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Pictorial Essays: Ultrasound features of Thyroid and Parathyroid lesions

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Introduction:

High-resolution Ultrasonography has improved in the past few years and has become a very valuable in diagnosis of the diseases of thyroid and parathyroid glands. After clinical examination Ultrasonography plays key role in evaluation of thyroid lesions. Nodular thyroid diseases are the most common cause of thyroid enlargement. Colloid multinodular goiter is the most common among all thyroid nodular diseases. Incidence of all thyroid diseases is higher in females than males. Most of the patients of primary hyperparathyroidism presented with symptoms caused by brown tumors and other symptoms of primary hyperparathyroidism. Parathyroid adenoma is the most common cause of primary hyperparathyroidism.

Discussion:

Most of the patients of thyroid gland disease are presented with complaint of neck swelling in the midline or side of the neck and some time with Dysphagia and hoarseness of the voice.

Fig 1

(A) Disease of the Thyroid gland

(a) Benign thyroid masses

Thyroid Adenoma:

Most of the adenomas are solitary but they may also develop as a part of the multinodular masses. On USG, adenomas appear as solid masses that may be hyperechoic, isoechoic or hypoechoic. (Fig. 1) They often have a peripheral hypoechoic halo that is smooth and thick. This halo is due to fibrous capsule and blood vessels, which can be readily seen by color Doppler. Often, vessels pass from the periphery to the central regions of the nodule, creating a "spoke-and-wheel-like" appearance. [5]

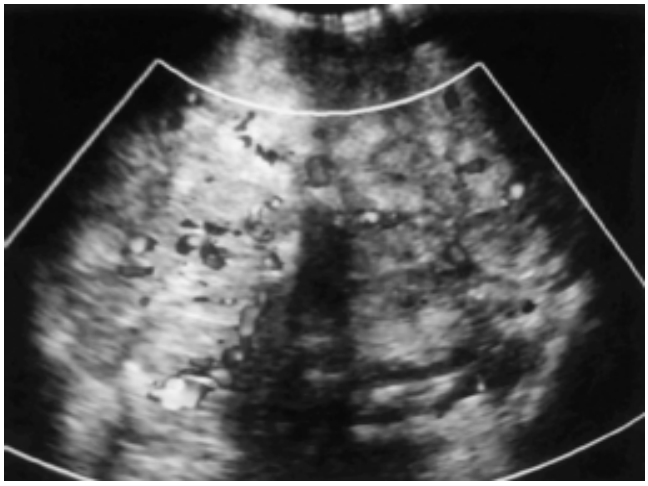

Fig 2

Multinodular Goiter:

Adenomatous or colloid multinodular goiter is the most common cause of the asymmetric thyroid enlargement. The peak age is 35 to 50 years, and females are three times more likely than males to have the disease.

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Histologically the initial stage is cellular hyperplasia of the thyroid acini, which is followed by nodule formation. The nodules often undergo cystic degeneration, and calcification may found which is often coarse and perinodular. On USG, most of the nodules are isoechoic compared to normal thyroid tissue. As the size of the mass increases, it may become hyperechoic due to numerous interfaces between the cells and colloid substance. (Fig.2). If the nodules are increased in size, the matrix becomes more inhomogeneous. Degenerative changes of goiterous nodules correspond to their USG appearances: Purely anechoic areas due to serous or colloid fluid (Fig.3); echogenic fluid or moving fluid-fluid levels correspond to hemorrhage; bright echogenic foci with comet-tail artifacts due to presence of dense colloid material (Fig.4); intracystic thin septations probably correspond to attenuated strands of the thyroid tissue.[7]

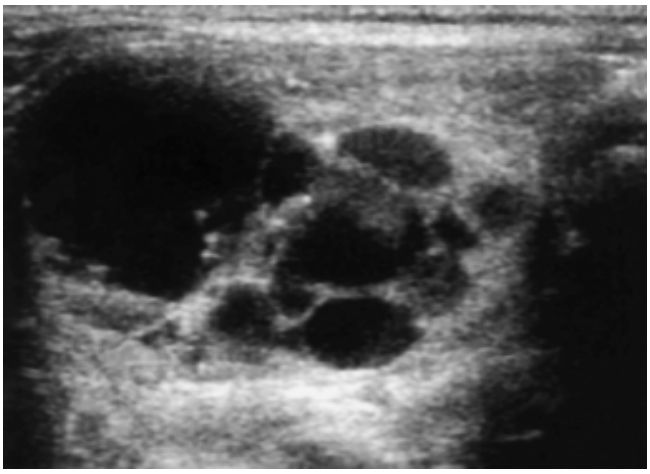

Fig 3

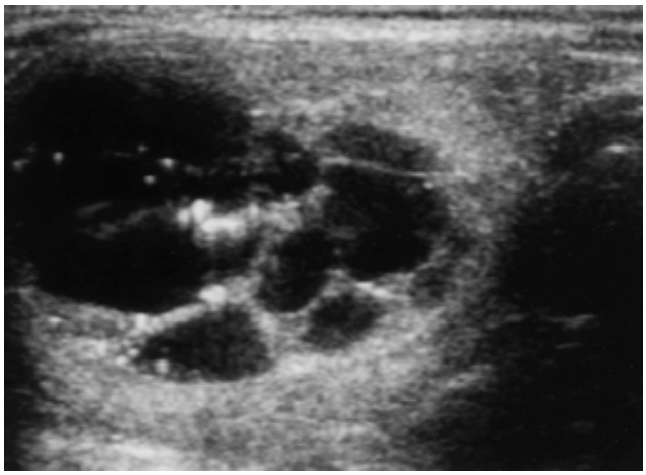

Fig 4

(b) Malignant Tumors of the Thyroid gland

The histological classification includes papillary carcinoma (60% to 80%), follicular carcinoma (20% to25%), anaplastic carcinoma (3% to 10%), medullary carcinoma (4% to 5%), lymphoma (5%), and metastases. [9]

Papillary Carcinoma:

Papillary thyroid carcinoma is prevalent in younger age with peak incidence in the third and fourth decades. The major route of spread of the tumor is through the lymphatic to nearby cervical lymph nodes. In fact, in 80% of cases patient of papillary carcinoma may present with enlarged cervical lymph nodes and palpably normal thyroid gland. Distant metastases are rare.

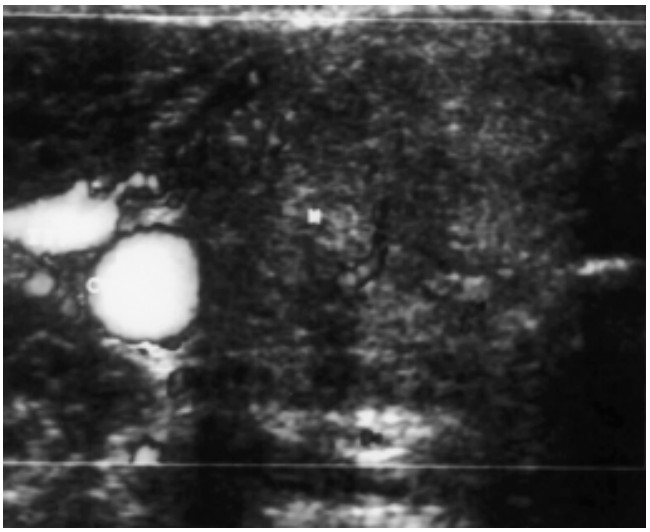

Fig 5

Fig 6

The USG characteristics of papillary carcinoma are:
-Hypoechogenicity (in 90% of cases) due to closely packed cell content, with minimal colloid substance. (Fig.5)
-Microcalcifications that appear as tiny punctate

hyperechoic foci either with or without acoustic shadows.

- Cervical lymph node metastases, which may contain tiny, punctate echogenic foci due to microcalcifications. (Fig.6)

Fig 7

Follicular carcinoma:

Follicular carcinoma has a female predominance and occurs with peak incidence in the fifth decade. There are two variants of follicular carcinoma, the minimally invasive follicular carcinoma and the widely invasive follicular carcinoma. Follicular carcinoma tend to spread via the blood stream rather than, via lymphatic, and distant metastases to bone, lung, brain and liver are most likely than metastases to cervical lymph nodes. There are no unique USG features that allow differentiation of follicular carcinoma from adenoma. (Fig.7) The USG features that suggest follicular carcinoma are:

- Irregular tumor margins.
- Thick irregular halo.
- Tortuous or chaotic arrangement of internal blood vessels on color Doppler.

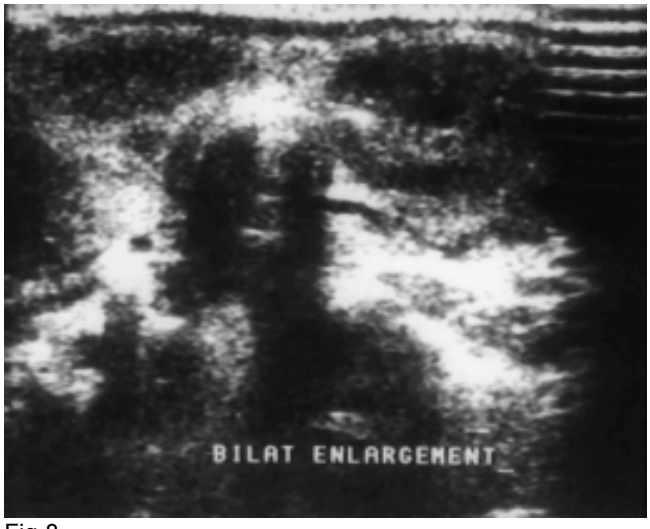

Fig 8

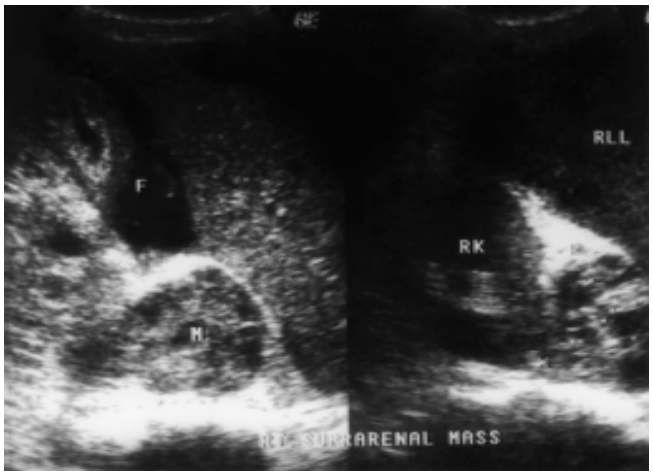

Fig 9

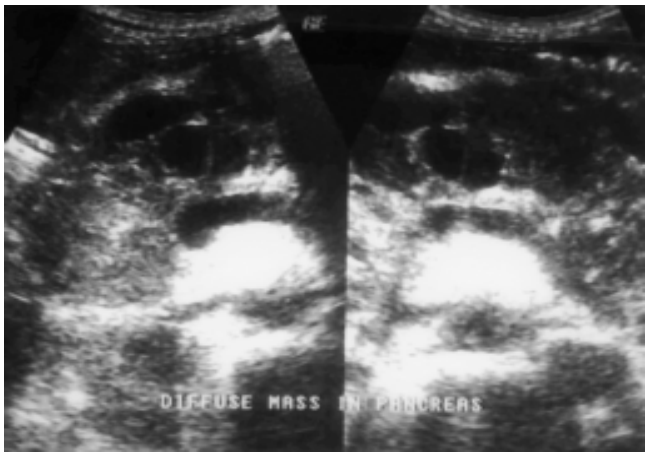

Fig 10

Medullary carcinoma:

It is derived from the parafollicular cells or C cells, and typically secretes the hormone calcitonin. The cancer is frequently familial (20%) and is an essential component of the multiple endocrine neoplasia (MEN) type II syndromes. MEN syndrome occurs in younger patients (mean age of 35 years). The disease is multicentric and/or bilateral in about 90% of the familial cases. (Fig.8, 9,10)

The USG appearance of Medullary carcinoma is similar to that of papillary carcinoma. Local invasion and metastases to cervical nodes occur more frequently in medullary carcinoma than papillary carcinoma. Bright echogenic foci caused by calcifications are detectable in 80% to90% of cases. (Fig.11) These foci can be seen not only in the primary tumor but also in metastatic lymph nodes and even in hepatic metastases.

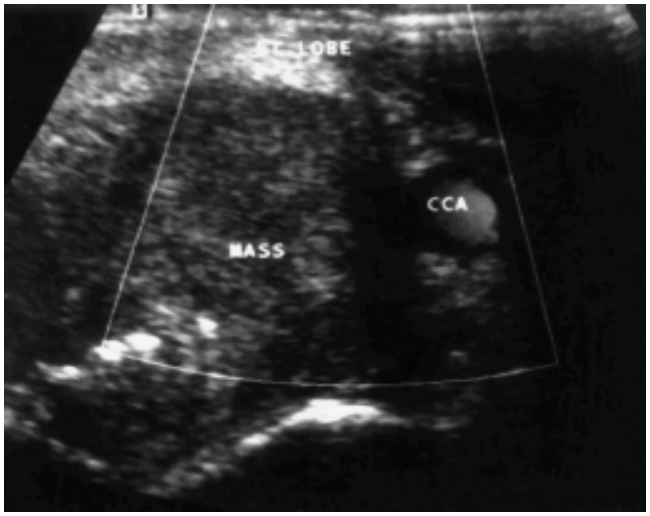

Fig 11

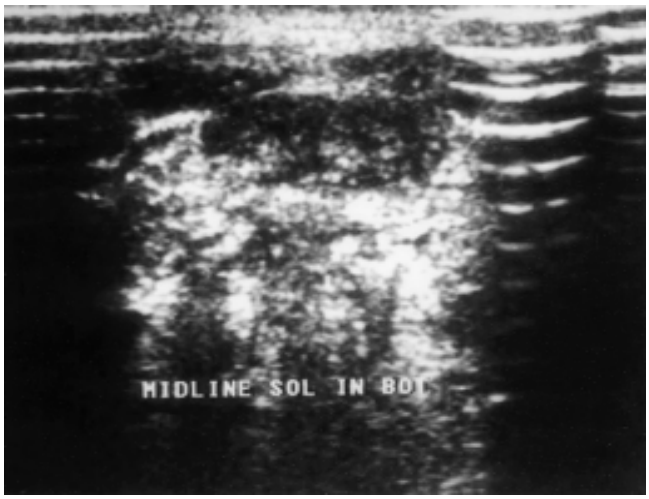

Fig 12

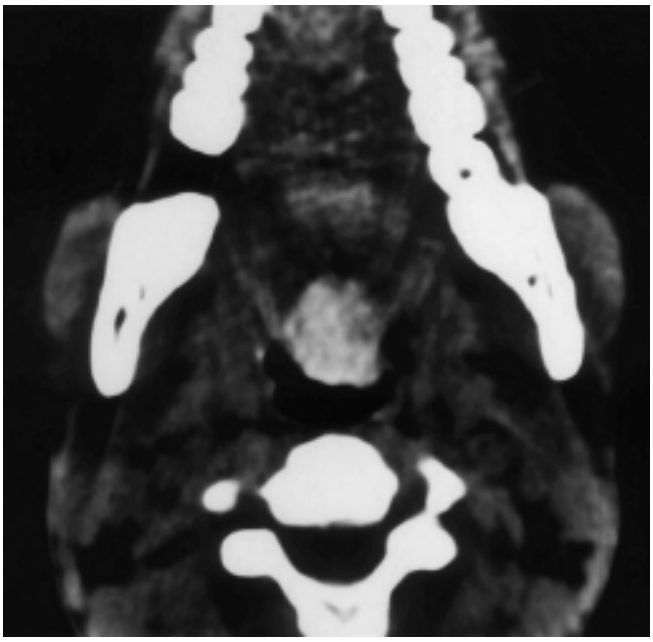

Fig 13

Anaplastic carcinoma:

Anaplastic carcinoma is typically disease of the elderly; it represents one of the most lethal of solid tumors. On USG these carcinomas are usually hypoechoic and are often seen to encase or invade blood vessels and muscles, and show areas of necrosis and hemorrhage and amorphous calcification.

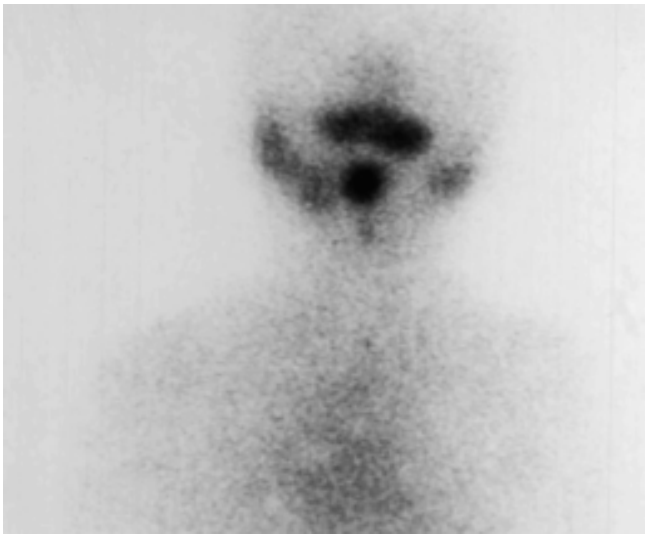

Fig 14

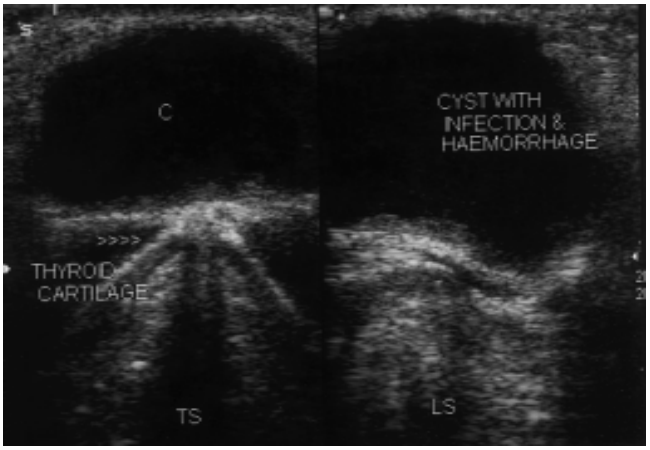

Fig 15

Fig 16

Congenital lesions of the thyroid gland:

Lingual Thyroid gland and Thyroglossal duct cyst:

Rests of the thyroid tissue remaining along the thyroglossal duct may lead to development of ectopic thyroid glands. Lingual thyroid gland commonly found in the midline at the foramen of caecum. In 70% to 80% of cases this is the only functioning thyroid tissue. Lateral ectopic thyroid gland occurs lateral to the carotid sheath and IJV. [3] USG shows presence of the thyroid gland at the base of tongue and normal thyroid gland may or may not be present at the normal location. (Fig.12) CT scan shows presence of hyperdense lesion at the base of the tongue. (Fig.13) Radionuclide imaging is helpful for localizing ectopic thyroid gland.(Fig.14) Thyroglossal cyst usually found in midline at the level of hyoid bone or thyroid cartilage. On USG it appears as well defined anechoic to hypoechoic lesion with internal echoes due to internal hemorrhage or infection. (Fig.15, 16)

Hashimoto's Thyroiditis (Lymphocytic thyroiditis):

Hashimoto's Thyroiditis is an autoimmune disorder of unknown cause leading to destruction of the gland and hypothyroidism. It occurs predominantly in women over age of forty years. It typically occurs as a painless, diffuse enlargement of the thyroid gland. The typical USG appearance is diffuse glandular enlargement with a homogeneous but coarsened parenchymal echo texture, generally more hypoechoic than normal thyroid parenchyma. (Fig.17) Fibrotic septations may produce a pseudolobulated appearance of the parenchyma. Multiple discrete hypoechoic micronodules from one to six mm in diameter have been described as strongly suggestive of chronic thyroiditis. Occasionally, discrete nodules occur and FNAC is needed to establish the diagnosis. Hashimoto's Thyroiditis is associated with an increased incidence of malignant lymphoma, leukemia, papillary and Hurthle cell neoplasms. [10]

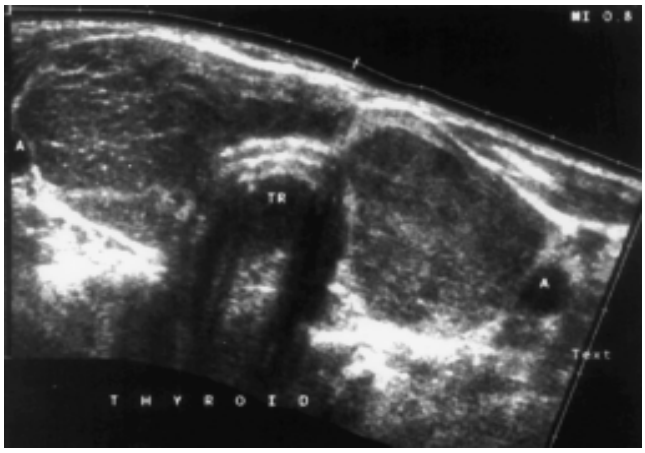

Fig 17

(B) Disease of the Parathyroid Glands:

The most common abnormality associated with the dysfunction of the parathyroid gland is hyperparathyroidism. There are two types of hyperparathyroidism, Primary and secondary hyperparathyroidism.

Primary hyperparathyroidism: Causes of primary hyperparathyroidism are adenomas (80% to 85%), hyperplasia (15% to 20%), and carcinoma (under 3%). Women are affected two to three times more frequently than men. Patient usually present with signs symptoms of hyperparathyroidism. (Fig.18)

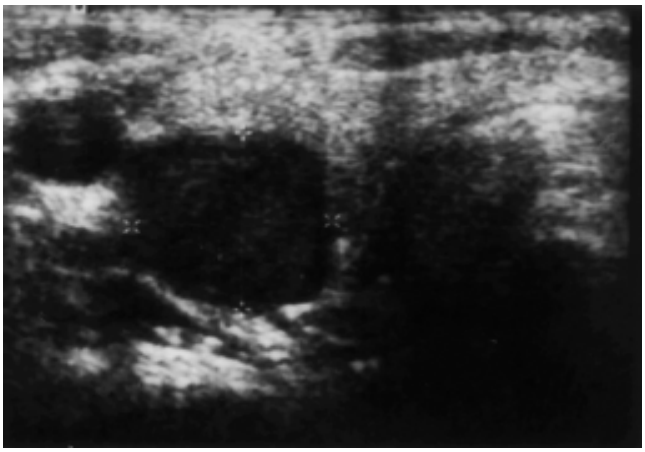

Fig 18

Parathyroid adenomas:

Parathyroid adenomas are the most common cause of primary hyperparathyroidism. The adenoma is a solitary lesion. [1]

USG appearance:

Size and shape: Parathyroid adenomas are usually oval. As they enlarge acquire a characteristic oblong shape. The cephalic or caudal end can be more bulbous, producing a triangular tapering, or tear drop shape. Most of the parathyroid adenomas are 0.8 to 1.5 cm in diameter. Echogenicity: The characteristic hypoechoic appearance is due to the uniform hypercellularity of the gland.

Internal architecture: Majority of the adenomas are solid. About 2% have internal cystic components due to cystic degeneration. Rarely it may contain calcification.

Typical locations:

The typical superior parathyroid adenoma usually is adjacent to the posterior aspect of the mid portion of the thyroid gland. The location of typical inferior parathyroid

adenoma is more variable, but usually it lies close to caudal tip of lower pole of the thyroid gland.

Ectopic location: The four most common ectopic locations are retrotracheal adenoma, mediastinal adenoma, intrathyroid, and carotid sheath adenoma.

Parathyroid hyperplasia:

Parathyroid hyperplasia leads to enlargement of multiple parathyroid glands. On USG, the echogenicity and structure of hyperplasia are similar to small parathyroid adenomas. However, the glands may be inconsistently and asymmetrically enlarged, and diagnosis of parathyroid hyperplasia is often difficult to make sonographically. [1]

Parathyroid carcinoma:

Parathyroid carcinoma is usually less common cause of hyperparathyroidism than that of adenomas. Carcinomas have no specific imaging features. Carcinomas frequently have lobulated contour, heterogeneous internal architecture, calcifications, and internal cystic component; but only the presence of local invasion of the thyroid glands, adjacent muscles, or vessels, or nodal metastases would suggest preoperative diagnosis.

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