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Research Article

Clinical Spectrum and Surgical Management of Parathyroid Adenoma: A Retrospective Observational Study

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ABSTRACT

Background: Primary hyperparathyroidism (PHPT) is an endocrine disorder characterized by inappropriate parathyroid hormone secretion, most commonly due to parathyroid adenoma. In developing countries, patients often present with advanced symptomatic disease.

Objective: To document the clinical spectrum, diagnostic evaluation, and management strategies of parathyroid adenoma in a tertiary care hospital.

Methods: This institution-based retrospective observational study included 21 patients who underwent surgery for parathyroid adenoma over a five-year period. Diagnosis was confirmed by postoperative histopathological examination. Clinical presentation, biochemical parameters, imaging findings, and anatomical location of adenomas were analyzed.

Results: The majority of patients were symptomatic, with fatigue, renal colic, renal calculi, and skeletal manifestations being the most common presentations. All patients demonstrated markedly elevated serum parathyroid hormone levels and hypercalcemia, along with reduced bone mineral density. Multimodality imaging aided accurate localization, with the left inferior parathyroid gland being the most frequent site.

Conclusion: Parathyroid adenoma in the Indian population frequently presents late with significant skeletal and renal morbidity. Early recognition, appropriate imaging, and surgical excision result in favorable biochemical and clinical outcomes.

Keywords: Parathyroid ademona, Hypercalcemia.

INTRODUCTION

Primary hyperparathyroidism (PHPT) is an endocrine disorder characterized by excessive and inappropriate secretion of parathyroid hormone (PTH), resulting in disruption of calcium and phosphate homeostasis. Although relatively uncommon, with a reported prevalence ranging from 0.1% to 0.7% in the general population, PHPT remains the third most common endocrine disorder after diabetes mellitus and thyroid diseases.[1–4] Persistent elevation of PTH promotes osteoclastic bone resorption, enhances intestinal calcium absorption through activation of vitamin D, and increases renal tubular calcium reabsorption, ultimately leading to hypercalcemia and its systemic manifestations.[5,6]

Parathyroid adenoma is the most frequent cause of PHPT, accounting for approximately 80–85% of cases, whereas multiglandular

hyperplasia and parathyroid carcinoma constitute the remaining etiologies.[7,8] Parathyroid adenomas are commonly located adjacent to the superior or inferior poles of the thyroid gland; however, ectopic parathyroid tissue may be encountered in nearly 15% of patients due to abnormal embryological migration. Ectopic locations include the mediastinum, intrathymic region, intrathyroidal tissue, and tracheoesophageal groove.[9]

The clinical presentation of PHPT has evolved considerably over recent decades. In developed countries, widespread biochemical screening has resulted in increased detection of asymptomatic disease. In contrast, patients from developing countries, including India, frequently present with overt symptomatic disease and advanced metabolic complications.[3,4,16–18] Clinical manifestations arise primarily from chronic hypercalcemia and prolonged PTH excess, involving multiple organ systems. Skeletal manifestations include bone pain, osteoporosis, osteitis fibrosa cystica, and pathological fractures, while renal involvement commonly presents as nephrolithiasis, nephrocalcinosis, and renal colic.[6,7] Gastrointestinal symptoms such as abdominal pain, nausea, constipation, and pancreatitis may also occur. Neuromuscular complaints including fatigue, generalized weakness, and neuropsychiatric disturbances are frequently observed in symptomatic patients.[6]

Acute pancreatitis is an uncommon but clinically significant presentation of PHPT and has been attributed to calcium-mediated activation of pancreatic enzymes within acinar cells.[19–21] Such atypical presentations may delay diagnosis and increase disease-related morbidity.

The diagnosis of parathyroid adenoma is primarily biochemical and is established by elevated serum calcium levels associated with inappropriately elevated serum PTH concentrations.[5] Following biochemical confirmation, accurate preoperative localization is essential for successful surgical management. Ultrasonography of the neck and technetium-99m sestamibi scintigraphy are widely accepted first-line imaging modalities. Advanced imaging techniques such as contrast-enhanced computed tomography (CECT) and magnetic resonance imaging (MRI) are valuable adjuncts in cases with inconclusive findings or suspected ectopic adenomas.[10–14]

Parathyroidectomy remains the definitive treatment for PHPT and is associated with excellent biochemical and clinical outcomes. Surgical excision results in normalization of serum calcium and PTH levels, improvement in bone mineral density, reduction in renal complications, and enhanced quality of life.[15,17,22] With improvements in preoperative localization and minimally invasive surgical techniques, focused parathyroidectomy has become increasingly favored in appropriately localized disease due to reduced operative morbidity and high cure rates.[14,15] Despite advances in diagnostic and therapeutic modalities, symptomatic PHPT continues to be commonly encountered in the Indian population, often presenting at an advanced stage with significant skeletal and renal involvement. The present study was undertaken to evaluate the clinical spectrum, biochemical profile, imaging characteristics, and surgical management of parathyroid adenoma in patients treated at a tertiary care centre.

MATERIALS AND METHODS

Study Design and Setting

This retrospective observational study was conducted in the Department of Otorhinolaryngology and Head–Neck Surgery at Gauhati Medical College and Hospital (GMCH), Guwahati, Assam, India. The study included patients managed over a five-year period from November 2020 to November 2025.

Study Population

A total of 21 patients with histopathologically confirmed parathyroid adenoma who underwent surgical management during the study period were included in the study.

Inclusion Criteria

- Patients diagnosed with primary hyperparathyroidism secondary to parathyroid adenoma.
- Patients who underwent parathyroidectomy during the study period.
- Histopathological confirmation of parathyroid adenoma.
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Exclusion Criteria

- Patients with incomplete medical records.
- Patients diagnosed with parathyroid hyperplasia or parathyroid carcinoma.
- Patients managed conservatively without surgical intervention.

- Patients lost to postoperative follow-up.

Data Collection
Patient records were retrospectively reviewed using hospital medical records, operative notes, laboratory reports, and radiological investigations. Data collected included demographic profile, presenting complaints, biochemical investigations, imaging findings, operative details, histopathological diagnosis, and postoperative outcomes.

Clinical Evaluation
A detailed clinical history was obtained from hospital records with special emphasis on skeletal, renal, gastrointestinal, and neuromuscular symptoms associated with hyperparathyroidism. Comprehensive clinical examination findings were documented for all patients.

Laboratory Investigations
The following biochemical investigations were analyzed:

- Serum calcium
- Serum phosphorus
- Serum alkaline phosphatase
- Serum parathyroid hormone (PTH)
- Serum vitamin D
- Renal function tests
- Liver function tests
- Complete blood count

Radiological and Imaging Evaluation
Preoperative localization studies were performed using one or more of the following imaging modalities:

- Ultrasonography (USG) of the neck
- Technetium-99m sestamibi scintigraphy
- Contrast-enhanced computed tomography (CECT) of the neck
- Magnetic resonance imaging (MRI) in selected cases
- Dual-energy X-ray absorptiometry (DEXA) scan for bone mineral density assessment
- Ultrasonography of abdomen and pelvis for evaluation of nephrolithiasis or nephrocalcinosis

Intraoperative Parathyroid Hormone Monitoring
Intraoperative serum PTH monitoring was performed in all patients. Blood samples were obtained pre-incision and at 0, 5, 10, and 20 minutes following adenoma excision. A reduction in serum PTH level greater than 50% from the baseline value at 10 minutes post-excision was considered indicative of successful adenoma removal.

Surgical Management
All patients underwent parathyroidectomy under general anesthesia. Surgical exploration was performed based on preoperative localization findings. Excised specimens were subjected to histopathological examination for definitive diagnosis.

Postoperative Follow-up
Patients were monitored postoperatively for symptomatic improvement and normalization of biochemical parameters, including serum calcium and serum PTH levels. Follow-up records were reviewed from outpatient visits documented in hospital records.

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using descriptive statistical methods. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages.

Ethical Considerations
The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Institutional Ethics Committee approval was obtained prior to commencement of the study (IEC approval number to be inserted by the authors). As this was a retrospective observational study based on hospital records, patient confidentiality and anonymity were strictly maintained throughout the study period.

RESULTS
A total of 21 patients with histopathologically confirmed parathyroid adenoma were included in the present study. The study population comprised 12 females (57.1%) and 9 males (42.9%), with a female predominance. The majority of patients belonged to the 20–40-year age group (57.1%), followed by the 40–60-year age group (33.3%). Only two patients (9.5%) were younger than 20 years of age.
Most patients were symptomatic at the time of presentation. Fatigue and generalized weakness were the most common presenting complaints, observed in 19 patients (90.5%). Renal manifestations, including renal colic and nephrolithiasis, were documented in 15 patients (71.4%). Skeletal involvement was also

significant, with pathological fractures identified in 11 patients (52.4%). Gastrointestinal symptoms such as abdominal pain, nausea, and vomiting were present in two patients (9.5%). Acute pancreatitis and palpable neck swelling were uncommon presentations, each observed in one patient (4.8%). Several patients demonstrated multiple overlapping clinical manifestations at presentation.

Biochemical evaluation revealed elevated serum parathyroid hormone (PTH) levels in all patients. Serum PTH levels ranged between 100 pg/mL and more than 300 pg/mL. Five patients (23.8%) had PTH levels between 100–150 pg/mL, eight patients (38.1%) between 150–200 pg/mL, four patients (19.0%) between 200–250 pg/mL, and two patients each (9.5%) had levels between 250–300 pg/mL and greater than 300 pg/mL, respectively.

The estimated mean age of patients was 35.2 ± 11.8 years. The estimated mean serum parathyroid hormone level at presentation was 196.4 ± 60.5 pg/mL.

Hypercalcemia was observed in all patients, with serum calcium levels exceeding 12 mg/dL at presentation. Bone mineral density assessment using dual-energy X-ray absorptiometry (DEXA) demonstrated reduced bone mineral density in all cases, with T-scores ranging from −1 to −3.5, suggestive of varying degrees of osteopenia and osteoporosis.

Preoperative localization studies demonstrated that the left inferior parathyroid gland was the most common site of adenoma, accounting for 14 cases (66.7%). The right superior parathyroid gland was involved in four patients (19.0%), while the right inferior and left superior parathyroid glands accounted for two cases (9.5%) and one case (4.8%), respectively.

All patients underwent parathyroidectomy with histopathological confirmation of parathyroid adenoma. Postoperatively, significant reduction in serum PTH and calcium levels was observed in all patients, accompanied by gradual symptomatic improvement during follow-up. The findings of the study have been summarized in Table 1 and Figures 1a–1e.

Parameter	Category	Number of Patients (n)	Percentage (%)
Sex distribution	Male	9	42.9
	Female	12	57.1
Age distribution (years)	< 20	2	9.5
	20–40	12	57.1
	40–60	7	33.4
Clinical presentation*	Fatigue and weakness	19	90.5
	Renal colic / renal calculi	15	71.4
	Pathological fractures	11	52.4
	Abdominal pain, nausea, vomiting	2	9.5
	Pancreatitis	1	4.8
	Palpable neck swelling	1	4.8
Serum PTH level (pg/mL)	100–150	5	23.8
	150–200	8	38.1
	200–250	4	19.0
	250–300	2	9.5
	> 300	2	9.5
Serum calcium level	> 12 mg/dL	21	100
Bone mineral density (DEXA)	Reduced BMD (T-score −1 to −3.5)	21	100

Anatomical location of adenoma	Left inferior parathyroid	14	66.7
	Right superior parathyroid	4	19.0
	Right inferior parathyroid	2	9.5
	Left superior parathyroid	1	4.8
*Multiple Clinical Manifestations Were Observed in Several Patients.			

Table 1. Demographic, Clinical, Biochemical, and Anatomical Characteristics of Patients with Parathyroid Adenoma (n = 21)

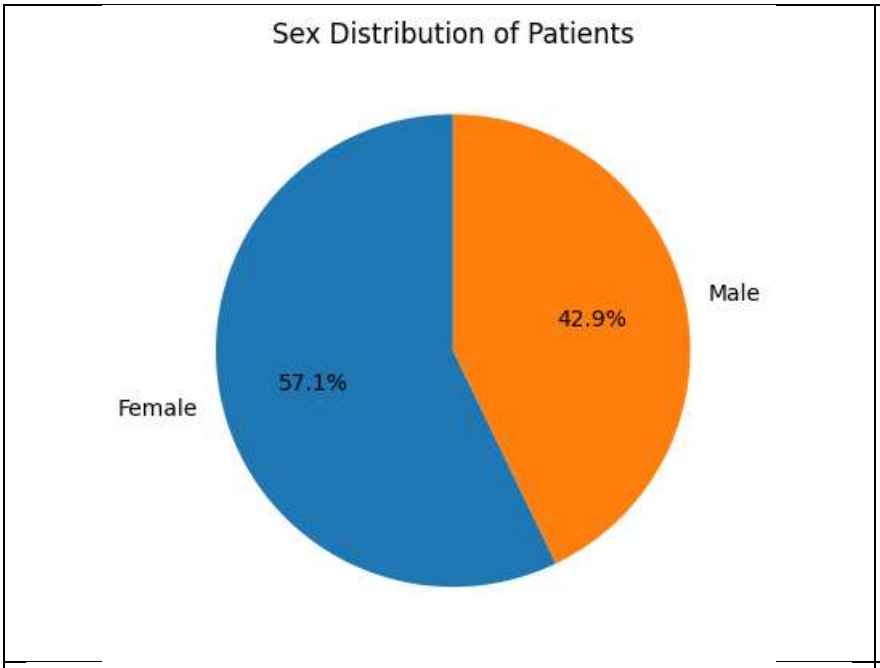


Figure 1a: Illustrates the sex distribution of patients with parathyroid adenoma. Females constituted 57.1% of the study population, while males accounted for 42.9% of cases

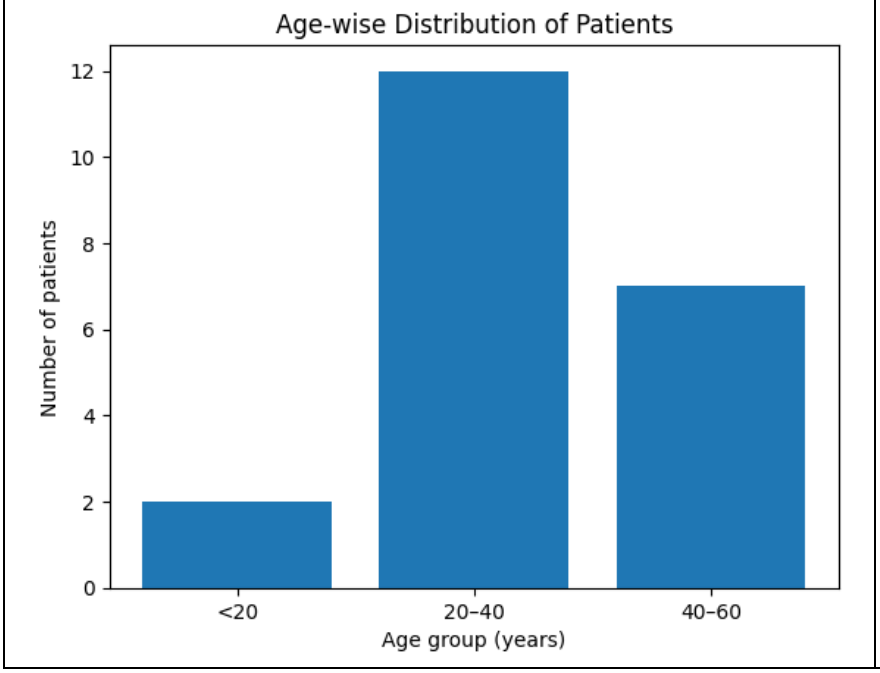


Figure 1b: Depicts the age-wise distribution of patients. Most patients belonged to the 20–40-year age group (57.1%), followed by 40–60 years (33.4%). Only 9.5% were younger than 20 years.

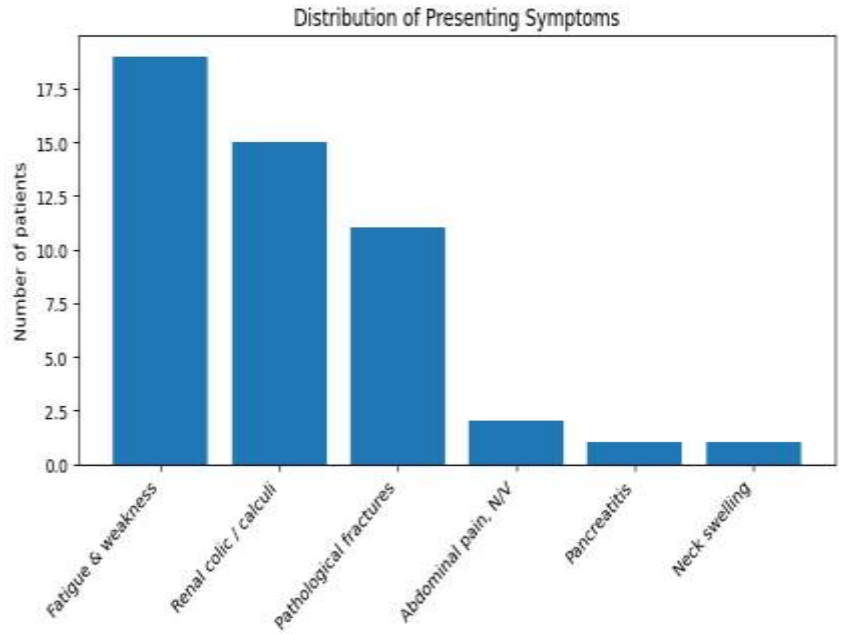


Figure 1c: Shows the distribution of clinical presentations. Fatigue and generalized weakness were the most common symptoms (90.5%), followed by renal manifestations (71.4%) and skeletal involvement (52.4%).

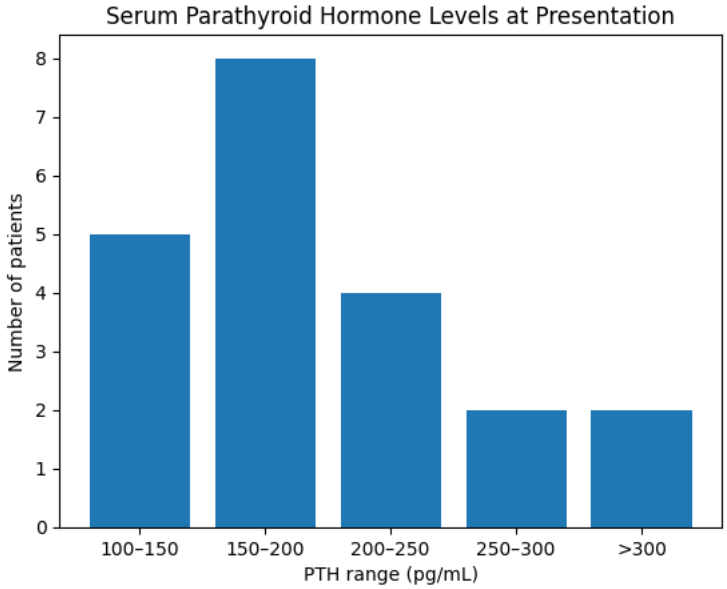


Figure 1d: Demonstrates serum parathyroid hormone levels at presentation. All patients showed markedly elevated PTH levels, most commonly between 150–200 pg/mL.

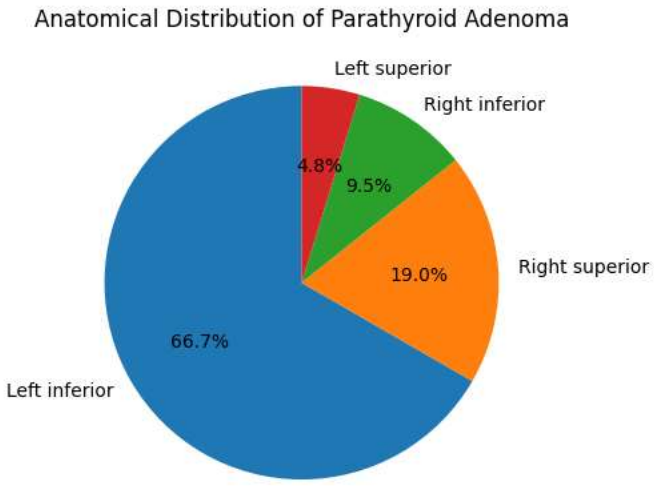


Figure 1e: Represents the anatomical distribution of parathyroid adenomas. The left inferior parathyroid gland was the most common site (66.7%).

DISCUSSION

Primary hyperparathyroidism (PHPT) is an important endocrine disorder and remains the most common cause of persistent hypercalcemia in adults. Parathyroid adenoma accounts for approximately 80–85% of PHPT cases and represents the most frequently encountered pathological entity in surgical practice.[1,2] Although widespread biochemical screening in developed countries has increased the detection of asymptomatic disease, patients in developing countries such as India continue to present with advanced symptomatic disease, as observed in the present study.

In the present study, females were more commonly affected than males, with a female predominance similar to that reported in previous studies.[3,4] Most patients belonged to the 20–40-year age group, indicating relatively younger presentation compared to Western populations, where PHPT is commonly diagnosed in older individuals through routine biochemical screening.[5]

The majority of patients in our cohort were symptomatic at presentation. Fatigue and generalized weakness were the most common complaints, followed by renal and skeletal manifestations. Renal involvement in the form of nephrolithiasis and renal colic was frequently observed. Persistent hypercalcemia and hypercalciuria secondary to excessive PTH secretion are the principal mechanisms responsible for renal complications in PHPT.[6] Similar findings have been reported in several Indian studies where delayed diagnosis often results in advanced renal disease.[7,8]

Skeletal manifestations were also prominent, with reduced bone mineral density and pathological fractures documented in a substantial proportion of patients. (Figure 2a-2e) Chronic elevation of PTH stimulates osteoclastic bone resorption, leading to osteopenia, osteoporosis, and increased fracture risk.[5] Severe skeletal involvement in Indian patients has been attributed to prolonged disease duration, delayed diagnosis, nutritional deficiencies, and coexisting vitamin D deficiency.[7,9] These findings emphasize that PHPT remains an important and underrecognized cause of metabolic bone disease in developing countries.

Gastrointestinal manifestations were less common in the present study. One patient presented with acute pancreatitis, a rare but recognized complication of PHPT. Hypercalcemia-induced activation of pancreatic enzymes and calcium deposition within pancreatic ducts have been proposed as possible pathogenic mechanisms.[10–12] Such atypical presentations may lead to diagnostic delay if serum calcium and PTH levels are not evaluated routinely.

Biochemical evaluation revealed markedly elevated serum PTH levels and hypercalcemia in all patients, reflecting advanced disease burden. The estimated mean serum PTH level in the present study was 196.4 ± 60.5 pg/mL. Universal hypercalcemia at presentation further supports the continued predominance of symptomatic PHPT in the Indian population.[7,8]

Accurate preoperative localization is essential for successful surgical management. In the present study, ultrasonography, Tc-99m sestamibi scintigraphy, and contrast-enhanced computed tomography (CECT) were utilized for localization. The left inferior parathyroid gland was the most common site of adenoma, consistent with previous anatomical studies.[13] Multimodality imaging improves localization accuracy and facilitates focused surgical exploration with reduced operative morbidity.[14,15]

Parathyroidectomy remains the definitive treatment for PHPT. (Figure 3a-3b) All patients in the present study underwent successful surgical excision with postoperative reduction in serum calcium and PTH levels accompanied by symptomatic improvement. Previous studies have demonstrated that successful parathyroidectomy improves bone mineral density, reduces renal complications, and significantly enhances quality of life.[16,17]

The present study has certain limitations, including its retrospective design, relatively small sample size, and single-centre setting. Long-term follow-up data were also limited. Nevertheless, the study highlights the continued burden of symptomatic PHPT in the Indian population and emphasizes the importance of early diagnosis, appropriate biochemical evaluation, accurate localization, and timely surgical intervention.

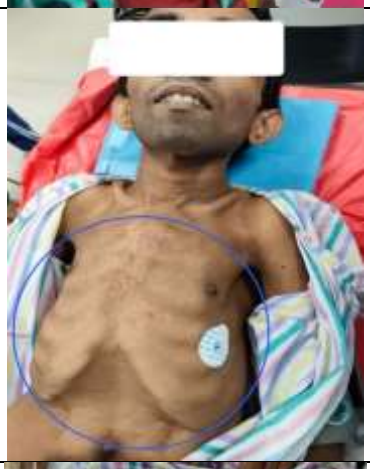
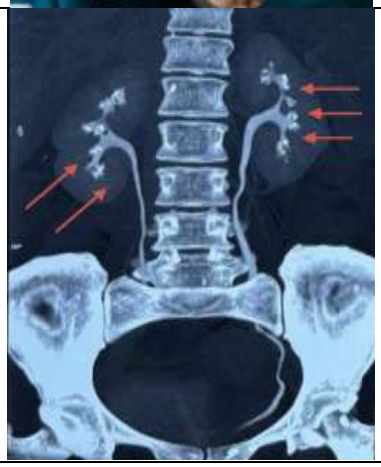
	Figure 2a- fractured distal phalanges in bilateral upper limbs in a case of right superior parathyroid adenoma
	Figure 2b- multiple rib fractures in a case of right superior parathyroid adenoma
	Figure 2c- Right acetabular fracture with splinting in a case of right superior parathyroid adenoma in a 27years old male
	Figure 2d- CT pelvic region & KUB suggesting of bilateral nephrocalcinosis in a 44years old female with right inferior parathyroid adenom

Figure 2e- CECT neck showing left inferior parathyroid adenoma in a 38years old mal

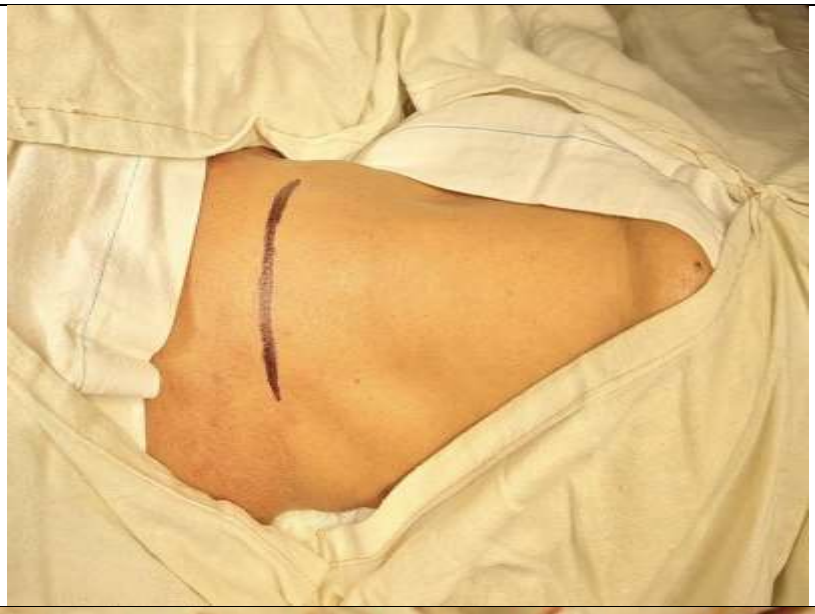


Figure3a-
Modified Kochers Incision over neck

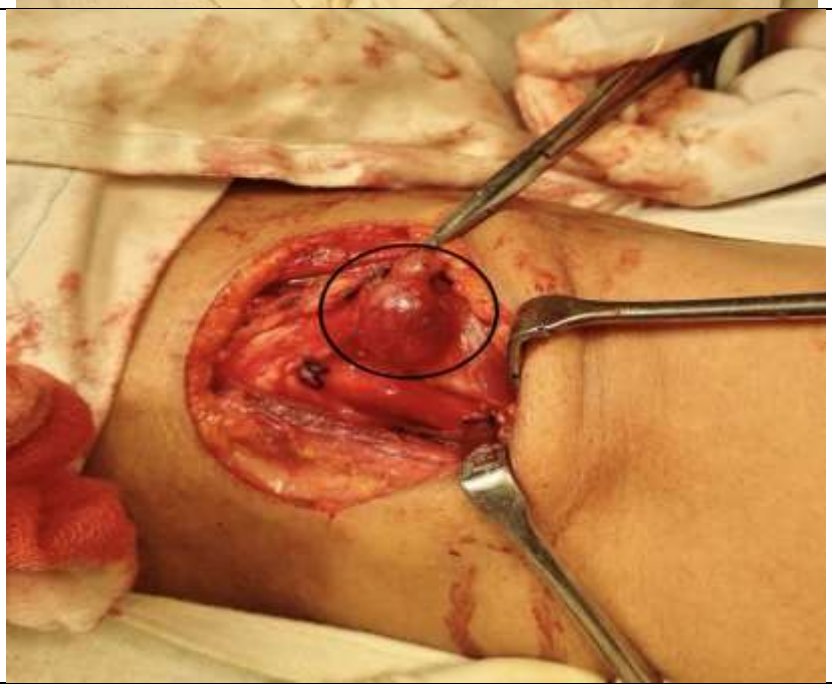


Figure
3b- Intraoperative picture of left inferior parathyroid adenoma excision delineating the adenoma (marked with black circle)

CONCLUSION

Parathyroid adenoma remains an important cause of symptomatic primary hyperparathyroidism in the Indian population, with patients frequently presenting with advanced skeletal and renal manifestations due to delayed diagnosis. Comprehensive biochemical evaluation combined with multimodality imaging is essential for accurate localization and surgical planning. Timely parathyroidectomy remains the definitive treatment and is associated with excellent biochemical and clinical outcomes.

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