

Enlarged parathyroid glands with variable sonomorphology in a case of tertiary hyperparathyroidism: Sonographic-histopathologic correlation

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Abstract

The typical sonomorphology of homogeneously hypoechoic texture of an enlarged parathyroid gland (PG) is a reflection of uniform arrangement of the parathormone-producing chief cells. A variable cellular arrangement, hemorrhage, fibrosis, and adipocytes cause heterogeneous appearance. We describe a case of a 32-year-old male, a case of tertiary hyperparathyroidism, with increased serum parathormone levels, hypercalcemia, and enlargement of all four PGs, albeit with differing morphology. The left lower gland had two nodules, namely, superior and inferior. The inferior nodule of the left lower gland had an echogenic core surrounded by a sonolucent rim whereas the superior nodule was homogeneously hypoechoic. The left upper gland had an echopattern exactly reverse of the inferior nodule of the left lower PG, i.e., hypoechoic gland surrounded by hyperechoic periphery. The appearance of the right-sided glands was that of the superior nodule of the left lower PG. On histopathology, the hypoechoic areas corresponded to numerous chief cells and congested vessels whereas edema gave rise to an increase in echogenicity. This report exemplifies atypical sonographic appearances of PG and their histopathologic correlation.

Key words: Parathyroid adenoma; parathyroid glands; ultrasonography

Introduction

A normal parathyroid gland (PG) is not visualized on ultrasonography; an enlarged one, however, appears as hypoechoic (compared to that of the normal thyroid tissue) tear-drop shaped nodule^[1,2] separated from thyroid gland by an intervening echogenic posterior capsule of thyroid.^[3] The uniform echostructure of the gland is a function of uniform arrangement of chief cells^[1,2] with intervening sparse adipocytes.^[4] The homogeneity is lost due to hemorrhage,

edema, acinar dilation, and fibrosis.^[1,2] In the present case, we discuss the histologic basis of differential sonomorphology of all the four enlarged glands in a 32-year-old male in the setting of tertiary hyperparathyroidism.

Case Report

A 32-year-old male, a known case of chronic renal failure induced secondary hyperparathyroidism on calcimimetics

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and maintenance dialysis, presented with bone pains, backache, and reduced activity since a few months. The clinical profile of the patient prompted serum biochemical investigations and ultrasonography of the neck. The serum profile revealed calcium 12 mg% (normal: 8.5–11.5 mg%), phosphate 2.6 IU/L (normal: 2.5–4.5 IU/L), vitamin D 19.08 ng/ml (normal: 30–100 ng/ml), parathormone 1721.6 pg/ml (normal: 9.5–75 pg/ml), and alkaline phosphate 1586 IU/L (normal: 80–279 IU/L). Ultrasonography of the neck was performed which revealed enlarged and homogeneously hypoechoic right upper and lower [Figure 1] parathyroid glands. On the left, however, the upper gland had a central hypoechoogenicity surrounded by peripheral hyperechoic rim [Figure 2A and B]. The left lower parathyroid gland had two nodules; the superior one was smaller and was homogeneously hypoechoic similar to the the right-sided glands whereas the inferior nodule revealed an echopattern reverse to that of the left upper, i.e., a sonolucent halo around the central echogenic region [Figure 2C and D]. Tc-99m sestamibi scan revealed increased uptake in all four glands [Figure 3]. Based on

the serum biochemistry and ultrasonography, the patient was diagnosed as a case of tertiary hyperparathyroidism. Subsequently, the patient underwent three-and-one half parathyroidectomy. The histopathology was consistent with enlarged parathyroid glands. The findings on microscopy revealed differential arrangement of cells and vessels giving rise to atypical appearance of the enlarged gland on the left side on ultrasonography [Figures 4 and 5; Table 1]. The patient is on regular dialysis and is due for a renal transplant.



Figure 1: Transverse scan reveals a homogeneously hypoechoic right lower parathyroid gland (horizontal arrow). The left lower parathyroid gland consists of a homogeneously hypoechoic superior nodule and an inferior nodule with peripheral hypoechoogenicity (vertical arrows)

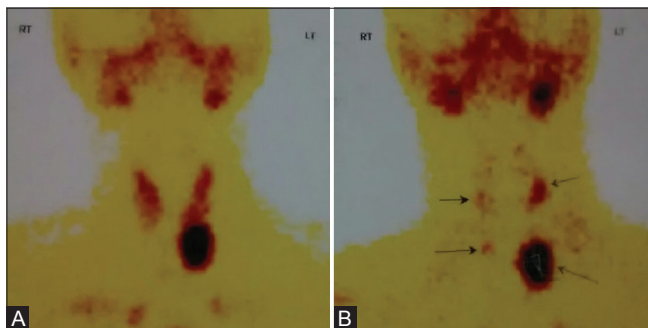


Figure 3 (A-B): Tc-99 m sestamibi scan: Images at 20 min (A) reveal uniform uptake in both lobes of thyroid with well-defined areas of increased tracer uptake in the lower part of the left lobe. Delayed image at 2 h (B) shows multiple areas of abnormal tracer uptake, largest being the left lower pole followed by left upper pole and two small areas involving the right upper and lower pole after adequate washout from both thyroid lobes (Image courtesy: Dr Panda P)

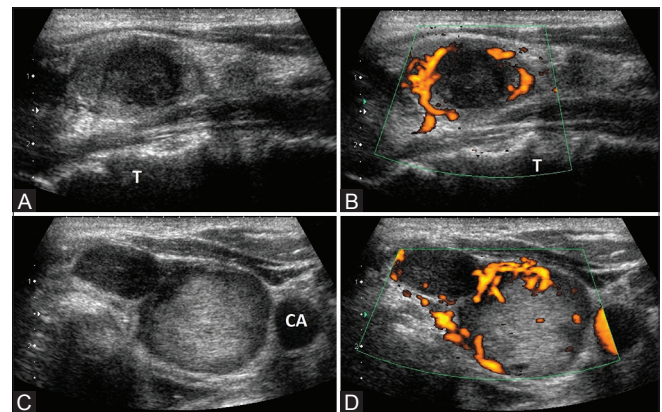


Figure 2 (A-D): Longitudinal sonogram reveals the enlarged left upper parathyroid gland with peripheral echogenicity and a sonolucent core (A). The left lower gland comprises a superior nodule which is homogeneously hypoechoic and an inferior nodule with sonolucent periphery and echogenic centre (C). Doppler signals reveal prominent peripheral vascularity in the left upper and inferior nodule of the left lower gland (B, D). (T = trachea, CA = carotid artery)

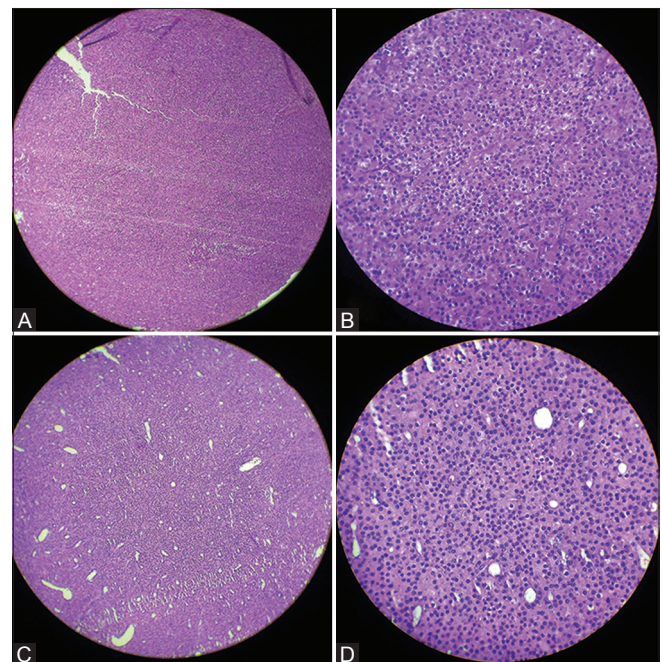


Figure 4 (A-D): Right lower and superior nodule of left lower gland: Histopathologic images reveal uniform arrangement of chief cells devoid of adipocytes in right lower (A, low power; B, high power) and superior nodule of the left lower gland (C, low power; D, high power). Compare the uniformity in arrangement of cells in both the glands

Table 1: A summary of the major histopathological observations and their radiological correlation

REGIONS OF THE GLAND	LEFT UPPER GLAND (hypoechoic centre with echogenic rim)	INFERIOR NODULE OF THE LEFT LOWER GLAND (echogenic core with echopoor periphery)
CENTRE	1) Nodules of chief cells with centrally placed congested vessels. (Number of nodules much more at centre than periphery)	1) Cell type: Only oxyphil 2) Little edema
PERIPHERY	1) Few nodules of chief cells (starting below the capsule) 2) Capsule 3) Compressed parenchyma	1) Nodules of chief cells 2) Congested vessels

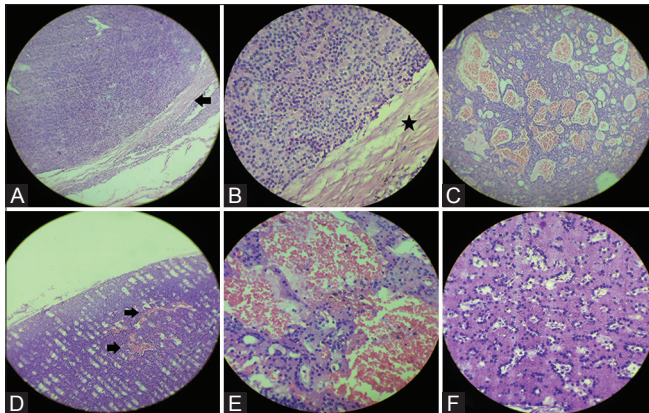


Figure 5 (A-F): The left upper gland (A, B, C): Photomicrograph reveals peripheral compressed parenchyma and a well-defined capsule (arrow in A, low power; asterisk in B, high power). The nodules at the centre contain numerous congested vessels (C; low power). The inferior nodule of left lower gland (D, E, F): Low (D) and high power (E) of the periphery of the nodules show nodules of chief cells with congested vessels. The vacuoles in (D) are due to processing artefact. The core of this nodule is composed of oxyphil cells with edema (F)

Discussion

The classic ultrasonographic features of an enlarged PG is that of an oval, homogeneously hypoechoic gland.^[1] This texture is a consequence of the homogeneity of arrangement of sheets of chief cells.^[1,2] In the sonographic-pathologic correlation of homogenous PG adenomas, Rastad *et al.*^[1] found solid arrangement of chief cells. A few adenomas, in their study, however, had small areas of oxyphil and transitional oxyphil cells, small acinar areas, and a few adipocytes. Furthermore, the authors mentioned that both an adenomatous and a hyperplastic gland looked alike on ultrasonography; although hyperplasia has a higher tendency to involve multiple glands.^[1] In addition, the hyperplastic glands may even be more sonolucent than their adenomatous counterparts. Pathologically, hyperplastic glands have chief cells and multiple small nodules of oxyphil and transitional oxyphil cells and are devoid of fat. The homogeneity in hyperplastic glands is, however, due to uniform cellular arrangement and small size of nodules beyond the resolution of ultrasonography.^[1]

The typical homogeneously hypoechoic appearance of parathyroid gland helps to differentiate it from its mimics.^[3] A posteriorly placed thyroid nodule is usually inhomogeneously hypoechoic and lacks the echogenic

interface with the thyroid gland.^[3] Yet another differential includes a lymph node, which, however, has a hyperechoic hilum with characteristic vascularity.^[3,4] The inferior nodule of the left lower gland in our case also looked like a lymph node, but the clinical context and absence of hilar vascularity ruled out the presence of a lymph node. A parathyroid carcinoma is more often heterogeneous; this morphology, however, may be seen in larger adenomas as well.^[3,5]

Inhomogeneity in the echotexture of PG mirrors uneven arrangement of cells at microscopic level.^[1,2,6,7] In addition, hemorrhage, fat, fibrosis, and acinar dilation gives rise to atypical appearances on ultrasonography.^[1,2] Acar *et al.*^[7] described 9 cases with differential central and peripheral echogenicity, which was an echopoor periphery surrounding an iso to hyperechoic central core. The authors attributed central echogenic areas to the presence of increased edema and ectatic vessels.^[7] In our case, the inferior nodule in the left lower gland also had a similar appearance [Figure 1, 2C and D]. However, on histopathology, the sonolucent periphery was found to be composed of nodules of chief cells with numerous ectatic vessels [Figure 5D-F; Table 1]. Because both uniformly arranged chief cells as well as congestion (due to the ectatic vessels) are known to cause hypoechoic, this possibly explains the hypoechoic peripheral rim. Further, the echogenic core in our case was composed of oxyphil cells with some edema. An increase in echogenicity was reported due to the presence of edema by Acar *et al.*^[7] Hence, we propose that edema (similar to the series of Acar *et al.*) with probable presence of oxyphil cells could have given rise to hyperechoic core of the inferior nodule of the left lower PG.

The left upper PG in our case had a sonomorphology reverse to that of inferior nodule of left lower PG; it had a hypoechoic centre surrounded by echogenic rim [Figure 2A and B]. On microscopy, the gland was seen to comprise numerous nodules of chief cells with a well-defined capsule. The nodules in the centre had markedly dilated, congested vessels; a reason for reduced echogenicity in the centre [Figure 5A-C; Table 1]. Further, the normal parenchyma and nodules at the periphery were compressed. The increase in echogenicity at the periphery was probably due to the presence of capsule, compressed normal parenchyma and nodules, and a few fibrous septae. Further, both right-sided glands and the superior nodule

of left lower gland were homogeneously hypoechoic on ultrasonography and revealed a uniform arrangement of chief cells on microscopy.

Conclusion

In conclusion, the homogeneously hypoechoic sonomorphology reflects uniform arrangement of chief cells of PG.^[1,2,6] It is this typical appearance that differentiates PG from its mimics. Variable microscopic structure due to hemorrhage, fibrosis, and edema lead to heterogeneous echostructure of the enlarged PG.^[1,2,6,7] Our case highlights that hypoechogenicity of the PG may be attributed to chief cells and congested vessels whereas edema can give rise to an increase in echogenicity.

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Conflicts of interest

There are no conflicts of interest.

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