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Parathyroid Carcinoma Presenting with Multiple Brown Tumors and Pathological Femoral Fracture Mimicking Metastatic Disease: A Case Report

Priyal Jain[1], Anuj Kumar[2], Vishesh Dhawan[3], Diljot Kaur Pannu[4]

[1]Department of General Surgery, Maharishi Markandeshwar (Deemed to be University), Haryana, India
Corresponding Author Email: *jainpriyal00000[at]gmail.com*

[2, 3, 4]Department of General Surgery, Maharishi Markandeshwar (Deemed to be University), Haryana, India

Abstract: ***Background: Parathyroid carcinoma is a rare endocrine malignancy accounting for less than 1% of primary hyperparathyroidism. Severe hypercalcemia and extensive skeletal involvement may occasionally produce brown tumors that mimic metastatic bone disease on imaging. Case Presentation: A 28-year-old woman presented with progressive anterior neck swelling and severe left hip pain following minor trauma, with progressive limitation of mobility. Imaging demonstrated a pathological femoral fracture and multiple expansile skeletal lesions. Neck ultrasonography identified a heterogeneous lesion inferior to the right thyroid lobe. Biochemical evaluation showed marked hypercalcemia (15.19 mg/dL), markedly elevated parathyroid hormone (944 pg/mL), and elevated alkaline phosphatase (479 U/L), with a serum phosphate level of 3.48 mg/dL. Whole-body FDG PET/CT demonstrated multiple skeletal lesions that initially raised concern for metastatic disease. Surgical exploration revealed a firm, enlarged right inferior parathyroid mass with adherence to surrounding soft tissues. En bloc excision was performed with preservation of the recurrent laryngeal nerve. Histopathology demonstrated capsular invasion and features consistent with parathyroid carcinoma. Postoperatively, serum calcium and PTH decreased substantially, with improvement in bone pain and mobility. Conclusion: Parathyroid carcinoma should be considered in patients with severe hypercalcemia, very high PTH concentrations, a cervical mass, and multifocal osteolytic skeletal lesions. Brown tumors can closely mimic metastatic disease; correlation of biochemical, radiological, operative, and histopathological findings is essential to avoid diagnostic error and inappropriate oncological treatment.***

Keywords: Parathyroid carcinoma; primary hyperparathyroidism; brown tumor; hypercalcemia; pathological fracture

1. Introduction

Primary hyperparathyroidism is characterized by excessive or inappropriate secretion of parathyroid hormone (PTH), resulting in disturbances of calcium and phosphate metabolism. Most cases are caused by benign parathyroid disease, whereas parathyroid carcinoma accounts for less than 1% of primary hyperparathyroidism and is associated with more severe biochemical abnormalities and clinically significant morbidity [1,3,7]. Parathyroid carcinoma may present with symptomatic hypercalcemia, skeletal disease, renal manifestations, and a palpable cervical mass [1,3,17].

Brown tumors are reactive osteolytic lesions associated with prolonged hyperparathyroid bone remodeling. They are composed of fibrovascular tissue, multinucleated giant cells, hemorrhage, and hemosiderin deposition. Although non-neoplastic, they can have aggressive radiological appearances and may resemble skeletal metastases, giant-cell lesions, aneurysmal bone cysts, or other osteolytic processes [7-12]. With increasing biochemical detection of primary hyperparathyroidism, advanced skeletal manifestations have become less common, making multifocal brown tumors an important diagnostic pitfall.

We report a young woman with parathyroid carcinoma presenting with multiple skeletal lesions and a pathological femoral fracture, in whom the radiological appearance initially raised the possibility of metastatic malignancy.

2. Case Presentation

1) **Patient and clinical presentation:** A 28-year-old woman presented to the surgical outpatient department with progressive swelling in the anterior neck and severe pain in the left hip after minor trauma. The hip pain progressively worsened over several weeks, causing restricted mobility and difficulty performing routine activities. There was no reported history of weight loss, fever, chronic renal disease, previous malignancy, or prolonged medication use. No significant family history of endocrine neoplasia or metabolic bone disease was reported.
2) **Clinical examination:** The patient was conscious and hemodynamically stable. A firm, mildly tender mass was palpable in the inferior aspect of the right thyroid region. The left hip was tender, with restricted range of motion and reduced ability to bear weight on the left lower limb. No focal neurological deficit was identified.
3) **Biochemical investigations:** Serum calcium was 15.19 mg/dL (reference range 8.5–10.5 mg/dL), serum PTH was 944 pg/mL (reference range 15–65 pg/mL), alkaline phosphatase was 479 U/L (reference range 40–129 U/L), and serum phosphate was 3.48 mg/dL (reference range 2.5–4.5 mg/dL). The marked hypercalcemia and substantially elevated PTH supported primary hyperparathyroidism and raised suspicion for a parathyroid malignancy in the clinical setting.
4) **Imaging:** Neck ultrasonography demonstrated a heterogeneous lesion measuring approximately 1.41 × 1.36 cm inferior to the right thyroid lobe, with cystic degeneration, increased vascularity, and internal

microcalcifications (Figure 2). MRI of the hips demonstrated multiple heterogeneous solid-cystic expansile osseous lesions involving the bilateral iliac bones, acetabula, pubic tubercles, proximal femur, and distal femoral shaft, with heterogeneous post-contrast enhancement and associated soft-tissue edema. A pathological fracture was noted in the left femur (Figure 3). Whole-body 18F-FDG PET/CT demonstrated multiple FDG-avid and non-FDG-avid expansile mixed lytic-sclerotic lesions involving the axial and appendicular skeleton, pelvis, femora, ribs, vertebrae, and mandible. The overall appearance was considered compatible with brown tumors in the appropriate clinical setting, although the multifocal pattern initially mimicked metastatic disease (Figure 4).

5) **Diagnostic assessment:** The working diagnosis was primary hyperparathyroidism associated with a right inferior parathyroid lesion and extensive skeletal disease, with brown tumors and a pathological femoral fracture. The differential diagnosis included metastatic malignancy and other osteolytic skeletal lesions.
6) **Operative management:** After correction/supportive treatment for severe hypercalcemia, including bisphosphonate therapy, electrolyte management, and analgesia as reported in the source case, the patient underwent surgical exploration. A firm, enlarged mass arising from the right inferior parathyroid region was found to be adherent to the surrounding soft tissues. En bloc excision of the lesion was performed with care to preserve the recurrent laryngeal nerve. Orthopedic management/stabilization of the pathological fracture was undertaken as part of the multidisciplinary treatment; the source article does not specify the exact orthopedic fixation procedure and this detail should be added by the authors if required for submission.
7) **Histopathology:** Gross examination showed an encapsulated tan-brown parathyroid mass with focal hemorrhagic areas. Microscopically, tumor cells were arranged in trabecular and nested patterns separated by thick fibrovascular septa. Moderate nuclear pleomorphism, coarse chromatin, conspicuous nucleoli, and moderate eosinophilic cytoplasm were described. Most importantly, capsular invasion with infiltration into adjacent tissue was identified, supporting the diagnosis of parathyroid carcinoma. No conclusive vascular invasion was identified in the analyzed sections (Figure 5).
8) **Postoperative course and follow-up:** Following surgery, serum calcium and PTH levels decreased substantially. Calcium and vitamin D supplementation were provided, with surveillance for hungry bone syndrome and continued biochemical monitoring. During follow-up, the patient reported reduced bone pain and improved mobility. Long-term surveillance was planned because of the substantial risk of recurrence associated with parathyroid carcinoma; the source article does not specify the duration of follow-up.

3. Discussion

Parathyroid carcinoma is an uncommon endocrine malignancy and is clinically important because of its potential to produce severe hypercalcemia, extensive skeletal disease, and recurrence [1,3,5,13,15,17]. The present case is unusual because the first major skeletal manifestation was a pathological femoral fracture accompanied by multiple osteolytic/mixed skeletal lesions, creating a radiological picture that could readily be interpreted as disseminated malignancy.

Brown tumors represent a severe skeletal response to prolonged PTH excess rather than true neoplasms. Increased osteoclastic activity causes progressive bone resorption and replacement by fibrovascular tissue containing giant cells and hemosiderin [7-12]. The mandible, ribs, pelvis, clavicle, femur, and vertebrae are recognized sites of involvement. Lesions may be expansile, multiloculated, mixed lytic-sclerotic, and cortically destructive, and MRI signal characteristics may vary because of hemorrhage and fibrosis [8-12]. FDG uptake may further increase the risk of radiological misinterpretation as metastatic disease.

The biochemical profile in this case was an important diagnostic clue. A serum calcium concentration of 15.19 mg/dL and PTH of 944 pg/mL represented marked abnormalities, together with a palpable cervical mass. Severe biochemical disease and a cervical mass are recognized clinical features that should prompt consideration of parathyroid carcinoma rather than uncomplicated benign primary hyperparathyroidism [1,3,17]. Nevertheless, biochemical severity alone does not establish malignancy; definitive diagnosis relies on histopathological evidence of invasion or metastatic disease.

Histologically, the most dependable criteria for parathyroid carcinoma include invasion of the capsule or adjacent structures and/or vascular or metastatic spread [4,5,19]. In this patient, capsular invasion with infiltration into adjacent tissue provided the key evidence of malignancy. The operative finding of a firm mass adherent to surrounding tissues was also clinically concerning.

Complete surgical excision at initial presentation is the cornerstone of treatment when parathyroid carcinoma is suspected [13,18]. En bloc resection is generally favored when there is concern for local invasion, with careful attention to recurrent laryngeal nerve preservation. Inadequate initial excision is associated with local recurrence and persistent or recurrent hypercalcemia. Reported recurrence can occur years after the initial operation, emphasizing the need for prolonged biochemical and clinical surveillance [15,17,23].

The principal lesson from this case is that extensive skeletal lesions should not automatically be attributed to metastatic cancer. In a young patient with osteolytic lesions, pathological fracture, and a cervical mass, serum calcium and PTH are inexpensive and highly informative tests. Early recognition of hyperparathyroid skeletal disease may prevent unnecessary oncological investigations or treatment and can direct the patient toward definitive endocrine surgical management.

4. Conclusion

Parathyroid carcinoma can rarely present with severe hypercalcemia, multiple brown tumors, and a pathological femoral fracture that mimics metastatic skeletal malignancy. In patients with multifocal osteolytic lesions, particularly when a cervical mass is present, assessment of serum calcium and PTH should be considered early. Accurate diagnosis requires integration of biochemical, radiological, operative, and histopathological findings. Definitive surgical excision and long-term surveillance remain central to management.

5. Learning Points

- Brown tumors may closely mimic multifocal skeletal metastases on CT, MRI, or FDG PET/CT.
- Marked hypercalcemia, very high PTH, and a palpable cervical mass should raise suspicion for parathyroid carcinoma.
- Capsular/adjacent tissue invasion on histopathology is a key criterion supporting parathyroid carcinoma.
- Long-term biochemical and clinical surveillance is important because recurrence may occur years after surgery.

Declarations
Informed consent: Informed consent was taken from patient
Ethics approval: Ethics committee approval was taken

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Figure 1: Clinical photograph showing anterior neck swelling, more prominent on the right side, suggestive of underlying parathyroid pathology



ROTARY AMBALA CANCER AND GENERAL HOSPITAL (RACGH)

Dr. KARTIK MITTAL
MBBS, MD, PDCC(RADIO-DIAGNOSIS)
CONSULTANT DIAGNOSTIC AND VASCULAR INTERVENTIONAL RADIOLOGIST

→ULTRASOUND →DOPPLER →CT SCAN →MRI SCAN →X-RAY → IVP →HSG→BARIUM STUDY →MAMMOGRAPHY
→VASCULAR INTERVENTION SURGERY →FNAC→BIOPSY →VARICOSE VEIN ABLATION→VASCULAR OPD/DAY CARE

PATIENT ID : 0000250404857 NAME : MALKEET AGE/SEX : 28/~~MALE~~ female
REF. BY : OTHER DATE : 16/11/2025

USG NECK PARA THYROID.

There is evidence of two heterogeneous lesion measuring 1.41 x 1.36 cm is noted below the right lobe of thyroid gland in its inferior and lower pole with cystic degeneration & increased vascularity and without area of microcalcification withi n .

Both lobes of thyroid and isthmus appear normal in size shape and echotexture.

Both **submandibular** and **parotid gland** appear normal in size shape and echotexture.

No focal lesion seen in the visualized region.

Major vessels of neck are normal.

No significant **lymphadenopathy** seen.

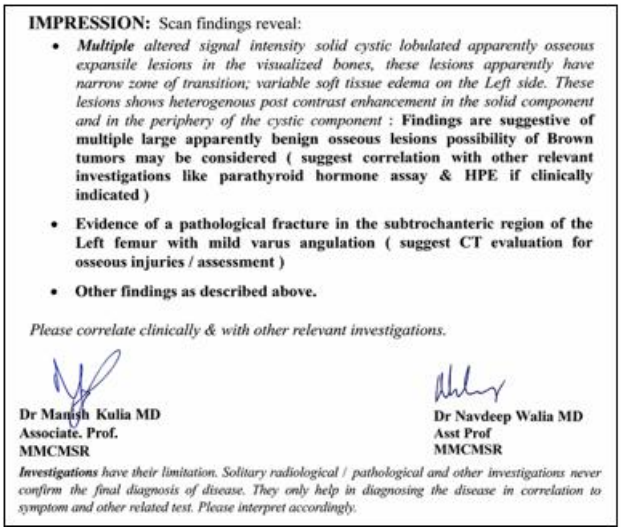
IMPRESSION : TWO HETEROGENEOUS LESION NOTED BELOW THE RIGHT LOBE OF THYROID GLAND IN ITS INFERIOR AND LOWER POLE ? COLLOID NODULE ? RIGHT ENALRGED PARA THYROID GLAND ? ADENOMA AS DESCRIBED ABOVE.

DR KARTIK MITTAL
-MD RADIO-DIAGNOSIS (KEM HOSPITAL MUMBAI)
FELLOW INTERVENTIONAL RADIOLOGY
(INSTITUTE OF LIVER AND BILLIARY SCIENCES, NEW DELHI)
EXCONSULTANT INTERVENTIONAL RADIOLOGY
(ARTEMIS AND MEDANTA HOSPITAL, GURGAON)

DR JASMINE KAUR
-MD DNB RADIODIAGNOSIS
-FELLOW ONCO IMAGING
-EX ASST PROFESSOR
(GOVT MEDICAL COLLEGE ,BIKANER)

This is only an opinion and not the final diagnosis. Clinical correlation is must. This report is not valid for medico-legal purpose.

Figure 2: Neck ultrasonography demonstrating a heterogeneous lesion measuring approximately 1.41 × 1.36 cm inferior to the right thyroid lobe, with cystic degeneration, increased vascularity, and internal microcalcifications. Patient identifiers have been redacted.



IMPRESSION: Scan findings reveal:

- ***Multiple*** *altered signal intensity solid cystic lobulated apparently osseous expansile lesions in the visualized bones, these lesions apparently have narrow zone of transition; variable soft tissue edema on the Left side. These lesions shows heterogenous post contrast enhancement in the solid component and in the periphery of the cystic component* : **Findings are suggestive of multiple large apparently benign osseous lesions possibility of Brown tumors may be considered (suggest correlation with other relevant investigations like parathyroid hormone assay & HPE if clinically indicated)**
- **Evidence of a pathological fracture in the subtrochanteric region of the Left femur with mild varus angulation (suggest CT evaluation for osseous injuries / assessment)**
- **Other findings as described above.**

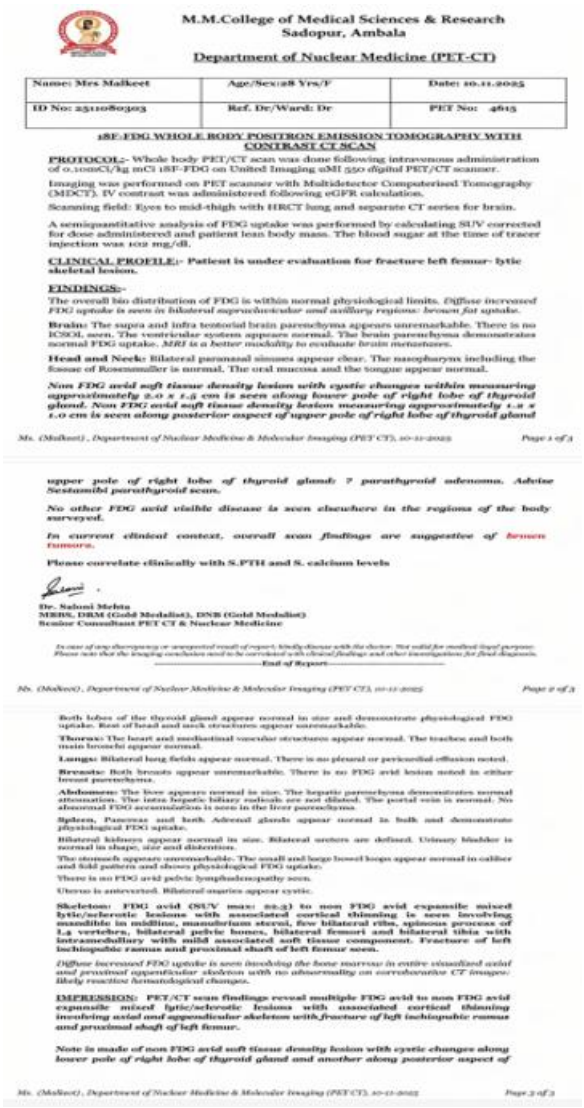
Please correlate clinically & with other relevant investigations.

Dr Manish Kulia MD
Associate. Prof.
MMCMSR

Dr Navdeep Walia MD
Asst Prof
MMCMSR

Investigations *have their limitation. Solitary radiological / pathological and other investigations never confirm the final diagnosis of disease. They only help in diagnosing the disease in correlation to symptom and other related test. Please interpret accordingly.*

Figure 3: Contrast-enhanced MRI of the bilateral hip joints showing multiple heterogeneous solid-cystic expansile osseous lesions involving the bilateral iliac bones, acetabula, pubic tubercles, proximal femur, and distal femoral shaft, with associated soft-tissue edema and a narrow zone of transition.



M.M.College of Medical Sciences & Research
Sadopur, Ambala

Department of Nuclear Medicine (PET-CT)

Name: Mrs Malkeet	Age/Sex:28 Yrs/F	Date: 10.11.2025
ID No: 25110803103	Ref. Dr/Ward: Dr	PET No: 4615

18F-FDG WHOLE BODY POSITRON EMISSION TOMOGRAPHY WITH CONTRAST CT SCAN

PROTOCOL:- Whole body PET/CT scan was done following intravenous administration of 0.11mCi/kg mCi 18F-FDG on United Imaging uMI 550 digital PET/CT scanner.

Imaging was performed on PET scanner with Multidetector Computerised Tomography (MDCT). IV contrast was administered following eGFR calculation.

Scanning field: Eyes to mid-thigh with HRCT lung and separate CT series for brain.

A semiquantitative analysis of FDG uptake was performed by calculating SUV corrected for dose administered and patient lean body mass. The blood sugar at the time of tracer injection was 102 mg/dl.

CLINICAL PROFILE:- Patient is under evaluation for fracture left femur- lytic skeletal lesion.

FINDINGS:-

The overall bio distribution of FDG is within normal physiological limits. *Diffuse increased FDG uptake is seen in bilateral supraclavicular and axillary regions: brown fat uptake.*

Brain: The supra and infra tentorial brain parenchyma appears unremarkable. There is no ICSOL seen. The ventricular system appears normal. The brain parenchyma demonstrates normal FDG uptake. *MRI is a better modality to evaluate brain metastases.*

Head and Neck: Bilateral paranasal sinuses appear clear. The nasopharynx including the fossae of Rosenmuller is normal. The oral mucosa and the tongue appear normal.

Non FDG avid soft tissue density lesion with cystic changes within measuring approximately 2.0 x 1.5 cm is seen along lower pole of right lobe of thyroid gland. Non FDG avid soft tissue density lesion measuring approximately 1.0 x 1.0 cm is seen along posterior aspect of upper pole of right lobe of thyroid gland

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upper pole of right lobe of thyroid gland: ? parathyroid adenoma. Advise Sestamibi parathyroid scan.

No other FDG avid visible disease is seen elsewhere in the regions of the body surveyed.

In current clinical context, overall scan findings are suggestive of brown tumora.

Please correlate clinically with S.PTH and S. calcium levels

Dr. Saloni Mehta
MBBS, DRM (Gold Medalist), DNB (Gold Medalist)
Senior Consultant PET CT & Nuclear Medicine

In case of any discrepancy or unexpected result of report, kindly discuss with the doctor. Not valid for medico-legal purpose. Please note that the imaging conclusion need to be correlated with clinical findings and other investigations for final diagnosis.

End of Report

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Both lobes of the thyroid gland appear normal in size and demonstrate physiological FDG uptake. Rest of head and neck structures appear unremarkable.

Thorax: The heart and mediastinal vascular structures appear normal. The trachea and both main bronchi appear normal.

Lungs: Bilateral lung fields appear normal. There is no pleural or pericardial effusion noted.

Breasts: Both breasts appear unremarkable. There is no FDG avid lesion noted in either breast parenchyma.

Abdomen: The liver appears normal in size. The hepatic parenchyma demonstrates normal attenuation. The intra hepatic biliary radicals are not dilated. The portal vein is normal. No abnormal FDG accumulation is seen in the liver parenchyma.

Spleen, Pancreas and both Adrenal glands appear normal in bulk and demonstrate physiological FDG uptake.

Bilateral kidneys appear normal in size. Bilateral ureters are defined. Urinary bladder is normal in shape, size and distention.

The stomach appears unremarkable. The small and large bowel loops appear normal in caliber and fold pattern and shows physiological FDG uptake.

There is no FDG avid pelvic lymphadenopathy seen.

Uterus is anteverted. Bilateral ovaries appear cystic.

Skeleton: FDG avid (SUV max: 10.3) to non FDG avid expansile mixed lytic/sclerotic lesions with associated cortical thinning is seen involving mandible in midline, manubrium sterni, few bilateral ribs, spinous process of L4 vertebra, bilateral pelvic bones, bilateral femori and bilateral tibia with intramedullary with mild associated soft tissue component. Fracture of left ischiopubic ramus and proximal shaft of left femur seen.

Diffuse increased FDG uptake is seen involving the bone marrow in entire visualized axial and proximal appendicular skeleton with no abnormality on corroborative CT images: likely reactive hematological changes.

IMPRESSION: PET/CT scan findings reveal multiple FDG avid to non FDG avid expansile mixed lytic/sclerotic lesions with associated cortical thinning involving axial and appendicular skeleton with fracture of left ischiopubic ramus and proximal shaft of left femur.

Note is made of non FDG avid soft tissue density lesion with cystic changes along lower pole of right lobe of thyroid gland and another along posterior aspect of

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Figure 4: Whole-body 18F-FDG PET/CT report demonstrating multiple FDG-avid and non-FDG-avid expansile mixed lytic-sclerotic skeletal lesions involving the axial and appendicular skeleton, pelvis, femora, ribs, vertebrae, and mandible. Patient-identifying header has been redacted.

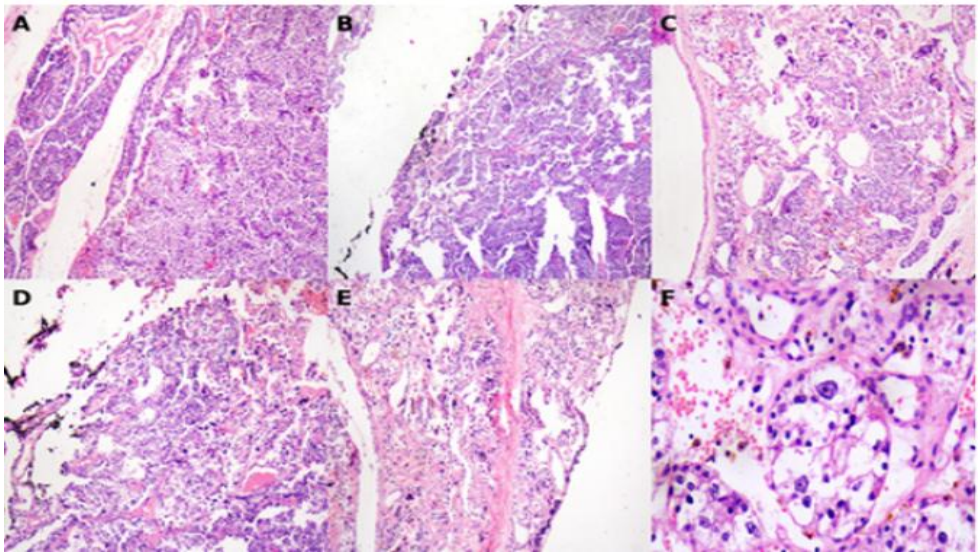


Figure 5: Histopathological features of parathyroid carcinoma on hematoxylin and eosin staining: (A) low-power view showing a capsulated tumor arranged in solid sheets; (B) tumor nests approaching the inked surgical margin; (C) nests and trabeculae separated by fibrovascular septa; (D) capsular invasion; (E) tumor extending to the inked surface; and (F) high-power view showing moderate nuclear pleomorphism, coarse chromatin, prominent nucleoli, and eosinophilic cytoplasm.