IN THE NAME OF GOD

DIFFUSE THYROID DISEASES

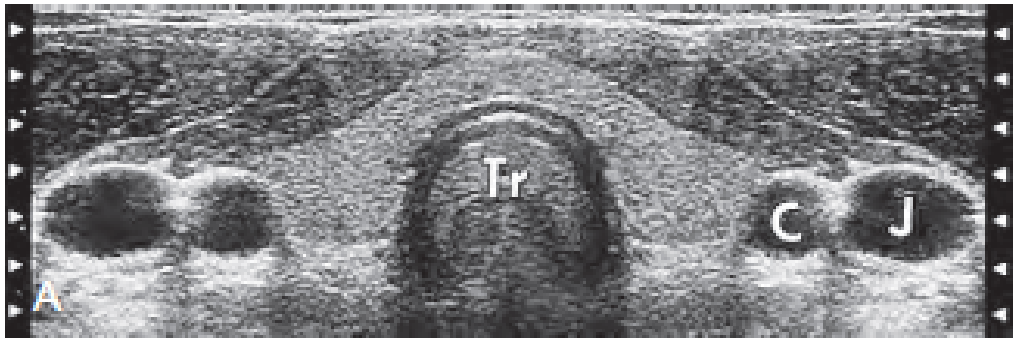
BY DR SHADI NOURI

ASSISTANT PROFESSOR

ARAK MEDICAL UNIVERCITY

Anatomy

anatomy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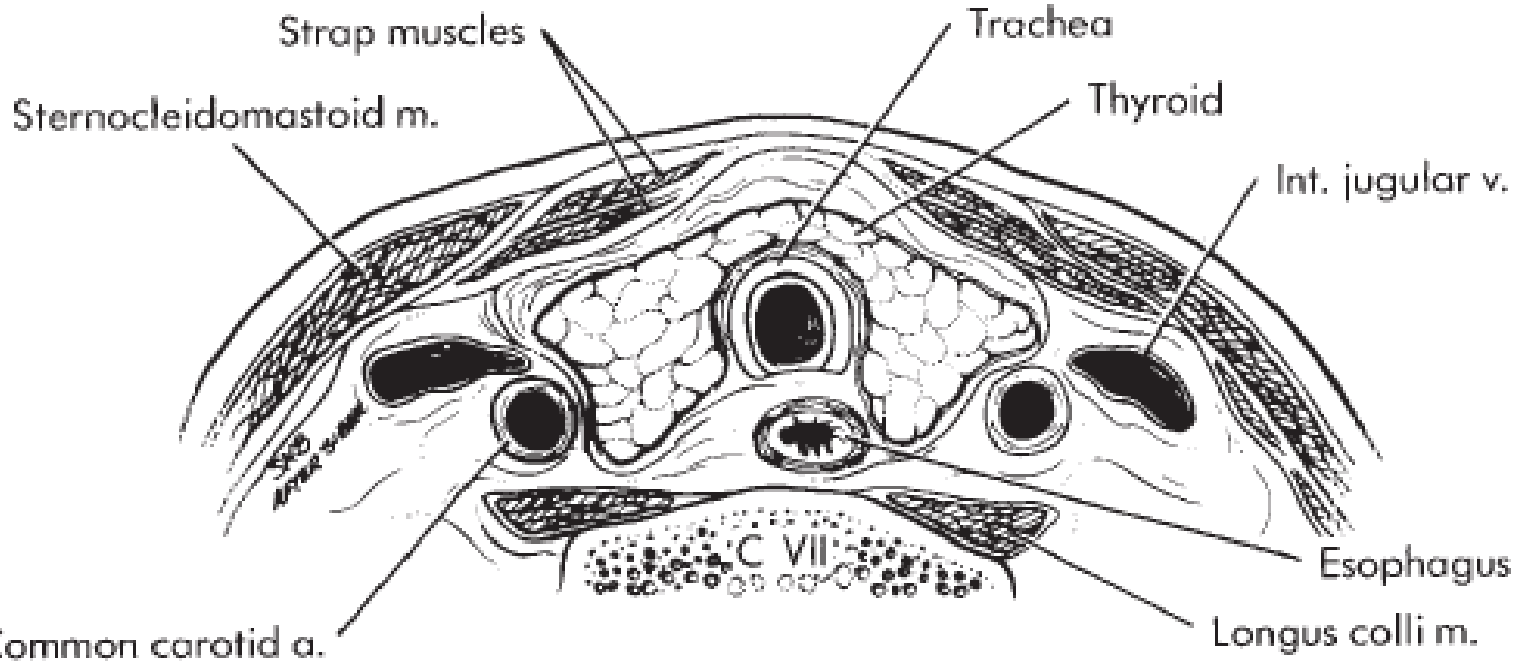

Strap muscles
Trachea
Sternocleidomastoid m.
Thyroid
Int. jugular v.
C VII
Esophagus
Longus colli m.
B Common carotid a.

Size of the thyroid gland

length :40 to 60 mm,

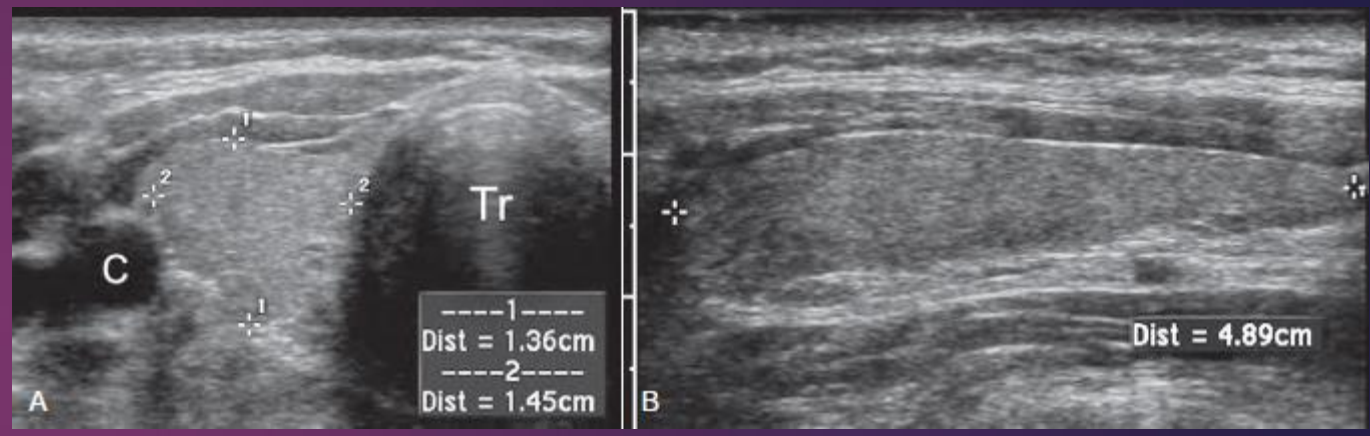
AP diameter :13 to 18 mm.

thickness of the isthmus is 4 to 6 mm.

AP diameter is the most precise because it is relatively independent of possible dimensional asymmetry between the two lobes.

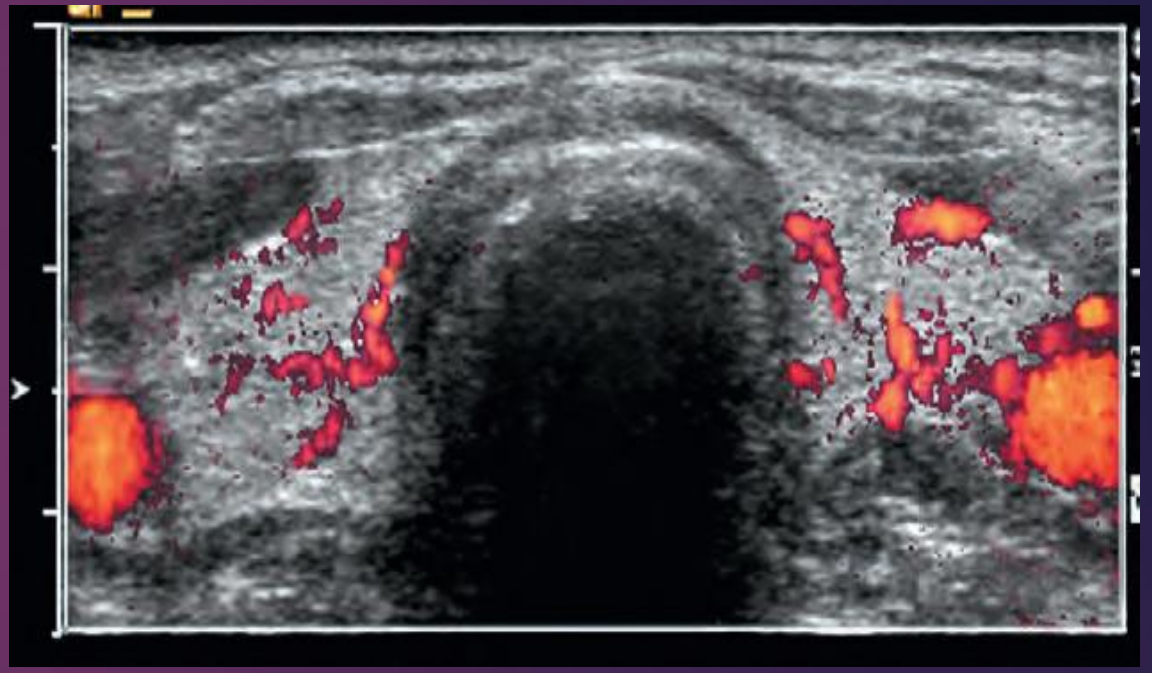
When the AP diameter is more than 2 cm, the thyroid

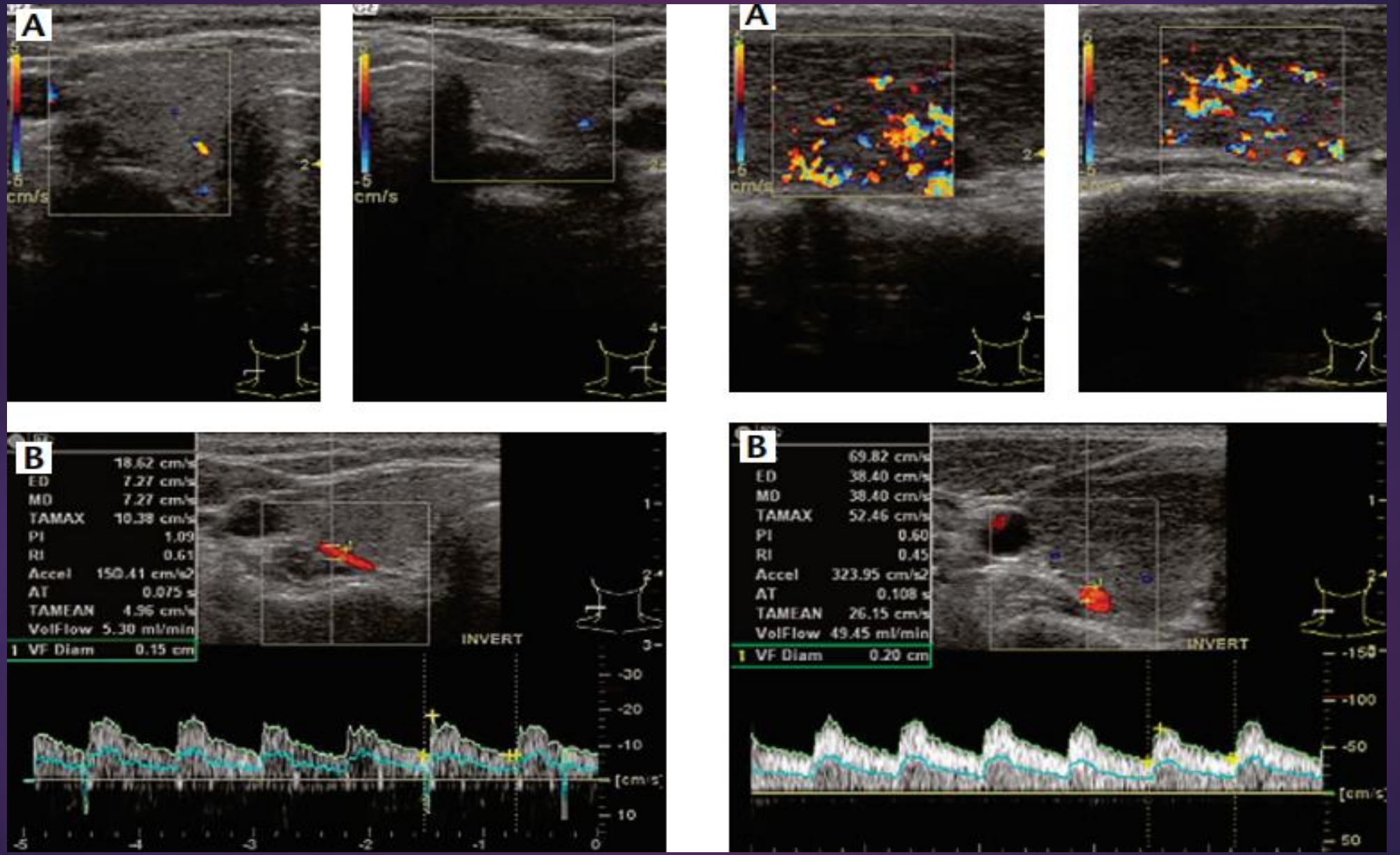
gland may be considered "enlarged



Thyroid vascular supply

- **superior thyroid artery and vein** are found at the upper pole of each lobe. The **inferior thyroid vein** is found at the lower pole , and the **inferior thyroid artery** is located posterior to the lower third of each lobe.
- major thyroid arteries PSV: 20 to 40 cm/sec
- intraparenchymal :15 to 30 cm/sec .





Euthyroid

hyperthyroid

Diffuse thyroid diseases

- Several thyroid diseases are characterized by diffuse rather than focal enlargement of the gland. This usually results in generalized enlargement of the gland (goiter) without any palpable nodules.

DIFFUSE THYROID DISEASES

Acute suppurative thyroiditis
Subacute granulomatous thyroiditis
Hashimoto's thyroiditis (chronic lymphocytic thyroiditis)
Adenomatous or colloid goiter
Painless (silent) thyroiditis

Differentiation of asymptomatic DTD from the normal thyroid gland

- parenchymal echogenicity, parenchymal echotexture, AP diameter of the thyroid gland, glandular margin, and parenchymal vascularity.
- I US features: decreased or increased parenchymal echogenicity, coarse parenchymal echotexture, increased AP diameter (>2 cm), lobulated glandular margin, and increased parenchymal vascularity

- Gray-scale US can provide the volume of the thyroid gland and indicate features of DTD. The thyroid gland volume can be obtained from maximum measures in the longitudinal (L), AP, and transverse (T) axes of both lobes and the isthmus
- In addition, unusual focal lesions found in patients with DTD need to be evaluated according to their features on B-mode and Doppler US and an investigation by fine-needle aspiration (FNA) biopsy may be indicated because papillary thyroid carcinoma and primary thyroid lymphoma are more likely in patients with HT than in the general population

Thyroiditis

infiltration of the thyroid gland with inflammatory cells :

group of autoimmune, inflammatory and infectious processes.

may be acute and self-limiting or chronic and progressive.

Thyroiditis

- chronic autoimmune lymphocytic (Hashimoto's) thyroiditis,
- colloid or adenomatous goiter
- Graves' disease

Role of sonography in diagnosis

- Diagnosis of these conditions is usually made on the basis of clinical and laboratory findings and occasionally by fine-needle aspiration cytology (FNAC).
- Sonography is seldom required and when performed it is the
- thickness of the isthmus which facilitates the recognition of diffuse thyroid enlargement.

Goiter

Goiter (rarely **thyromegaly**) refers to enlargement of the thyroid gland.

It can occur from multiple conditions.

the upper limits of normal for thyroid gland volume :

adult males: 25 mL

adult females: 18 mL

13-14 years: 8-10 mL

3-4 years: 3 mL

neonate: 0.8-1.5 m

Diffuse Nontoxic Goiter

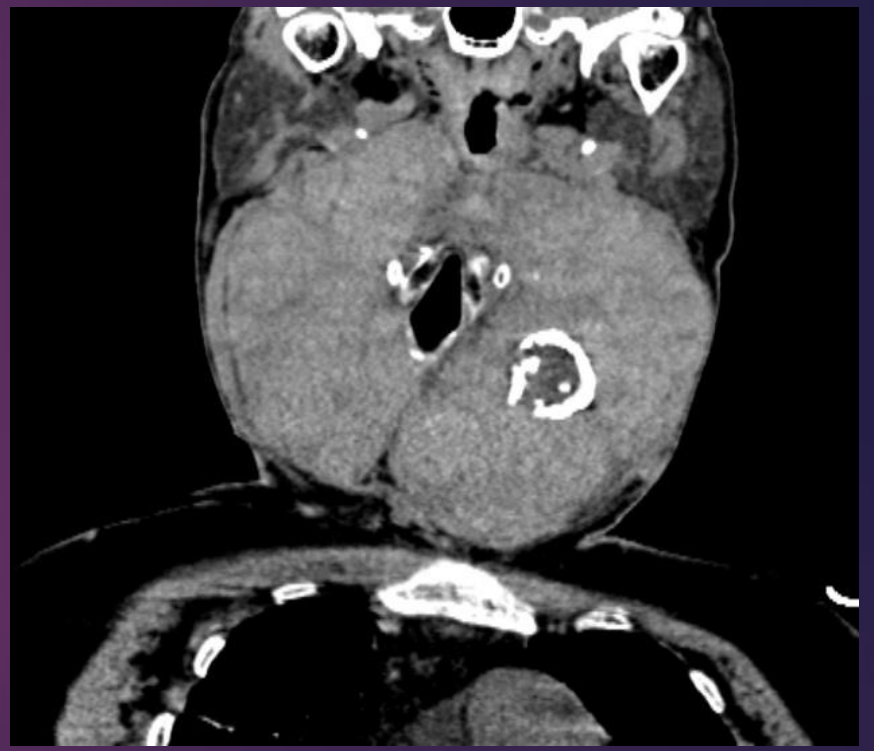
- non-nodular enlargement of the thyroid associated with a euthyroid state.
- two stages :
- The first stage is hyperplasia characterized by diffuse glandular enlargement and hyperemia.
- The second stage is colloid involution, which occurs when a euthyroid state is maintained.
- Over time, most simple goiters progress to MNGs, which may remain nontoxic or may induce thyrotoxicosis

Imaging Features
simple goiter

- On ultrasonography,
- simple goiter : diffuse glandular enlargement with uniform or irregular echogenicity (increased or decreased).

Imaging Features Multinodular goiter

- Multinodular goiter is characterized by nodularity, focal
- hemorrhage, focal calcifications, cyst formation and scarring.
- Glandular enlargement may be asymmetric, involving one
- lobe more than the other, with or without involving the
- isthmus.
- Thyroid goiters may extend substernally and into the
- anterior mediastinum



Although the appearance of diffuse parenchymal

inhomogeneity and micronodularity is typical of Hashimoto's

thyroiditis, other diffuse thyroid diseases, mostf requently **multinodular** or **adenomatous goiter,** may have a similar sonographic appearance.

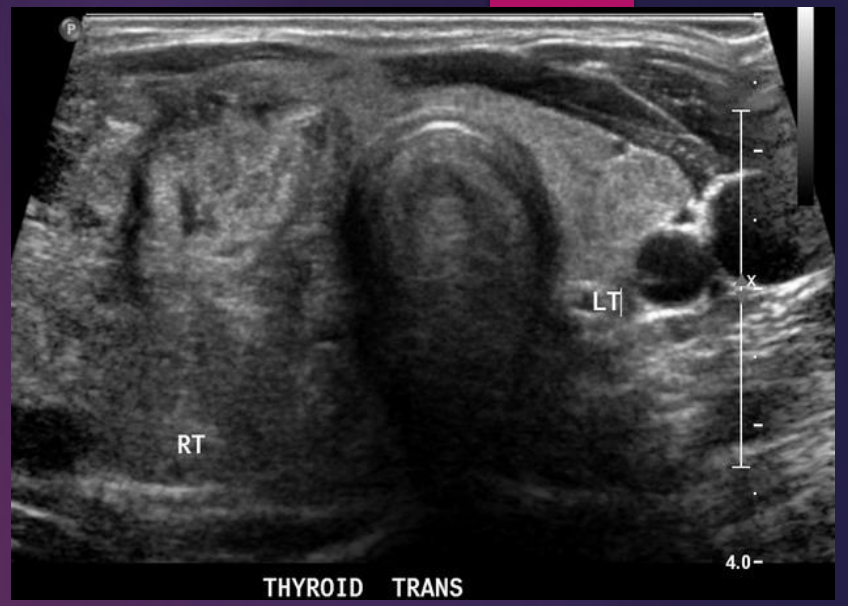
Most patients with adenomatous goiter have multiple discrete nodules

separated by otherwise normal-appearing thyroid parenchyma, others have enlargement with rounding of the poles of the gland, diffuse parenchymal inhomogeneity, and no recognizable normal tissue.

Adenomatous goiter affects women three times more often

than men

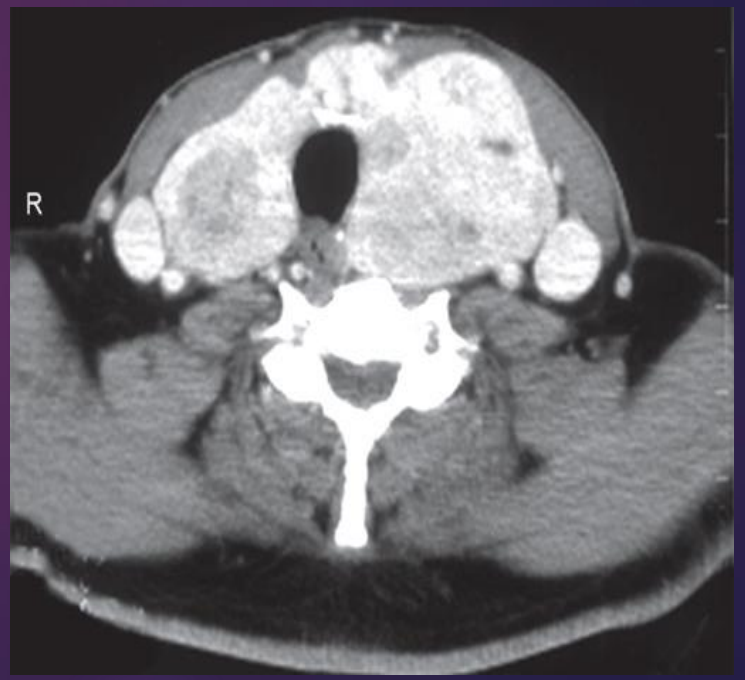
Imaging Features
Multinodular goiter



MNG on sono : irregular, diffuse inhomogeneous echogenicity or multiple focal hypoechoic nodules in a relatively normal thyroid gland

On CT, the gland is asymmetric in MNG with multiple low-density areas that reflect regions of hemorrhage, cyst formation, or necrosis. More focal regions of hyperdensity are common, reflecting calcifications, hemorrhage, or colloid

On MRI, MNG On T1-weighted images, multiple foci of high signal intensity may represent cysts containing colloid or hemorrhage. On T2-weighted images, diffuse heterogeneity is present

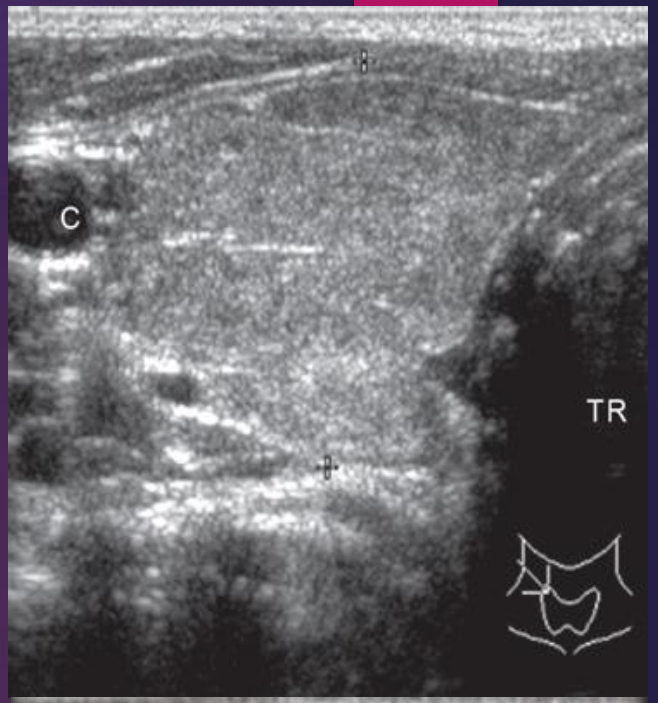


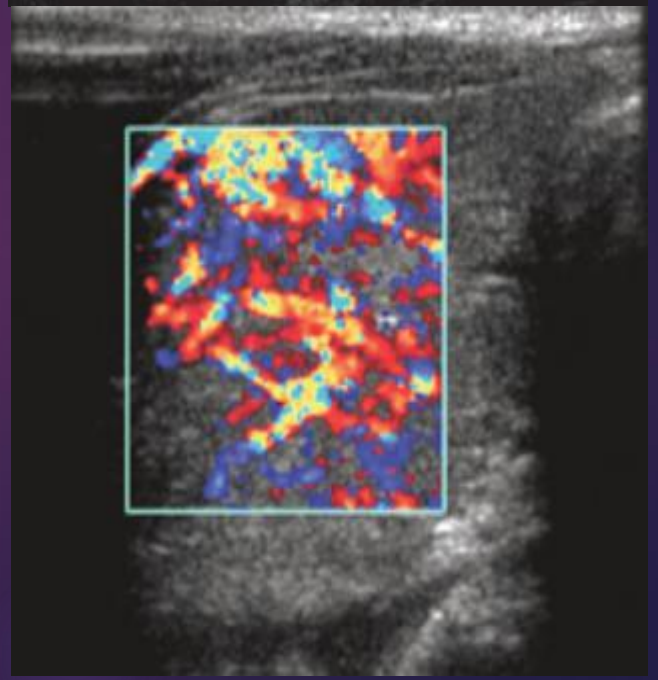
Graves' Disease (Diffuse Toxic Goiter)

- common ,biochemically by hyperfunction (thyrotoxicosis).
- It is the most common of the autoimmune disorders, female ,third to fourth decades.

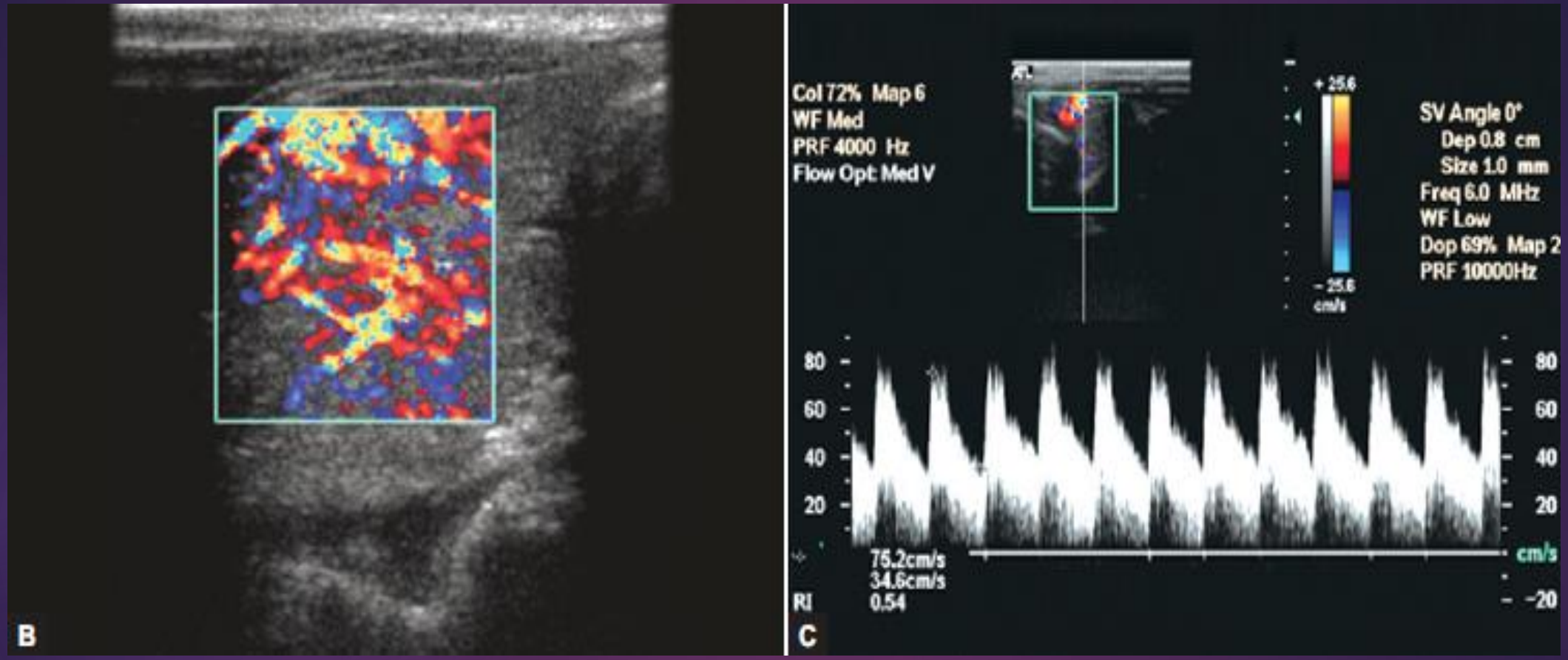
Imaging Features

On ultrasound, the echotexture is inhomogeneous and
the parenchyma may be diffusely hypoechoic because of
extensive lymphocytic infiltration
Color Doppler sonography often demonstrates a
hypervascular pattern ("thyroid inferno"),
indicating an acute stage of the process.
Spectral Doppler :PSV to exceed 70 cm/sec
which is the highest velocity found in thyroid disease.



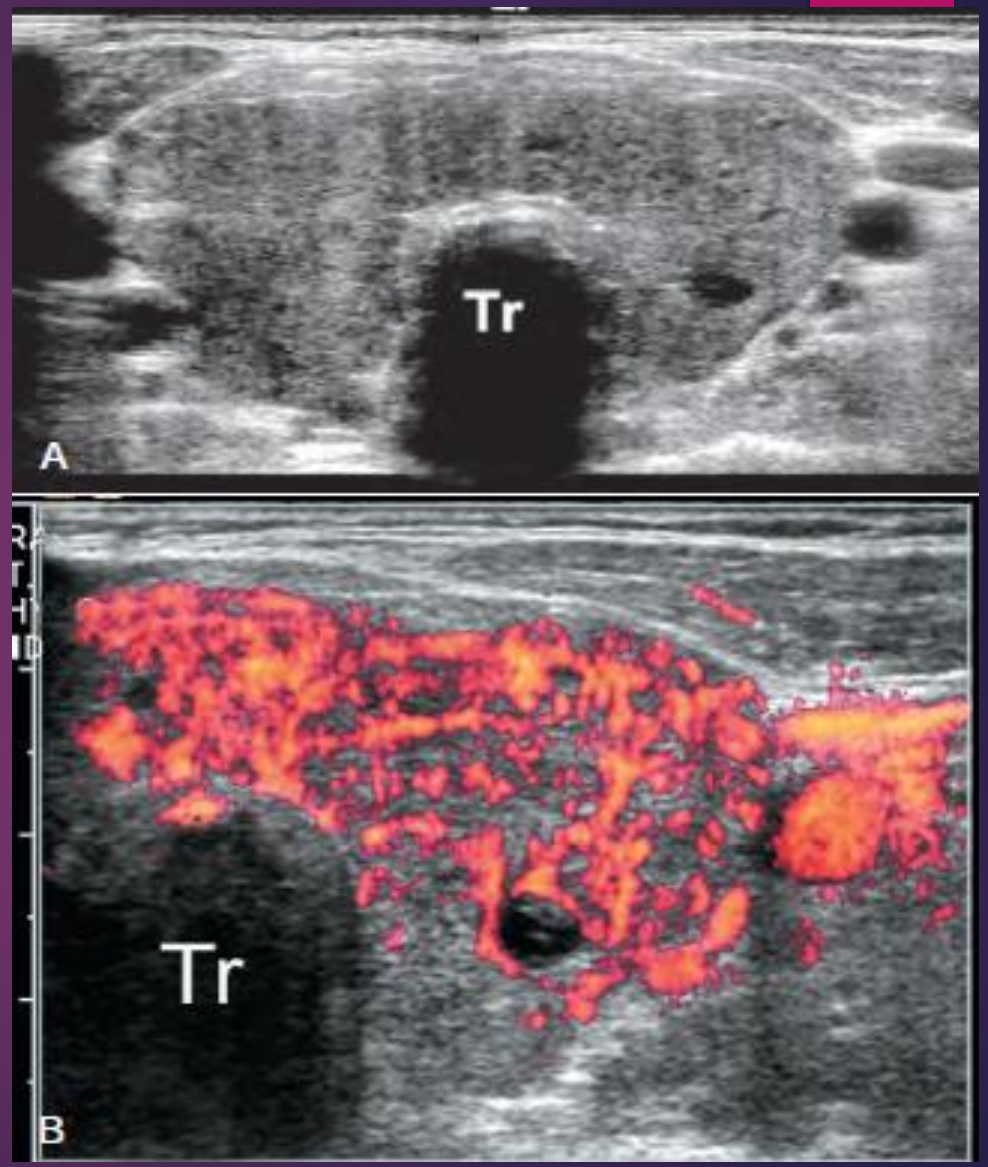


Graves disease



significantly increased intraglandular vascularity in a patient of Graves' disease: Thyroid inferno.
(C) Spectral Doppler of the same showing markedly increased peak systolic velocity (75 cm/sec)

Graves’ disease.



Marked diffuse enlargement of both thyroid lobes and the isthmus. The gland is diffusely hypoechoic. **B,** Transverse color Doppler image of the left lobe shows increased vascularity, indicating an acute stage of the Graves’ disease

Differential diagnosis of GD from destructive thyroiditis in thyrotoxicosis

- Doppler US is useful for the differential diagnosis of GD from destructive thyroiditis, which causes thyrotoxicosis in its early stage. Destructive thyroiditis includes HT, subacute granulomatous thyroiditis, postpartum thyroiditis, and painless (silent) thyroiditis.
- Before treatment or effective therapy, GD shows a diffuse increase in vascularization of the parenchyma, referred to as thyroid inferno.
- Thyroid hypervascularization can also occur in HT, but to a lesser degree .

The vascularity of the thyroid parenchyma can be determined using a visual scale according to the classification created by Schulz et a

pattern 0, blood flow limited to the peripheral thyroid arteries while parenchymal flow is absent;

pattern I, presence of mildly increased parenchymal flow;

pattern II, clearly increased color flow with a diffuse homogenous distribution;

and pattern III, markedly increased color flow with a homogenous distribution.

- PSV measurements of the thyroid artery have become accurate and reliable with excellent reproducibility .
- (superior or inferior thyroid arteries)
- The cutoff value for differentiating GD from thyroiditis is 40-50 cm/sec

Evaluation of disease remission, recurrence, and response to treatment in DTD

- In patients with GD, thyroid gland vascularization correlates with the underlying functional status, and this vascularization decreases when the disease is under control, but it can increase in cases of recurrence. Many authors have reported that a decrease in vascularity occurs in parallel with biochemical remission and disease control in GD and suggested that thyroid Doppler US has the potential to monitor the therapeutic response in patients with GD .
- In addition, patients who responded to treatment with drugs or radioiodine presented a significant reduction in parenchymal vascularity and the PSV of the inferior thyroidal artery.

Chronic Autoimmune Lymphocytic (Hashimoto's) Thyroiditis

Hashimoto's thyroiditis is the most common type of thyroiditis ▶
patient develops antibodies to their own thyroglobulin. ▶
its diagnosis is based on serology. ▶
painless, diffuse enlargement of the gland in young or middle ▶
aged women and is often associated with hypothyroidism. ▶
It may also be seen in children in whom it is the most common ▶
thyroiditis. ▶

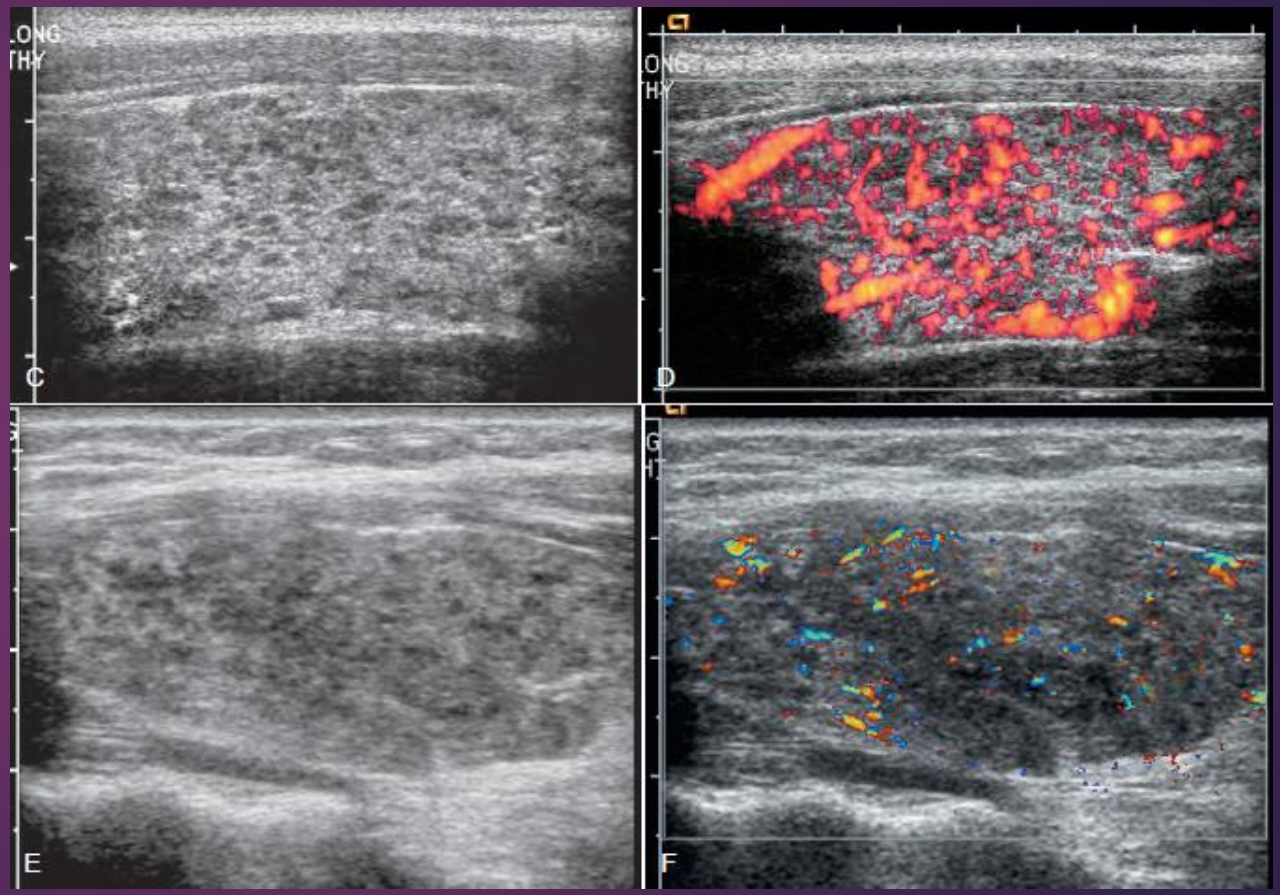
Imaging Features

- Ultrasonography : variety of patterns
- The thyroid may be normal or more often enlarged in size and is diffusely abnormal with coarse heterogeneous echogenicity of the parenchyma, generally more hypoechoic.
- **Micronodulation :** Multiple, discrete hypoechoic micronodules from 1 to 6 mm strongly suggestive and highly sensitive sign of chronic thyroiditis.
- (lobules of thyroid parenchyma which have been infiltrated by lymphocytes and plasma cell, are surrounded by multiple linear echogenic fibrous septations.

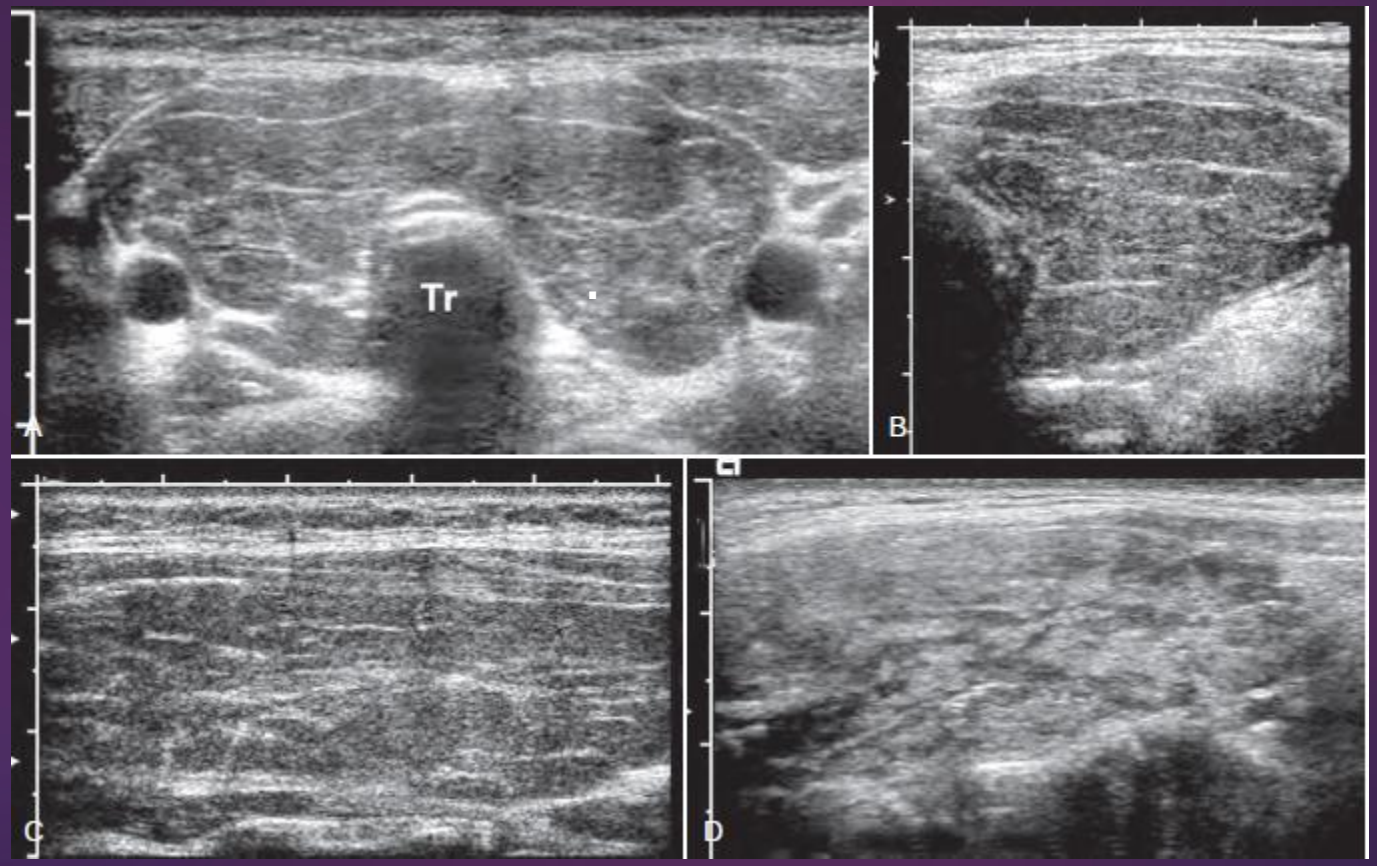
Micronodulation

multiple tiny hypoechoic nodules and increased flow on power Doppler. This increased flow may indicate an acute phase of the thyroiditis.

multiple tiny hypoechoic nodules and decreased flow
on color Doppler scan. The blood flow is normal or diminished in most cases of Hashimoto’s thyroiditis.



coarse septations

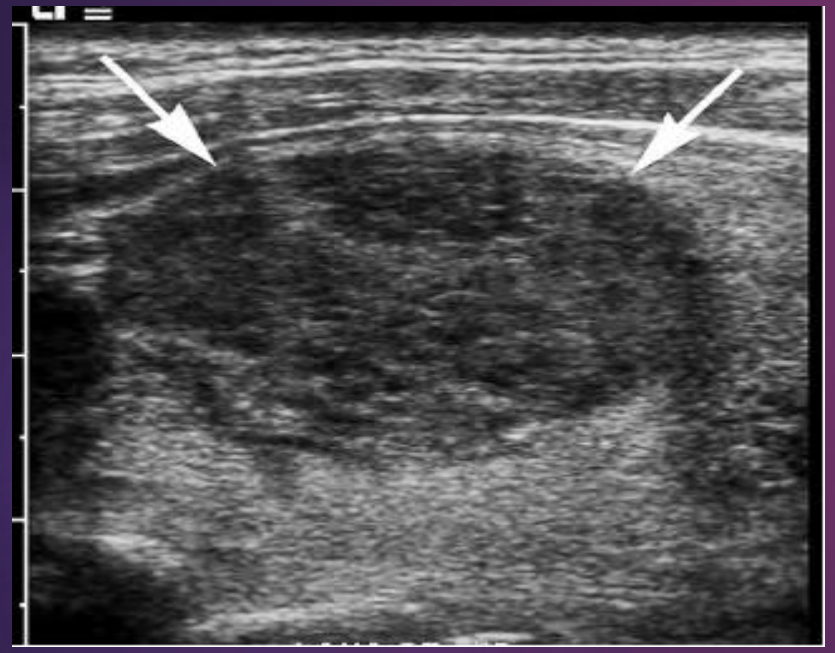


Doppler in HT

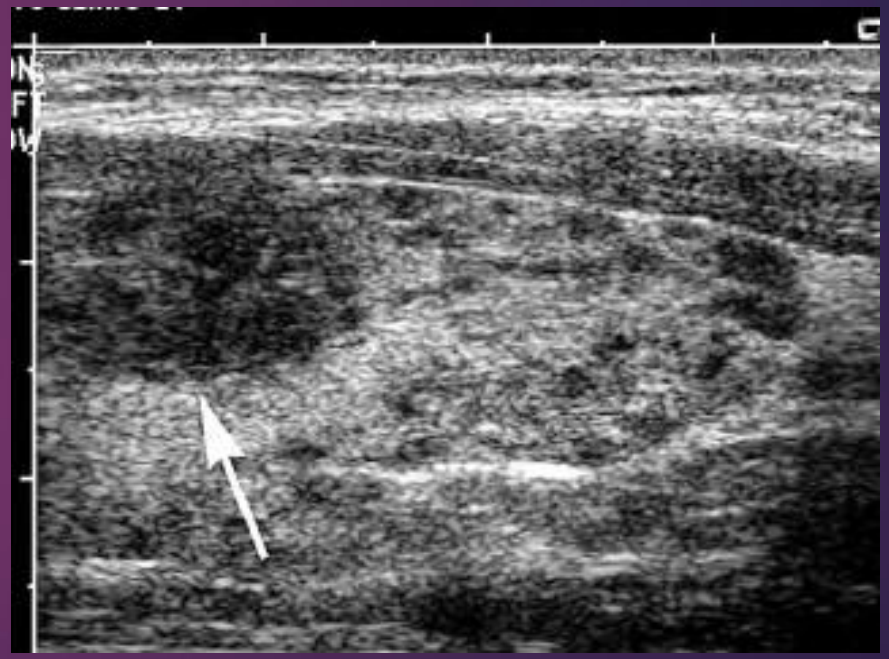
- In the early stages of disease, HT shows diffuse hypervascularization, which can be similar to the thyroid inferno described for GD, but in a less intense form and with a lower PSV in the thyroid arteries (<40 cm/sec) .
- In the latter stages of HT, thyroid vascularity can decrease because of extensive fibrosis. However, the PSV values were significantly higher in HT patients with hypothyroidism than in their euthyroid counterparts , and the thyroid blood flow did not correlate with the functional state of the gland in HT .
- Unlike GD or HT, subacute granulomatous thyroiditis shows decreased or scant vascularity in the acute stage and slightly increased vascularity in the recovery stage

Nodule in **Hashimoto's thyroiditis**

A dominant nodule in Hashimoto's thyroiditis should be considered "indeterminate" needs FNA



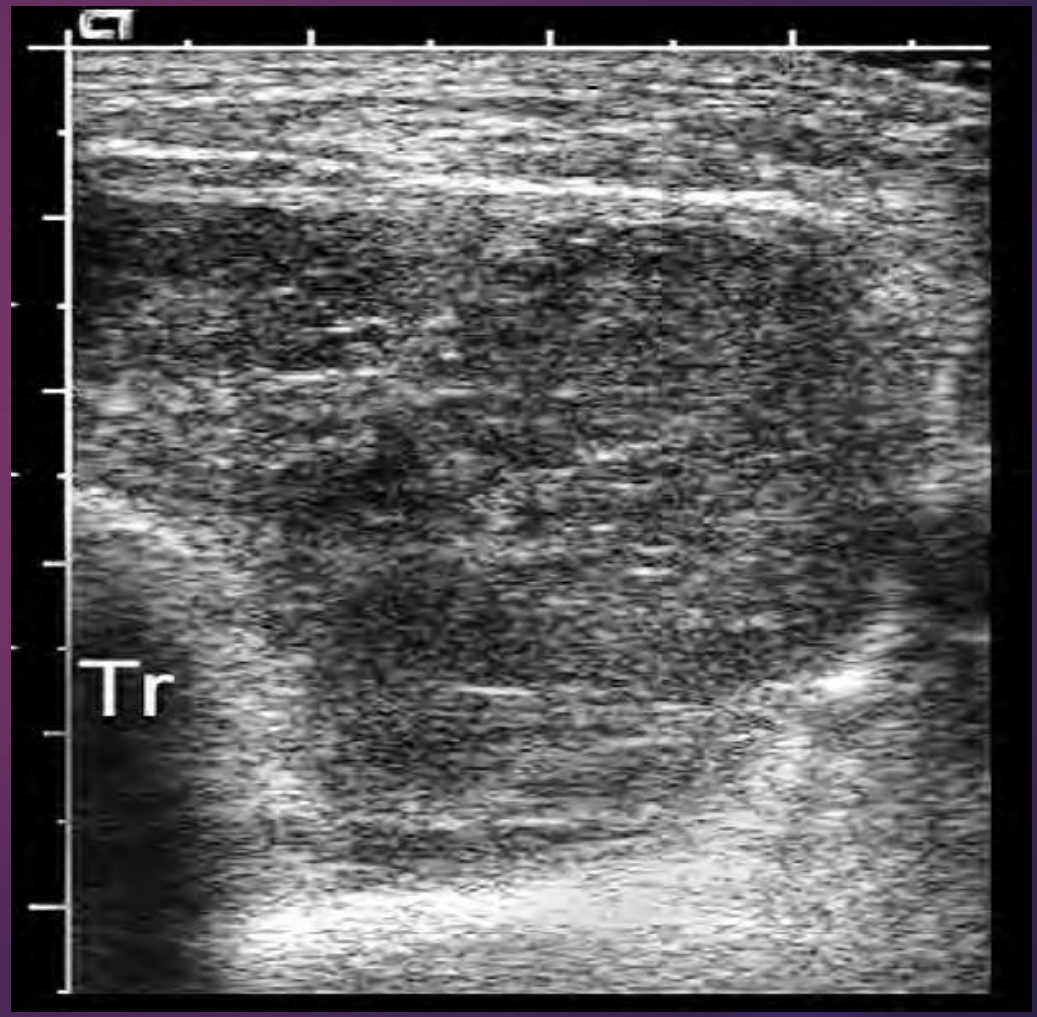
Hashimoto's thyroiditis



papillary thyroid cancer

Lymphoma in Hashimoto’s thyroiditis

diffuse hypoechoic enlargement caused by lymphoma



CT shows an inhomogeneous distribution of iodine.

on MRI T2-weighted images may show areas of increased signal intensity.

Following contrast administration, there may be regions which enhance more than the remainder of the gland.

Scintigraphy does not show any typical pattern in Hashimoto's thyroiditis. The uptake of radioiodine or 99mTc pertechnetate is most commonly heterogeneous and patchy and may be uniformly increased or mildly to severely decreased

Ultrasound may be used to follow patients with

Hashimoto's thyroiditis to detect occult malignancy.

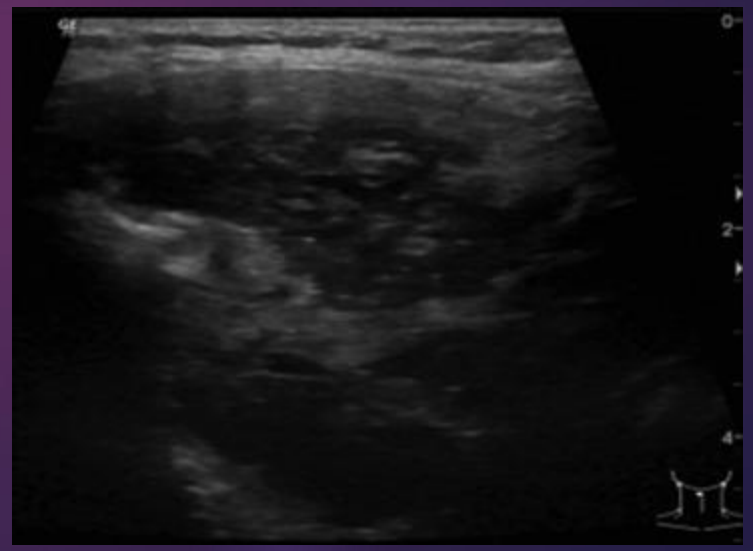
increased risk of malignancy of which a non-Hodgkin's

lymphoma is the most common to occur.

Thyroid lymphoma : solitary or multiple focal hypoechoic lesions

or diffuse disease .A cervical lymphadenopathy raises

the suspicion of lymphoma.



- The end stage of chronic thyroiditis is atrophy when the thyroid gland is small with ill-defined margins and
- heterogeneous echotexture due to progressive increase of fibrosis

Silent Painless Thyroiditis and Postpartum Thyroiditis

- These are two different types of subacute lymphocytic
- thyroiditis which are usually self-limiting: painless thyroiditis and Postpartum thyroiditis
- Patients may present with goiter, thyrotoxicosis and antithyroid antibodies.
- When the inflammatory process occurs in the absence of pregnancy, it is termed painless thyroiditis.
- Postpartum thyroiditis typically occurs 4–6 weeks following delivery in up to 5% of postpartum women and may recur with subsequent
- pregnancy.
- It usually resolves after transient hypothyroidism, though some patients may progress to chronic lymphocytic thyroiditis.

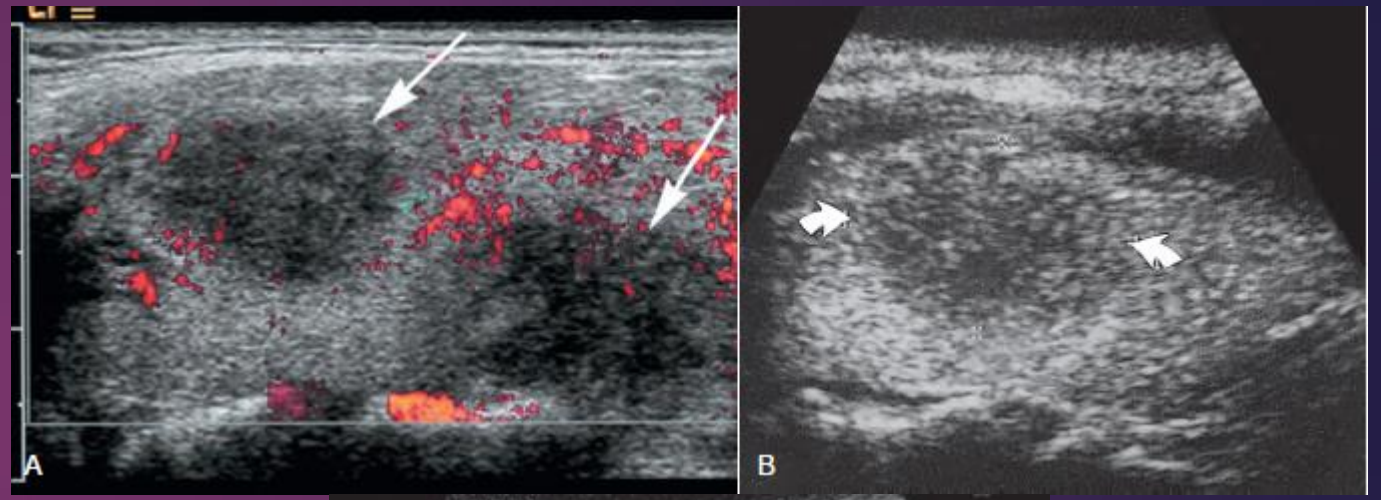
Painless (silent) thyroiditis

- has the typical histologic and sonographic pattern of chronic autoimmune thyroiditis : hypoechogenicity, micronodulation, and fibrosis,
- but clinical findings resemble classic subacute thyroiditis, with the exception of node tenderness.
- Moderate hyperthyroidism with thyroid enlargement usually occurs in the early phase, in some cases followed by hypothyroidism of variable degree.
- In most cases the disease spontaneously remits within 3 to 6 months, and the gland may return to a normal appearance.

- Postpartum thyroiditis typically occurs 4–6 weeks following delivery in up to 5% of postpartum women and may recur with subsequent pregnancy.
- In most cases the disease spontaneously remits within 3 to 6 months, and the gland may return to a normal appearance.
- In postpartum thyroiditis the progression to hypothyroidism is more common.

Acute Suppurative Thyroiditis

- It is a rare inflammatory disease
- usually caused by bacterial infection
- usually affects children, immunocompromised or debilitated patients.
- The infection usually develops in the perithyroidal soft tissues.
- With disease progression, focal abscesses may develop and there may be obliteration of the adjacent soft tissues in the neck resulting
- from associated myositis and cellulitis



abscess

Imaging Features

On ultrasound: an ill-defined, hypoechoic, heterogeneous mass with internal debris with or without septa or gas. Adjacent inflammatory nodes

. On cross-sectional imaging, the affected portion of

the gland will be enlarged and heterogeneous in CT density

and MRI signal intensity.

Subacute Granulomatous Thyroiditis (de Quervain's Disease

spontaneously remitting inflammatory disease.

usually occurs following a viral upper respiratory tract infection.

The peak incidence : second to fifth decades

Imaging Features

Sonographically the gland may appear enlarged and hypoechoic, with normal or decreased vascularity.

On noncontrast CT the gland is slightly enlarged with a lower than normal attenuation.

Scintigraphy shows a low radioactive iodine uptake that usually reverts to normal as the patient returns to a euthyroid state

Invasive Fibrous Thyroiditis (Riedel's Struma)

- rarest type of inflammatory thyroid disease , characterized by a fibrosing reaction which destroys the thyroid and extends into the adjacent soft tissues of the neck.
- The cause of Riedel's thyroiditis is unknown.
- more common in women, the fourth to seventh decades of life.
- Some cases may be associated with mediastinal or retroperitoneal fibrosis as well as sclerosing cholangitis.

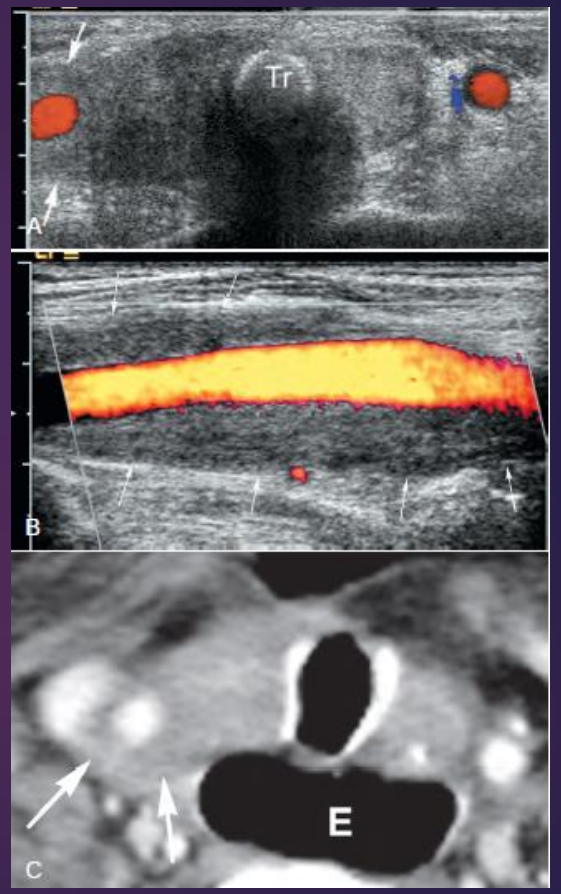
Riedel's Struma,imaging features

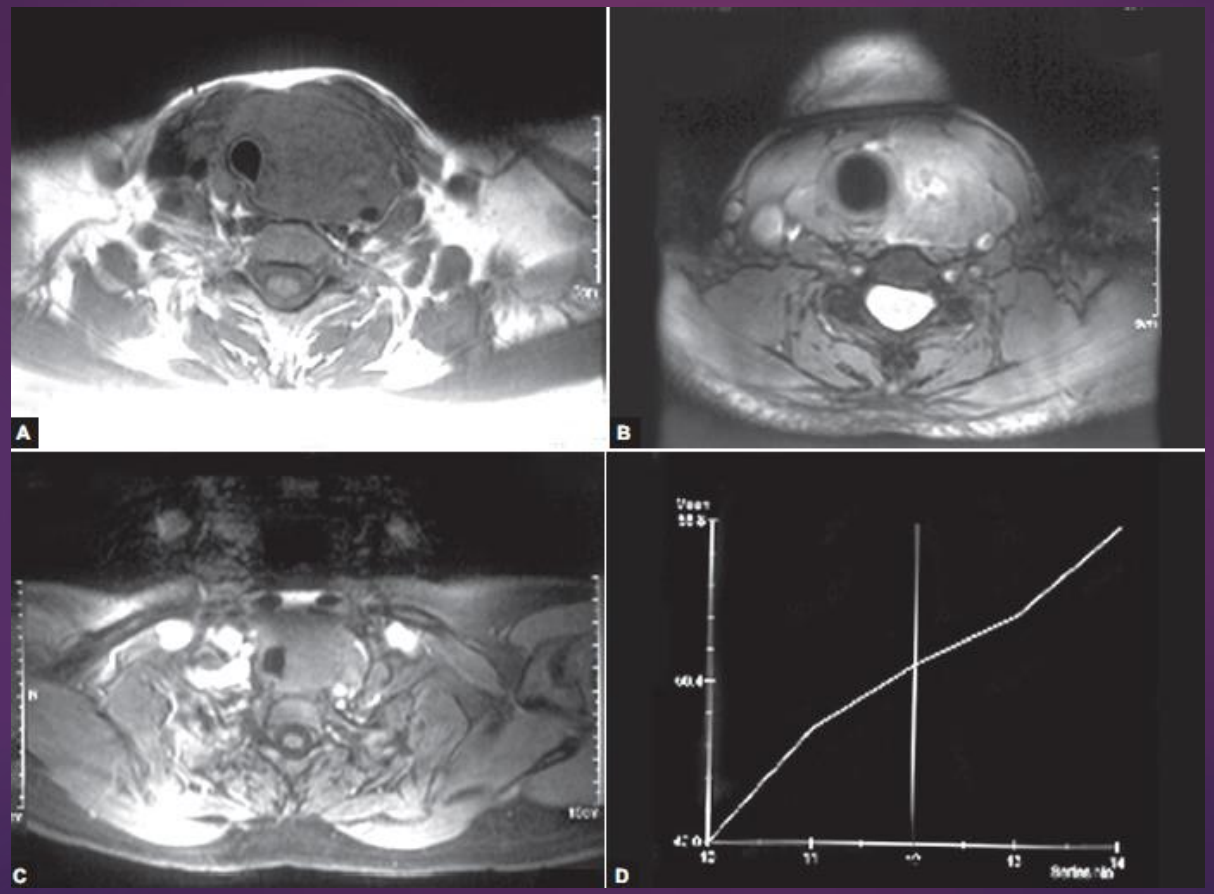
Ultrasonographic appearance of Riedel's thyroiditis may mimic anaplastic thyroid carcinoma when there is extrathyroid extension of the inflammatory process with encasement of adjacent vessels.

an open biopsy may be required to distinguish the two conditions. On ultrasound the thyroid may be hypoechoic and on CT the involved thyroid may be hypodense compared to the normal thyroid.

The characteristic MRI appearance includes decreased signal intensity on T1-weighted and T2-weighted images, believed to correspond to fibrosis, as well as infiltration of adjacent soft tissues in the neck.

It is distinguished from Hashimoto's thyroiditis which shows increased intensity on T2-weighted MR images.

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- Axial T1-weighted images sequence shows an iso- to mildly hypointense nodule in the left lobe and isthmus which is iso- to
- mildly hyperintense on T2-weighted sequence; (B) It is causing tracheal attenuation and displacement to the right with compression of the left
- CCA and IJV; (C) The lesion is showing mild homogeneous contrast enhancement; (D) The time signal intensity curve reveals a slow persistently
- rising curve suggestive of a benign etiology. FNAC: Riedel's thyroiditis

MISCELLANEOUS THYROID CONDITIONS

Other inflammatory but rare thyroid conditions include tuberculosis, sarcoidosis, fungal diseases, and opportunistic organisms, especially in patients with acquired immunodeficiency syndrome (AIDS).

Radiation received from external beam or radioactive iodine therapy may lead to fibrosis and atrophy of the thyroid gland.

MISCELLANEOUS THYROID CONDITIONS

- Amyloidosis and hemochromatosis may replace thyroid parenchyma and may cause decreased signal intensity on T2-weighted MR images.