Journal of Surgery
Ishaq A, et al. J Surg 11: 11574
www.doi.org/10.29011/2575-9760.11574
www.gavinpublishers.com
Research Article

Individual and Combined Sensitivity of Ultrasound and 99mtc-MIBI in Localizing Parathyroid Adenoma; Our Experience

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Citation: Ishaq A, Siddiqi W, Khan MJS, Kewalramani G, Kumari S, et al. (2026) Individual and combined sensitivity of ultrasound and 99mTc-MIBI in localizing parathyroid adenoma; Our experience. J Surg 11: 11574 DOI: 10.29011/2575-9760.011574

Received Date: 18 February 2026; **Accepted Date:** 23 February 2026; **Published Date:** 25 February 2026

Abstract

Objectives: To calculate individual and combined sensitivity of ultrasound and 99mTc-MIBI scan in localizing parathyroid adenoma in patients diagnosed with primary hyperparathyroidism.

Materials and methods: This is a single institute retrospective study analysing the results of 45 patients who underwent parathyroid adenoma excision in study specified duration. Patients details were reviewed using electronic medical record system and imaging findings were compared with final post op histopathology to calculate sensitivity of high resolution ultrasound and MIBI scan in localizing parathyroid adenoma. Cases using combined modalities were analysed to calculate combined sensitivity.

Results: Our results show that ultrasound has a sensitivity of 91.85 % while MIBI scan has sensitivity of 81.5 % in diagnosing parathyroid adenoma in patients with primary hyperparathyroidism and combined sensitiv

ity for both modalities is 94.28 %.

Conclusion: In expert hands ultrasound is more sensitive than MIBI scan in localizing parathyroid adenoma. However, combining both modalities can even increase sensitivity to 94.28 percent. Other modalities like PET Choline scan and parathyroid wash out show promising results with increased sensitivity and specificity but need further studies to analyse these results.

Introduction and Background

Primary Hyperparathyroidism (PHPT) is a frequent endocrine disorder, ranking as the third most common after diabetes and thyroid diseases, with an estimated prevalence of approximately 0.3% in the general population [1,2]. Globally, parathyroid tumors affect less than 0.5% of the general population, and among these, benign parathyroid adenomas represent approximately 98% of cases, while atypical adenomas and parathyroid carcinomas are much rarer, comprising 1.2–1.3% and less than 1% respectively [3] Epidemiological data indicate that a single parathyroid adenoma is responsible for 80% to 85% of PHPT cases, with double adenomas accounting for 4% to 5% and parathyroid hyperplasia for 10% to 12% [4,5]. PHPT itself has a reported prevalence ranging from 1 to 7 cases per 1,000 adults, and the incidence increases with age, particularly affecting women three times more often than men, most commonly between the ages of 50 and 70 [4-6] The incidence and prevalence of PHPT and parathyroid adenomas vary by region and are influenced by diagnostic practices and population demographics. In the United States, the age-adjusted prevalence of PHPT is estimated at 233 per 100,000 women and 85 per 100,000 men, with the highest rates observed in women aged 70–79 years [6]. European studies report incidence rates ranging from 13.7 to 50.4 per 100,000 person-years, with a higher burden among women and older adults [6]. Although data from South America, Asia, Australia, and Africa are more limited, there is a consensus that PHPT is underdiagnosed in developing regions, likely due to less widespread biochemical screening [6]. Within the Middle East, and specifically in the Gulf region, the epidemiology of PHPT and parathyroid adenomas has been less extensively studied. However, available regional data suggest an increasing trend in the diagnosis of PHPT, mirroring global patterns. For example, a large multicenter study in Saudi Arabia reported a prevalence of 11.3 to 12.8 cases per 100,000 hospital population, with single parathyroid adenoma found to be the cause in approximately 85% of cases [7]. The gender distribution in this cohort was similar to international data, with females outnumbering males by a ratio of about 3:1 and a mean age at diagnosis of around 60 years [7]. Comparable findings have been reported in other Gulf countries, such as Qatar, indicating that the majority of PHPT cases in the region are also attributable to solitary parathyroid adenomas [7].

Regarding the United Arab Emirates (UAE), published data remain limited. Nevertheless, studies conducted at major tertiary centers in the UAE have demonstrated that the clinical presentation, imaging characteristics, and surgical outcomes of parathyroid adenoma patients are consistent with regional and international trends [8]. The majority of PHPT cases in the UAE are caused by solitary adenomas, and the demographic profile of affected patients—predominantly middle-aged women—is similar to that seen elsewhere [8]. While precise national incidence and prevalence rates for parathyroid adenomas in the UAE are not yet available in the literature, the disease burden appears to align with that reported in neighboring Gulf states and the wider Middle East [8,7]. Hyperparathyroidism is a generalized disorder of Calcium (Ca), Phosphate (P), and bone metabolism caused by increased secretion of Parathyroid Hormone (PTH). The elevation of PTH usually leads to hypercalcemia, hypophosphatemia, and relative hypocalciuric. Primary hyperparathyroidism may be caused by an adenoma or hyperplasia , secondary hyperparathyroidism is usually seen with renal failure and owing to various causes, such as osteomalacia, familial hypocalciuric hypercalcemia, and lithium therapy. Tertiary hyperparathyroidism occurs when one or more hyperplastic glands in secondary hyperparathyroidism begin functioning autonomously, resulting in hypercalcemia . The size of a normal parathyroid gland ranges between 40-50 mg and therefore is infrequently visualized; however, when adenoma or hyperplasia occur the size increases up to ten fold and it can be detected in imaging modalities . The condition is characterized by the excessive and inappropriate secretion of Parathyroid Hormone (PTH), typically due to a solitary parathyroid adenoma, though multiglandular disease and parathyroid carcinoma are less common etiologies.

Parathyroid hormone plays a critical role in regulating calcium homeostasis, and its dysregulation leads to hypercalcemia, with clinical manifestations ranging from asymptomatic biochemical abnormalities to nephrolithiasis, osteoporosis, and neuropsychiatric disturbances. Surgical excision of the hyperfunctioning Parathyroid Gland(s) remains the only definitive cure for PHPT, with long-term cure rates exceeding 95% in experienced hands [9]. Over the past two decades, the surgical management of PHPT has evolved significantly. Traditional bilateral neck exploration, which involves identification and assessment of all four parathyroid glands, has largely been supplanted by Minimally Invasive Parathyroidectomy (MIP) when preoperative localization is successful. The shift towards focused surgical approaches is driven by the desire to reduce operative time, hospital stay, and surgical morbidity, including risks of recurrent laryngeal nerve injury and postoperative hypocalcemia, while maintaining high cure rates [10]. The success of MIP is critically dependent on the accurate preoperative localization of the abnormal gland. High-resolution neck Ultrasonography (US) and technetium-99m sestamibi (99mTc-MIBI) scintigraphy are the most widely used imaging modalities for this purpose. Ultrasonography is non-invasive, widely available, and cost-effective, but its diagnostic accuracy is highly operator-dependent and can be compromised by concomitant thyroid pathology or ectopic gland locations. A comprehensive meta-analysis by Ruda et al. (2005) [11] reported the sensitivity of ultrasonography for detecting parathyroid adenomas

to range from 72% to 89% in large series, with some studies in expert centers reporting even higher values. The variability in sensitivity is often attributed to differences in operator experience and patient selection. In agreement with an earlier study by Ibrahim and Elsadawy, it was shown in the current study that the US has a 94.6% sensitivity. Actually, ultrasonographic sensitivity could be related to the experience of the radiologist, which could explain the variability. 99mTc-MIBI scintigraphy remains the most commonly employed nuclear medicine technique for parathyroid imaging. This modality exploits the differential uptake and retention of the radiotracer between thyroid and parathyroid tissues, with adenomatous or hyperplastic parathyroid glands typically demonstrating more avid and prolonged uptake. The sensitivity of MIBI scintigraphy for localizing solitary parathyroid adenomas is reported to be between 80% and 90%, and it is particularly valuable in identifying ectopic glands or multiglandular disease [12,13]. Combining ultrasonography and MIBI scintigraphy has been shown to improve localization accuracy, with concordant findings between the two modalities strongly predicting successful focused surgical intervention [11]. Recently PET Choline CT is used for most accurate localization or where ultrasound and MIBI Scan fail to localize the adenoma . PET Choline CT is very expensive and is not widely available . The reported sensitivity of PET Choline ct varies between 94-97% being less while lesion based analysis is done and more when patient based analysis is done in different studies [14] Choline , one of the phosphatidylcholine precursor which is phospholipid component of cell membrane is taken avidly by parathyroid adenomas as well as certain neoplastic lesions and this is the theory behind its use [15]. Parathyroid adenomas are usually very small lesions and 5-15% are found at ectopic location as well which makes it difficult detection by conventional imaging and failure of surgery in 5-10 % of cases [16].

Accurate preoperative localization not only facilitates minimally invasive surgery but also reduces the need for extensive neck exploration, thereby minimizing operative time and the risk of complications. If accurately localized , the procedure can even be performed under local anesthesia . Intraoperative PTH monitoring, where available, provides real-time biochemical confirmation of successful gland excision, as a drop in PTH levels of more than 50% from baseline within 5–10 minutes post-excision is considered indicative of cure [9]. However, this technique may not be universally available or routinely performed. Persistent or recurrent hypercalcemia following surgery may indicate missed or supernumerary abnormal glands, highlighting the importance of precise preoperative localization [17]. Approximately 10% of patients may experience transient postoperative hypercalcemia, particularly those with higher preoperative calcium and PTH levels, but most achieve normocalcemia within the first postoperative month [2]. Persistent PHPT is defined as failure to achieve normocalcemia within six months of surgery, and recurrence refers to hypercalcemia developing after an initial period of normocalcemia. Curative parathyroidectomy is defined as the normalization of calcium levels lasting a minimum of 6 months after surgery . If this is achieved after removal of gland identified by pre operative radiology this indicates not only success of surgery but as well as that the radiological method used for detection is sensitive and specific enough to detect the involved gland.

Currently, there is no consensus about the time that serum calcium normalizes after parathyroidectomy. After a successful parathyroidectomy, serum calcium levels normalize and reach a nadir at 48–72 hours postoperatively; however, approximately 10% of patients have transient, persistent postoperative hypercalcemia, which is more likely to occur in patients with higher preoperative serum calcium and PTH levels. Most patients with PHPT have normal serum calcium levels within the first two weeks after parathyroidectomy, and 96% will have normal serum calcium levels in the first postoperative month. Persistent PHPT is defined as a failure to achieve normocalcemia within 6 months after parathyroidectomy [9]. On the other hand, Patients with a partial biochemical response after parathyroidectomy have a greater risk of recurrent hypercalcemia compared to those with complete biochemical response. The postoperative presence of persistently increased PTH but normocalcemia or persistently increased calcium but normal PTH increases the risk of recurrent hypercalcemia 1.6 and 2 times, respectively. Given the variability in reported sensitivities and the critical role of imaging in surgical planning, the present study aims to evaluate the sensitivity and specificity of preoperative ultrasonography and 99mTc-MIBI scintigraphy, both individually and in combination, for the localization of parathyroid adenomas in patients with PHPT by comparing the imaging results with post operative final histopathology. The findings of this study will inform best practices for preoperative assessment, potentially improving surgical outcomes by enabling more targeted, less invasive interventions and reducing the risk of persistent or recurrent disease.

Objectives and Aims

Objectives

To find out the sensitivity of ultrasound and 99mTc-MIBI scan both individually and in combination for pre operative localization of parathyroid adenoma in patients diagnosed with primary hyperparathyroidism.

Aim(s)

1. To find out which modality is more sensitive for localization of parathyroid adenoma in patients diagnosed with primary hyperparathyroidism.

2. To find out weather combining both modalities increases the chance of better pre operative localization.

Methodology

Setting: Department of General Surgery, Dubai Hospital, Dubai health , UAE

Duration of Study: From August 2017 to Jan 2025.

- **Sample Size:** In order to achieve 80% Sensitivity with the precision of 10% and 95% Confidence Interval, we needed to study 64 subjects. These subjects were recruited from August 2017 – January 2025. However , this is a retrospective study and only 45 patients fulfilled the criteria and included in study , patients who had pet choline ct only for localization are excluded from the study.
- **Study design:** Retrospective cross-sectional.
- **Sampling Technique**: continuous sampling
- **Data Collection:** Medical records of all the patients were reviewed retrospectively using electronic medical records used in our hospital from August 2017 till Jan 2025.
- All patients who underwent parathyroidectomy for primary hyperparathyroidism were studied and pre op imaging modality(ultrasound neck and mibi scan) results for localization of parathyroid adenoma were compared with final post operative histopathology to calculate the sensitivity of ultrasound and mibi scan individually and in combination. If the test (us or mibi) detects adenoma pre operatively and after surgery post operative histopathology confirms adenoma then the test(us or mibi scan) is said to be sensitive to detect adenoma
- **Data Analysis:** All analysis was conducted by using the Statistical package for social sciences (SPSS) version 24.
- **Inclusion Criteria:** All patients who underwent parathyroidectomy from August 2017 till Jan 2025 and had ultrasound neck or 99mTc-MIBI scan individually or in combination for pre operative localization of parathyroid adenoma . Patients were diagnosed as having primary hyperparathyroidism biochemically by endocrine team and after being radiologically localized by either us or mibi or both of them or us with pth wash out were included in study . Cases where PET CHOLINE CT was the only modality used for localization were excluded from study also patients with MEN were excluded as all patients diagnosed with MEN underwent total parathyroidectomy + thymectomy regardless of localization and in some cases localization was not even considered.
- **Exclusion criteria:** Patients who did not do these two imaging modalities for pre op localization of parathyroid adenoma (ultrasound neck 99mTc-MIBI scan) for example cases where pet choline ct was the only modality used to localized pth adenoma.

Ultrasound Technique

In our institute ultrasound to localized pth adenoma is done by radiologist as well as endocrinologist . A senior radiologist uses 12-15 MHZ probe for high resolution and first thyroid is scanned and then inferior and superior and dorsal aspects of both thyroid glands are scanned to localize pth adenoma, pth adenoma is relatively hypoechoic to thyroid gland with polar blood supply , the area scanned extends from mandible to supra clavicular fossae and on both sides to lateral aspect of sternocleidomastoid muscle. Where there is discrepancy between radiologist and endocrinologist ,ultrasound was repeated by second endocrinologist and where applicable parathyroid wash out was taken as well . Our endocrinologist are certified for doing ultrasound for both thyroid and parathyroid and are accredited by American Thyroid Association.

Tc -99m MIBI SPECT/CT Technique

In our institute 555MBq Tc-99m MIBI is injected intravenously and after that static images are obtained at 10 and at 2-3 hours using a dual head -head combined SPECT/CT camera. in early phase both thyroid and parathyroid lesions will demonstrate uptake but on delayed images after 2-3 hrs MIBI will be washed out from thyroid and only parathyroid will take up. so, parathyroid adenoma will show persistent retained activity in delayed images. This is how pth adenoma is detected using MIBI scan

- **Sources of Data ;** electronic medical record system
- **Collection of Data ;** After getting approval from ethical committee , medical records of all patients who underwent parathyroidectomy from August 2017 till Jan , 2025 were studied using electronic medical record system (SALAMA SYSTEM) .

Data Management

Statistical Analysis Strategies

All analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 24. Mean values ± standard deviation were computed for all quantitative variables, including patient age, and sensitivity of ultrasound and 99mTc-MIBI scan individually and combined while sex and location of adenoma was dealt with as categorical.

Results

45 patients were included in study during the specified period. All patients were diagnosed with primary hyperparathyroidism by institutional endocrine department after extensive biochemical work up and were referred to us for surgical intervention. After

diagnosis patients underwent either ultrasound or MIBI Scan or both of them. Ultrasound was done by a senior radiologist as well as endocrinologist certified by American thyroid association. Hypoechoic nature and polar vessel signs were used for ultrasound diagnosis of parathyroid adenoma, where these signs were not properly appreciated parathyroid wash out was used as adjunct. MIBI scan protocol is already described above. All cases were discussed in Thyroid MDT and where there was discrepancy between radiology results either of modality was repeated as per individual case discussion. Some patients did not have both modalities attributable to financial constraints specially in case where it was clearly identified by single modality. 3 patients had parathyroid wash out as well as adenoma was not localized by MIBI and ultrasound doubt full. After MDT discussion patients were booked for minimally invasive parathyroid excision. All patients were explained about need for exploration as well as failure of surgery. After induction ultrasound was repeated by operating surgeon to double check the location and no discrepancy was found between pre op ultrasound (where done) and on table ultrasound findings . We used small incision 2 cm above the sternal notch to get access to the gland. Frozen section biopsy was used as a method of confirmation for removal of identified gland which usually takes 15-20 minutes to report . Once frozen section confirmed the diagnosis surgery was abandoned. Majority of our patients were female as shown in demographic details in Table 1. The average age of patients was 74.89 years with a range from 35-91 years**.**

parameters	values
Mean age in years	74.84
Gender	
Female	39
Male	6
Average calcium levels pre op	11.2
Average calcium immediately post op	9.4
Average calcium 2 weeks post op	9.1
Ectopic adenoma	1
Frozen section used	45
Parathyroid carcinoma	1
Lymph node	1
Sever post op hypocalcaemia	1
Intraoperative pth used	10
Intrathyroidal pth adenoma	2
Average weight of parathyroid adenoma	6 gms
Weight of largest adenoma	19.6 gms
Average size of pth adenoma on ultrasound	22 mm
Maximum size of pth adenoma on ultrasound	6 X 3.5 X 1.7

Table 1 : Patient's demographics and characteristics.

Ultrasound was done in 42 patients and MIBI scan was done for 38 patients and 35 patients hasd both ultrasound and MIBI Scan (shown in Table 2).

5 of the patients had both modalities negative for localization and were advised for PET choline ct , they lost follow up and were not included in study (Table 2).

Modality used	Number of patients
ultrasound	42
Mibi scan	38
Combination of both modalities	35

Table 2: Number of patients per individual and combined radiology modality used.

The average size of adenoma on ultrasound was 22 mm with range from 3 mm to 60 mm (Table 1). Average weight of adenoma was 6 gms with range from 2 gms till 19.6 gms (Table 1). Most of our patients achieved normocalcemia within 48-76 hours after surgery 6/45 patients took 3-4 weeks to achieve normocalcemia and one patient took 4 months to get calcium levels back to normal (Table 1) Two patients had negative frozen section and they were deemed as negative exploration requiring further work up and MDT discussion. One Patient has parathyroid carcinoma found to be metastatic after work up and patient later passed away during work up in 2 months. Operative location of adenoma when compared with ultrasound and MIBI Scan is shown in Table 3 and 4.

Ultrasound location	Per operative findings
Right superior 2	One found posteriorly at inferior location
Right inferior 26	All same location
Left superior 1	found AT SAME LOCATION
Left inferior 16	One not detected rest at same location

Table 3 : Comparison of ultrasound localization of adenoma position with per-operative findings.

Mibi location	Per operative findings
Right superior	Found at same location
Right inferior	Found at same location
Left superior	Found at same location
Left inferior	One not detected

Table 4 : Comparison of mibi scan localization of adenoma position with per-operative findings.

Sensitivity of ultrasound as per our results is found to be 91.85 % while it was 81.5% for MIBI and combined sensitivity was calculated as 94.28% (Tables 5,6).

Modality used	Confirmed on histopathology
Ultrasound 42	39
Mibi scan 38	31
Combination of both 35	33

Table 5 : Comparison of adenoma localization with final histopathology.

Modality used	sensitivity
Ultrasound	91.85
MIBI scan	81.5
Ultrasound and MIBI Scan combined	94.28

Table 6: Individual and combined sensitivity of ultrasound and mibi scan in locazing parathyroid adenoma.

Our results show ultrasound to be more sensitive then MIBI scan. However, the combined sensitivity for both the modalities is even higher.

Discussion

While the definitive management for primary hyperparathyroidism is excision of gland producing excessive parathyroid hormone, it needs accurate pre op localization. Accurate pre-op localization can not only reduce the timing of surgery but can also reduce the morbidity and mortality associated with surgery, making surgical excision possible even under local analgesia with smaller incision. After being diagnosed with primary hyperparathyroidism all our patients underwent ultrasound alone or with MIBI scan, followed by case discussion in Thyroid MDT. We used intraoperative frozen section for confirmation that the involved gland is taken out. Two of our patients did not show confirmation on frozen section and in these two cases exploration was continued and further frozen sections were sent. One of these patient was diagnosed with primary hyperparathyroidism and it was localized on pre op ultrasound as well as MIBI scan as left inferior parathyroid adenoma but per-operatively we could not identify, patient even had left hemithyroidectomy because intra operative us showed suspicion of intrathyroidal pth adenoma but all frozen sections were negative, almost 6 samples sent and exploration did not find any adenoma after hemithyroidectomy and neck exploration so discussion was done with family and operation was abandoned with a view for re-discussion and re evaluation after MDT meeting. Patient had repeat mibi scan post operatively which showed adenoma at left inferior location. MDT consideration for targated angioembolization as well as ethanol ablation were discussed with interventional radiologist and it was agreed to procede with ethnol ablation but patient did not continue further management at our institute. Follow up call was given to patient and he still did not do any further work up or surgery at anywhere lese as well.

Second patient had investigations done from another facility and it was localized as left inferior parathyroid adenoma on MIBI Scan as well as PET choline CT. Ultrasound and MIBI Scan done in our facility could not localize the adenoma but MDT decided to go-ahead for left inferior pth adenoma excision based on MIBI and PET choline ct done from out side facility. frozen section was negative for peroperative suspected adenoma and showed fatty tissue and another suspected specimen was sent and frozen section showed lymph node. During surgery patient had in jury to internal jugular vein which was repaired and surgery was abandoned. This patient later travelled to Parent country and work up there showed ectopic pth adenoma at superior mediastinum and she underwent sternotomy and removal of parathyroid adenoma . Reterospective review of images in radiology meeting actually showed ectopic pth adenoma at medistinal location which was missed previously. One Patient has parathyroid carcinoma found to be metastatic after work up and patient later passed away during work up in 2 months. We did not have facility of intraoperative pth initially but we have started this facility now for past 18 months and these patient also underwent intraoperative pth as per protocol(after induction , before mobilization, 5 minutes after excision and 10 minutes after excision) . All these patients PTH dropped more than 50 percent of normal 5 minutes after excision. In our institute parathyroid sample goes to laboratory from operation theatre and it takes longer than frozen section to get results so we mainly rely on frozen section for diagnostic confirmation of parathyroid adenoma.

The patient with largest adenoma was initially having 1.4 x 1 x 0.9 cm right inferior adenoma on ultrasound with calcium levels of 10.9. While waiting for surgery she presented to emergency with symptomatic hypercalcemia and found to have calcium levels of 13.4 and repeat ultrasound showed increase in size of adenoma from above mentioned figure to 6 X 3.5 X 1.7. Suspicion of parathyroid cancer was raised and after MDT discussion and work up she was booked for right inferior parathyroid adenoma excision . She was found to have huge right inferior parathyroid adenoma weighing 19.6 gms and PTH dropped from 3654 to 140 pg/ml five minutes after excision of adenoma. This was reported as a case by our institute .Final histopathology confirmed parathyroid adenoma with no evidence of malignancy. Most of patients achieved normocalcemia within 48-76 hours after surgery 6/45 patients took 3-4 weeks to achieve normocalcemia and one patient took 4 months to get calcium levels back to normal. Over all the results of our study are comaparable with results anywhere else in the world showing ultrasound being more sensitive than MIBI

Scan. Combining both modalities increased sensitivity to 94.28 percent which is also same as literature anywhere else. Our results show ultrasound to be more sensitive then MIBI scan. As a mater of fact ultrasound is operator dependent and more experienced the sonologist much better the results In our institue we not only perfom ultrsound by experienced radiologist but also our senior endocrinologist always repeats the ultrasound and where there is doubt they even take parathyroid washout to confirm the localization. Our senior endocrinologist are certified in thyroid and parathyroid imaging by Endocrine Certification in Neck Ultrasound (ECNU) by American Association of Clinical Endocrinologists (AACE) and sometimes they can detect adenomas that are not even detected by senior radiologists. We discuss all cases in Thyroid and parathyroid MDT and if needed then radiologist repeats the ultrsound again and patient is not charged for all these repeat images. Having experts in ultrsound and getting it done by two authorites and adding adjuncts of parathyroid washout makes ultrsound a better modality for detection of parathyroid adenoma in our institute specifically but many global results show the same as well. However, the combined sensitivity for both the modalities is even higher.

Recently we have strted using PETCholine CT as a new detection modality specilayy in difficult cases and it shows promising results with what ever small numbers we came a cross . However , cases detected by PET Choline CT only were not included in study .We Have two cases where ultrasound and MIBI could not detect adenoma and PET Choline ct detected and it was proven by histopathology . The results of our study will add to literature the importasnce of acurate pre op localization and efficacy of different radiological modalities use to detect parathyroid adenomas . Also none of such study is done in our region and can provide base for future multi-centre studies across UAE to get more genralized results . With recent use of PETCHoline CT , future studies can be done to compare sensitivity of this new modality with already existing modalities . Our study also highlighted the improtance of use of parathyroid wash out but we had only 2 cases . Future studies can be done even to compare parathyroid wash out with other modalitties as a localization stratigy which although iinvasive like FNAC but has promising results in our opinion based on few cases that we have.

Limitations of study

Our study has limitations because first of all its retrospective study so bias and sampling variation can not be excluded . We could not achieve sample size of 65 patients (being retrospective in nature further patients can not be added after the specified duration)as we have excluded cases where adenoma was localized based on PET choline Ct only ,reason being financial constraints and insurance approval. if localization was done by PET choline CT insurance di not approve repeating ultrasound and MIBI scan . Also study shows ultrasound to be more sensitive but this could be attributed to the expertise available in our centre and use of radiologist as well as endocrinologist as separate physicians to localize the gland radiologically along with and use of intraoperative pth as adjunct for localization where indicated.

Conclusion

Minimally invasive ,Targeted excision of parathyroid adenoma can be safely carried out with negligible rates of failure for patients with primary hyperparathyroidism having acurate pre op localization. Results of our study show that with the help of dedicated and experienced physicians specialized for ultrasound in thyroid and parathyroid pathologies along with use of parathyroid wash out in dubious cases and thorough MDT discussion, ultrasound alone can be modality of choice for pre op localization of parathyroid adenoma .Using ultrasound only is costeffective as well. While combining both modalities can increase sensitivity further and intraoperative frozen section biopsy with intraoperative PTH can help confirm the diagnosis to achieve 100 percent results.

Declarations

Funding

None.

Conflicts of interest/Competing interests

None .

Ethics approval

Study was approved by MBRU irbs(institutional review board Mohammad bin Rashid university of medical sciences Dubai , UAE) and DSERC.(dubai scientific research committee)

Consent to participate

Wavier of consent was granted by ethical approval committee and IRBS based on the fact that this is a retrospective study and direct humans are not involved only already present data is analysed . Furthermore , the general consent of hospital has a column where it is stated that patients data will be used for research and audit purpose . Patients who disagree to sign that column were not included in the study .

Written Consent for publication

It is hospital policy to consent (in general consent)all aptients that their data will be published in any type of scientific research if indicated and only those patients are included who signed this consent .

Availability of data and material

Data is available and will be provided if asked.

Code availability software application or custom code

All authors agree to code availability and software.

Acknowlegeement

Marwan abdelrahim abdelghafer Zidan for helping in statistical analysis

Author's contribution

- Dr Aliya Ishaq --- Conceptualization, study design, data interpretation, supervision, and critical revision of the manuscript.
- Dr Warda Siddiqi--- Literature review, data collection, data analysis, manuscript drafting, and coordination of the writing process.
- Muhammad Jamshaid Husain Khan---------- Literature review, data collection, data analysis, manuscript drafting.
- Goutam Kewalramani--- Data collection, results organization, and preparation of figures and tables.
- Sarla Kumari ------ Reference management, formatting, and proofreading.
- Dr Arfan Al Awa ---- Senior supervision, endocrinological validation, statistical oversight, and final manuscript approval.

Authors deceleration

All authors declare that all data and materials as well as software application or custom code support published claims and comply with field standards.

1.Aliya ishaq --- main idea , study design , writing and getting proposal

approved by ethical committee , data analysis , writing manscrupt ,

corrosponding author .

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