergoing focused parathyroidectomy for parathyroid adenoma had a mean age of 32.36 (SD = 9.76). The study found that 28.6% of the parathyroid adenoma patients were female and 71.4% were male. In contrast, a study showed that parathyroid adenomas were predominately found in females [7]. In the present study, it was observed that the

majority of hyperparathyroidism patients (64.3%) presented with renal symptoms, 35.7% of patients presented with bone and abdominal symptoms; muscle weakness and fatigue were reported in 28.6% of the cases, and 21.4% experienced memory impairment. The present study discovered that 21.4% of patients with hyperparathyroidism had both hypertension and bone problems, and 35.7% had a history of renal disease. During the latter part of the previous century, USG and sestamibi scans emerged as valuable preoperative imaging tools. As in previous studies, several institutions use a combination of ultrasound and sestamibi scans for preoperative imaging [8, 9]. The combination of these methods has been shown to enhance sensitivity [10]. It was well-established that USG stands out as one of the most frequently utilized imaging methods for preoperative localization in PHPT [1].

Sestamibi scans and USG were evaluated prior to surgery in the current study. Adenomas locations were also determined through intraoperative evaluations. First of all, this study found that the precision of an USG in pinpointing the precise location of parathyroid adenomas was constrained. Only 28.6% of individuals who had left or right side USG assessments had their adenomas confined. This implies that precise preoperative localization using an USG alone may not be possible.

The most accurate localization was achieved through preoperative assessments, with a 100% localization in this study by Sestamibi scan. This aligns with the findings of several other studies that emphasize the reliability of intraoperative findings in guiding the surgeon to the precise location of the adenoma [1]. This study also found a subset of patients (21.4%) whose sestamibi scans and intraoperative assessments agreed on the diagnosis of adenomas in the superior mediastinum. This emphasizes the necessity of a thorough preoperative assessment that takes into account unique adenoma sites, which might not be seen by conventional imaging techniques. Intraoperative assessment, on the other hand, remains the gold standard, ensuring the maximum accuracy. To improve preoperative localization, it is best to combine imaging modalities and keep an eye out for uncommon adenoma placements.

In terms of the biochemical frozen section, the findings show that 85.7% of patients had a significant reduction in their previous level, whereas 14.3% did not. The primary sign of single-gland disease appears to be a decrease in PTH levels within the normal range and to less than half of the maximum preoperative PTH level at the 10-minute mark following surgery. This method is known as “biochemical frozen section.” [11, 2]. Furthermore, histological examination revealed that the majority of patients (85.7%) had parathyroid adenoma, with the remaining 14.3% diagnosed with thymic hyperplasia. The high success rate of considerable reduction parathormone level in patients with parathyroid adenoma after focused parathyroidectomy is a positive result, implying that preoperative localization is critical in surgical decision-making. These findings support the current trend of using minimally invasive procedures to treat parathyroid adenoma.

In this study, it was discovered that 57.1% who developed complications in the postoperative phase experienced bone pain and circumoral paresthesia, 42.9% reported digital paresthesia, and 14.3% suffered from carpopedal spasm. Transient hypocalcemia is a common complication following parathyroid surgery with reported incidence rates ranging from 5% to 52% [12].

The average postoperative hospital stay was 3.8 days, according to the previous study [7]. According to this study findings, the typical length of time patients spent in the hospital after surgery was 8.2 (SD= 6.26). In comparison to bilateral neck exploration, focused parathyroidectomy has a number of benefits, including a quicker recovery time, less surgical dissection, cost savings, a shorter hospital stay, and a lower risk of temporary postoperative hypocalcemia [13]. No patient in the current study was found to have an "ugly scar" after surgery. According to Noureldine et al., minimally invasive parathyroidectomy should produce similar curative outcomes to the traditional 4-gland exploration, with the main advantage of reducing skin incisions and improving cosmetic outcomes [14].

The result of the current study shows that preoperative USG had a high sensitivity in detecting enlarged parathyroid glands. Similar findings with high accuracy in localizing parathyroid adenoma using preoperative USG were reported in a study by Thomas *et al.*, 2019 [15]. Additionally, research by Alemadi et al. reviewed that data from several trials came to the conclusion that while preoperative localization techniques, such as USG, can be useful in parathyroidectomy, their accuracy can vary greatly between different facilities and operators [16].

Sestamibi scans are a highly accurate method for determining the precise site of parathyroid adenomas, as evidenced by the fact that 100.0% of patients had concordant scans in all locations, including the left lower, left upper, right lower, right upper, and superior mediastinal. This high degree of accuracy is particularly important since it can result in surgical procedures that are more focused and less intrusive. Similar research was done by Khorasani and Mohammadi utilizing sestamibi scans and they found a range of 54.0% to 100.0% concordance between preoperative scans and peroperative findings [17]. This inaccuracy could be explained by variations in patient populations, surgical methods, or sestamibi scan interpretation. However, the results of the current study, which boast a 100% accuracy rate, imply that careful attention to scan interpretation and surgical technique can greatly increase the reliability of preoperative localization. Numerous studies have shown that the combination of sestamibi scans and USG for preoperative localization of parathyroid adenoma produces a diagnosis accuracy greater than 90.0% [18].

In the current study, USG demonstrated a sensitivity of 75.0%, specificity of 50%, accuracy of 71.4%, positive predictive value (PPV) of 90.0%, and negative predictive value

(NPV) of 25.0%. These findings imply that although USG has a moderate sensitivity and a reasonably high PPV for detecting parathyroid adenomas, it may miss some instances. Cheung et al. conducted a meta-analysis to investigate the usefulness of USG and found that it had a positive predictive value (PPV) of 93.2% and a per-patient pooled sensitivity or detection rate of 76.1% [19]. The correct diagnosis of either the correct lateralization or the correct multi-gland illness was described in their study as sensitivity. PPV is a test result that is positive and suggests the presence of multiple gland diseases or a single adenoma.

According to this study, sestamibi scans had sensitivity values of 100.0%, specificity values of 0.0%, accuracy values of 85.7%, PPV values of 85.7%, and NPV values of 0.0%. Sestamibi scan demonstrated outstanding sensitivity but had a low degree of specificity, which increased the likelihood of false-positive results.

Solorzano, Carneiro-Pla, and Irvin discovered that the performance characteristics of USG and sestamibi scan were equivalent in observational cohort research [20]. In particular, both modalities demonstrated a negative predictive value of 92%, a specificity of 97%, and a sensitivity of 76% for patient-based analysis. Additionally, the sestamibi scan's positive predictive value (PPV) was 92%, whereas ultrasound's PPV was 90%. Overall, USG had a diagnosis accuracy of 91%, whereas sestamibi scan had a marginally greater diagnostic accuracy of 92%. The results discussed above support the findings of the current investigation.

Our results demonstrate that biochemical frozen section analysis is very reliable for detecting parathyroid adenomas, with no false positives or false negatives.

The individual clinical situation and the availability of resources will determine the preoperative localization technique used in parathyroid adenoma instances. Despite its moderate sensitivity, USG can still be useful because of its non-invasiveness and comparatively high PPV. Sestamibi scan, on the other hand, should be used with caution due to its high sensitivity but poor specificity, which can result in needless exploratory surgery. The most dependable method is biochemical frozen section analysis since it combines high sensitivity and specificity, ensuring accurate localization without the risk of misinterpretation. Each technique has benefits and drawbacks. Based on the demands of each patient and the resources at their hospital, the surgeon should carefully examine the localization method selection.

5. Conclusion

In patients with primary hyperparathyroidism, ultrasonography and a sestamibi scan can effectively predict the location of a parathyroid adenoma, which enhances localization of the adenoma. Preoperative localization enables patients to have focused parathyroidectomy, which is potentially cost-effective, reduces postoperative complications, and improves hospital stay with good cosmesis and patient satisfaction; ultimately, it improves postoperative outcome. Because the study group was drawn from a single tertiary hospital in Dhaka, the findings might not accurately represent the nation as a whole.

Abbreviations

PHPT	Primary Hyperparathyroidism
SGD	Single Gland Disease
MGD	Multi Gland Disease
BNE	Bilateral Neck Exploration
USG	Ultrasonography
PTH	Parathyroid Hormone
SPSS	Statistical Package for the Social Sciences
SD	Standard Deviation
PPV	Positive Predictive Value
NPV	Negative Predictive Value
HTN	Hypertension
DM	Diabetes Mellitus

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Tay D, Das JP, Yeh R. Preoperative Localization for Primary Hyperparathyroidism: A Clinical Review. Biomedicines. 2021 Apr 6; 9(4): 390. https://doi.org/10.3390/biomedicines9040390

[2] Williams N, O'Connell PR and McCaskie A. Bailey & Love' s Short practice of Surgery, 27th edition. CRC PressTaylor & Francis Group, Boca Raton, FL. 2018; page number 823, 825, 829, 830. Text Book of Surgery.

[3] Taterra D, Wong LM, Vikse J, Sanna B, Pękala P, Walocha J, Cirocchi R, Tomaszewski K, Henry BM. The prevalence and anatomy of parathyroid glands: a meta-analysis with implications for parathyroid surgery. Langenbecks Arch Surg. 2019 Feb; 404(1): 63-70. https://doi.org/10.1007/s00423-019-01751-8

[4] John P. Bilezikian, Maria Luisa Brandi, Richard Eastell, Shonni J. Silverberg, Robert Udelsman, Claudio Marcocci, John T. Potts, Guidelines for the Management of Asymptomatic Primary Hyperparathyroidism: Summary Statement from the Fourth International Workshop, The Journal of Clinical Endocrinology & Metabolism, Volume 99, Issue 10, 1 October 2014, Pages 3561-3569, https://doi.org/10.1210/jc.2014-1413

[5] Udelsman R, Åkerström G, Biagini C, Duh QY, Miccoli P, Niederle B, Tonelli F. The surgical management of asymptomatic primary hyperparathyroidism: proceedings of the Fourth International Workshop. J Clin Endocrinol Metab. 2014 Oct; 99(10): 3595-606. https://doi.org/10.1210/jc.2014-2000

[6] Egan RJ, Scott-Coombes DM. The surgical management of sporadic primary hyperparathyroidism. Best Practice & research. Clinical Endocrinology & Metabolism. 2018 Dec; 32(6): 847-859. https://doi.org/10.1016/j.beem.2018.12.001

[7] Topal, Ugur, Kubilay Dalci, Ayse Unal, Ahmet Saritas, Isa Gunay, Aysun Uguz, and Gurhan Sakman. "Clinical and surgical approach to parathyroid adenomas: A single-center experience." Annals of Medical Research 26, no. 10 (2019): 2259. http://dx.doi.org/10.5455/annalsmedres.2019.08.471

[8] Wilhelm SM, Wang TS, Ruan DT, Lee JA, Asa SL, Duh QY, Doherty GM, Herrera MF, Pasieka JL, Perrier ND, Silverberg SJ, Solórzano CC, Sturgeon C, Tublin ME, Udelsman R, Carty SE. The American Association of Endocrine Surgeons Guidelines for Definitive Management of Primary Hyperparathyroidism. JAMA Surg. 2016 Oct 1; 151(10): 959-968. https://doi.org/10.1001/jamasurg.2016.2310

[9] Varadharajan K, Choudhury N. Current practice in the surgical management of parathyroid disorders: a United Kingdom survey. Eur Arch Otorhinolaryngol. 2018 Oct; 275(10): 2549-2553. https://doi.org/10.1007/s00405-018-5094-1

[10] Tunca F, Akici M, Işcan Y, Cem Sormaz I, Giles Senyurek Y, Terzioğlu T. The impact of combined interpretation of localization studies on image-guided surgical approaches for primary hyperparathyroidism. Minerva Endocrinol. 2017 Sep; 42(3): 213-222. https://doi.org/10.23736/S0391-1977.16.02396-8

[11] Horányi J, Duffek L, Szlávik R, Takács I, Tóth M, Romics L Jr. Intraoperative determination of PTH concentrations in fine needle tissue aspirates to identify parathyroid tissue during parathyroidectomy. World J Surg. 2010 Mar; 34(3): 538-43. https://doi.org/10.1007/s00268-009-0351-5

[12] Mahbub, S., Biswas, S. S., Dey, B. K., Alam, M. S., & Hoq, J. (2021). Parathyroid Adenoma: an experience in BIRDEM General Hospital. Bangladesh Journal of Otorhinolaryngology, 27(1), 44-51. https://doi.org/10.3329/bjo.v27i1.53204

[13] Khan A, Bilezikian J, Bone H, Gurevich A, Lakatos P, Misiorowski W, Rozhinskaya L, Trotman ML, Tóth M. Cinacalcet normalizes serum calcium in a double-blind randomized, placebo-controlled study in patients with primary hyperparathyroidism with contraindications to surgery. Eur J Endocrinol. 2015 May; 172(5): 527-35. https://doi.org/10.1530/EJE-14-0877

[14] Noureldine SI, Gooi Z, Tufano RP. Minimally invasive parathyroid surgery. Gland Surg. 2015 Oct; 4(5): 410-9. https://doi.org/10.3978/j.issn.2227-684X.2015.03.07

[15] Thomas PR, Beggs AD, Han TS. Utility of surgeon-performed pre-operative ultrasound in the localisation of parathyroid adenomas. JRSM Cardiovasc Dis. 2019 Jun 19; 8: 2048004019856950. https://doi.org/10.1177/2048004019856949

[16] Budoor Alemadi, Maryam Ahmad Alsaeed, Fatima Alsayyah, Salma Rahma, Fatheya Al Awadi, Fauzia Rashid; Correlation between Surgical Outcomes of Primary Hyperparathyroidism with Neck Ultrasound and Parathyroid Scan-Tc99m/MIBI Localization Studies in Dubai Hospital. Dubai Diabetes Endocrinol J 28 December 2022; 28(4): 136-142. https://doi.org/10.1159/000522194

[17] Khorasani N, Mohammadi A. Effective factors on the sensitivity of preoperative sestamibi scanning for primary hyperparathyroidism. Int J Clin Exp Med. 2014 Sep 15; 7(9): 2639-44.

[18] Scattergood S, Marsden M, Kyrimi E, Ishii H, Doddi S, Sinha P. Combined ultrasound and Sestamibi scintigraphy provides accurate preoperative localisation for patients with primary hyperparathyroidism. Ann R Coll Surg Engl. 2019 Feb; 101(2): 97-102. https://doi.org/10.1308/rcsann.2018.0158

[19] Cheung K, Wang TS, Farrokhyar F, Roman SA, Sosa JA. A meta-analysis of preoperative localization techniques for patients with primary hyperparathyroidism. Ann Surg Oncol. 2012 Feb; 19(2): 577-83. https://doi.org/10.1245/s10434-011-1870-5

[20] Solorzano, C. C., Carneiro-Pla, D. M. and Irvin, G. L. (2006) Surgeon-Performed Ultrasonography as the Initial and Only Localizing Study in Sporadic Primary Hyperparathyroidism. Journal of the American College of Surgeons, 202, 18-24. https://doi.org/10.1016/j.jamcollsurg.2005.08.014