

Ultrasound Evaluation of Thyroiditis: A Review

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ABSTRACT

Thyroiditis encompass a broad group of inflammatory disorders of the thyroid, with varied causes, clinical manifestations, natural history and specific treatment. It can be associated with normal, elevated, or depressed thyroid function, often with evolution from one condition to another. The differentiation is based primarily on the clinical setting, speed of symptom onset, family history, and presence or absence of prodromal symptoms and neck pain. As in most thyroid pathologies, ultrasound is the imaging modality of choice with further imaging workup rarely need. B-mode and color duplex-Doppler ultrasonography became a simple, non-invasive, reproducible and highly sensitive method for the diagnosis of thyroiditis. In B-mode, echogenicity is a parameter of extreme importance and can be observed in postpartum thyroiditis, subacute and autoimmune thyroiditis, as well as in Graves disease. Nevertheless, such disorders can be easily differentiated both by clinical-laboratory and color Doppler ultrasound. In this article we present the many kinds of thyroiditis and their respective ultrasound and Doppler ultrasound findings.

INTRODUCTION

Thyroiditis is defined as the inflammation of the thyroid gland and can be classified as either acute/subacute or autoimmune thyroiditis. The autoimmune diseases of the thyroid gland represent a spectrum of various disorders that have in common the presence of lymphocytic infiltrate of variable intensity in the thyroid parenchyma and production of antithyroid antibodies [1]. Among these disorders, chronic autoimmune lymphocytic thyroiditis stands out as the most common cause of hypothyroidism [2] and one of the most frequent organ-specific autoimmune diseases affecting humans [1]. Chronic autoimmune thyroiditis tends to manifest itself after 50 years of age. It affects 5% to 15% of women and 1% to 5% of men, according to diagnostic criteria and geographic location [3], being up to nine times more frequent in women.

US have been evolving very rapidly in recent years and is assuming an increasingly important role in the diagnosis of thyroid disease. Several parameters evaluated by the US contribute to the diagnosis thyroiditis, from B-mode evaluation (glandular volume, texture and echogenicity of the thyroid parenchyma) to color Doppler [4-7].

Table 1 summarizes the main clinical and ultrasonography findings in the different types of thyroiditis.

The analysis of the echogenicity of the thyroid parenchyma is performed subjectively by comparing it to the echogenicity of the pre-thyroid muscles and submandibular gland, classifying it as isoecogenic, hyperechogenic and hypoechogenic in relation to such structures. Typically, the normal thyroid gland exhibits

greater echogenicity than that of the prethyroid muscles and is slightly higher than that of the submandibular glands. The hypoechoic thyroid parenchyma is considered when its echo levels are similar or lower than in the submandibular glands, but higher than muscles (= slightly hypoechoic), or approach those of the pre-thyroid muscles (hypoechoic) (Figure 1).

Table 1: Main clinical and ultrasonographic findings in the different types of thyroiditis.

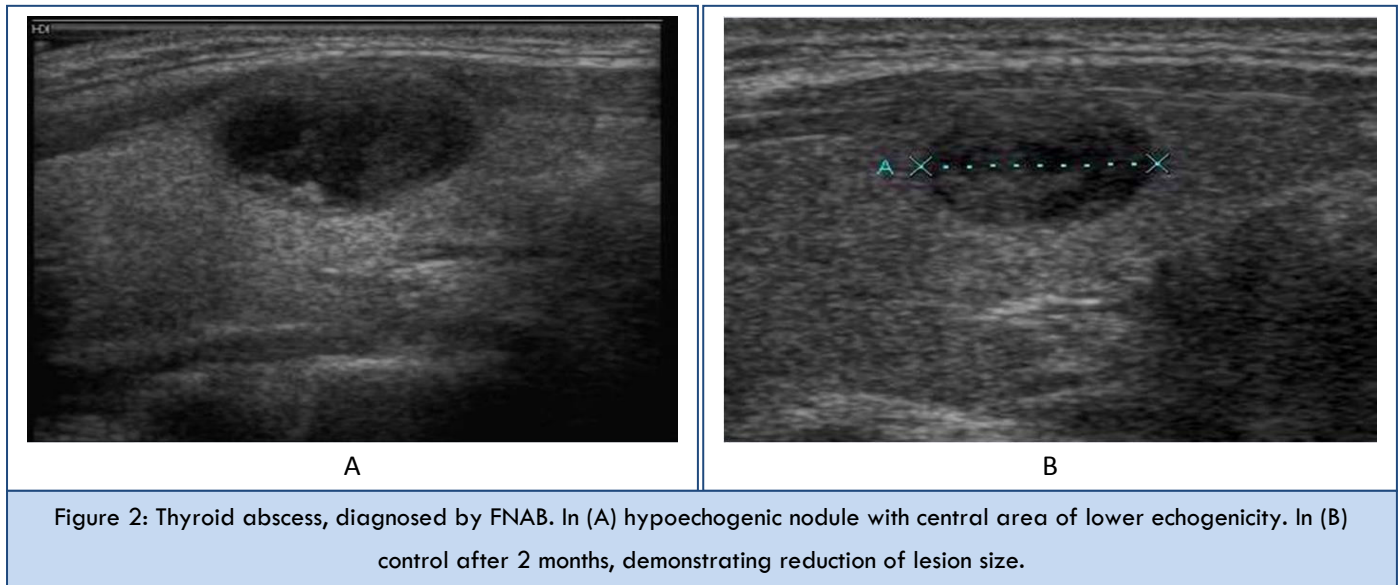
	Clinical findings	Thyroid function	Nodules/pseudonodules	Doppler ultrasound findings
Acute Suppurative	Fever and cervical pain.	Usually euthyroidism.	Abscess	Focal areas of low vascularization
Subacute granulomatous thyroiditis	Cervical pain, may be preceded by infection.	Hyperthyroidism or hypothyroidism.	Pseudonodules	Acute phase can present with diffuse hypervascularization. Subacute phase can present with diffuse hypovascularization.
Postpartum thyroiditis / painless sporadic thyroiditis	Painless and normal size gland	Hyperthyroidism or hypothyroidism. Can transition from hyperthyroidism to hypothyroidism	Usually no nodules	Acute phase can present with diffuse hypervascularization. Subacute phase can present with diffuse hypovascularization.
Hashimoto's thyroiditis / autoimmune thyroiditis	Painless goiter Gland dimension: normal, increased and atrophic gland	Hypothyroidism	True nodules and pseudonodules	Acute phase can present with diffuse hypervascularization. Subacute phase can present with diffuse hypovascularization or normal vascular pattern. Chronic phase can present reduced vascularization
Riedel's fibrosing thyroiditis	Hard painless goiter Feeling of suffocation	Usually euthyroidism.	None	Hypovascularization
Tuberculous thyroiditis	Fever and skin fistula.	Usually euthyroidism.	Abscess	Focal areas of low vascularization heterogeneous pattern



Figure 1: Autoimmune thyroiditis. Enlarged thyroid, presenting hypoechogenic areas with hyperechogenic lines of permeation, consistent with fibrosis.

Acute suppurative thyroiditis: Suppurative acute thyroiditis is a rare condition, which affects mainly children and young adults⁸, representing less than 1% of all thyroid disease [8]. It is usually caused by bacterial infections but can in some cases be related to other etiologies such as fungus, mycobacteria or even parasites. Patients usually present with fever, anterior neck pain, hoarseness, dysphagia and dysphonia and anterior neck swelling.

Ultrasound findings are usually in the left side upper pole (which can be related to pyriform sinus), and present as ill-defined hypoechoic areas of low vascularization, which can progress to intrathyroidal abscess [9]. In more severe cases the infection can extend either to more superficial planes or to the deep spaces of the neck. Infective and/or reactive adjacent lymph nodes may also be seen (Figure 2).



Subacute granulomatous thyroiditis (de Quervain): Subacute granulomatous thyroiditis, also known as de Quervain thyroiditis is a self-limited condition, of unknown etiology but usually preceded by upper airway viral infection [10]. It is the most common cause of thyroid pain and patients usually present with fever, partial or whole thyroid gland enlargement and neck pain.

Ultrasound findings in the acute phase include irregular and ill-defined hypoechoic areas, predominantly in the subcapsular region (Figure 3). Hyperthyroidism symptoms are frequent in this acute phase, attributable to follicular rupture. In the subacute phase findings progress to a more diffuse pattern, with pseudonodular formation usually more evident in the central area of the gland. Hypothyroidism symptoms are seen in this subacute phase, which tend to slowly regress.

Glandular edema is a characteristic of subacute granulomatous thyroiditis and can be related to diffuse reduction in vascular

mapping by Doppler ultrasound [11]. This type of thyroiditis tends to heal over time.

Postpartum thyroiditis: Postpartum thyroiditis usually occurs in the first year after delivery and can be present in up to 7% of woman [12,13] and has a strong association with presence of positive antithyroid antibodies, even before gestation, and lymphocytic infiltrate, suggesting an autoimmune etiology [14].

Postpartum thyroiditis is considered a painless subacute thyroiditis. Up to a third of the patients will present with the triphasic hormone pattern, with thyrotoxicosis in the first 6 months after delivery, followed by a hypothyroid phase which can last up to six months and the last phase which is the recovery phase. Most patients recover normal thyroid function within a year, but these patients have a higher risk of developing hypothyroidism afterwards.

Ultrasound findings include a diffusely hypoechoic gland or multiple hypoechoic foci in the thyroid parenchyma [15].

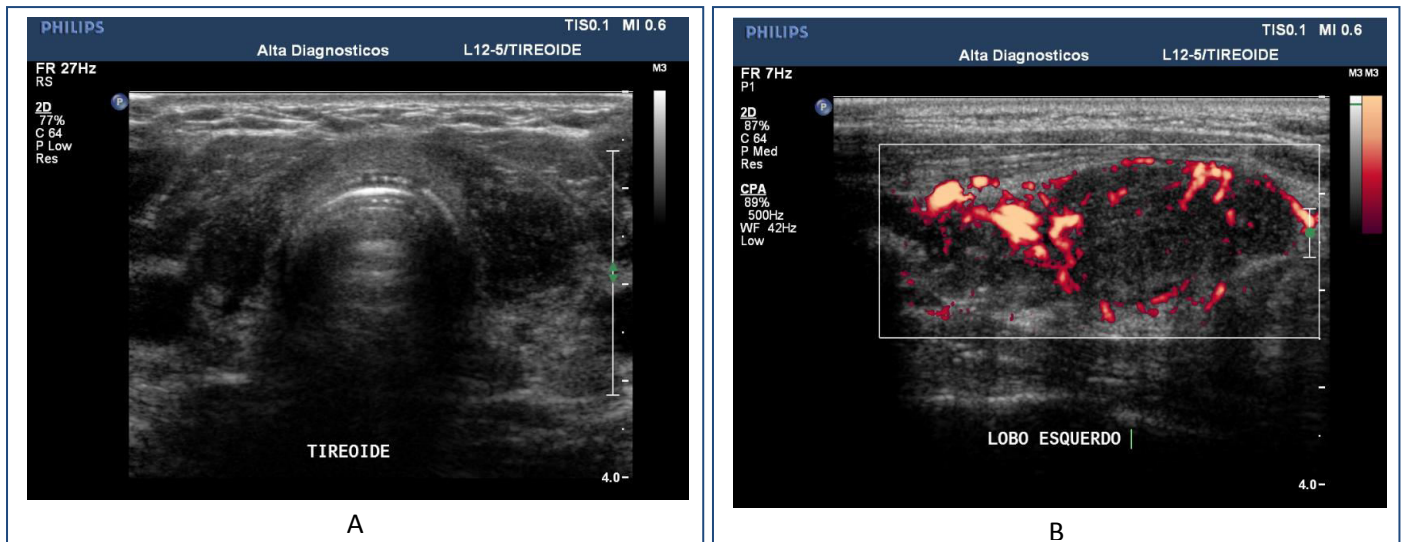


Figure 3: Subacute thyroiditis or De Quervain. In(A) thyroid gland of normal dimensions, globular morphology, presenting hypoechoic area at the periphery of the gland, compatible with the initial process of the disease. In (B) hypoechoic area in the subcapsular region with diagnosis of de Quervain confirmed by FNAB.

Painless sporadic thyroiditis (Silent thyroiditis): Painless sporadic thyroiditis, also known as silent thyroiditis is another type of subacute thyroiditis, which is very similar to postpartum thyroiditis, despite not having relation with pregnancy [16]. Ultrasound findings are also very similar to postpartum thyroiditis with diffusely hypoechoic gland multiple hypoechoic foci in the thyroid parenchyma.

Hashimoto's thyroiditis or Chronic lymphocytic/autoimmune thyroiditis: Dr. Hakaru Hashimoto first described what is nowadays known as Hashimoto's thyroiditis in 1912 [17]. In his publication he reports the findings in thyroid gland specimens excised from four woman who presented with an odd type of goiter, with the peculiar clinical and histologic findings which combined a non-specific or even hypothyroidism symptoms with a diffuse and massive lymphatic elements overgrowth in the gland. His publication was the stepping stone for understating the most common thyroid disease and Hashimoto's thyroiditis or Hashimoto's disease is in many cases used interchangeably with the term chronic lymphocytic / autoimmune thyroiditis.

Hashimoto's thyroiditis is the most common cause of thyroiditis. It has a strong female predilection (9:1), occurring in all ages but most commonly between the age of 30 and 50 and is associated with other autoimmune diseases, such as lupus, Graves' disease or pernicious anemia³. One of the

characteristics of Hashimoto's thyroiditis is the presence of serum thyroid antibodies in high concentration [18].

The disease can be divided into two forms: nodular focal form and diffuse form. Nodular focal form [19] presents as a hypoechoic thyroid nodule, with ill-defined borders and usually small in size, which makes it very hard to differentiate from a malignant thyroid nodule and can even in some cases lead to fine needle aspiration biopsy. Doppler ultrasound is non-specific as these nodules can present with a varied pattern of blood flow (Figure 4).

The diffuse form can initially present as an enlarged thyroid gland, with ultrasound imaging identifying multiple small hypoechoic nodules [20], due to focal lymphocyte surrounded by more normal areas of thyroid parenchyma and fibrosis, in a similar fashion as the subacute thyroiditis. This pattern resembles a giraffe hide pattern (Figure 5) [21]. The gland appearance progresses into that of a chronic hypertrophic thyroiditis, which is diffusely enlarged, pseudo lobulated hypoechoic and with multiple hypoechoic pseudo nodules separated by fibrotic bands. In some cases, the gland can further progress to the atrophic form, in which the gland becomes small, with ill-defined contours and diffusely heterogeneous parenchyma. In many cases there can be reactionary cervical lymph node enlargement, which sometimes present with a more rounded aspect.

Another pattern observed in Hashimoto's thyroiditis includes a uniformly hyperechoic ("white knight") appearance that can be interspersed with hypoechogenic areas of lymphocytic infiltrate (Figure 6). It is noteworthy that these areas do not present peculiar vascularization to duplex-Doppler study. Peripheral vessels may be observed, however, due to the increased vascularization of the adjacent parenchyma observed in chronic thyroiditis. These pseudo nodular areas should not be confounded with true nodules observed in multinodular goiters [22].

In the early stages doppler ultrasound usually shows diffuse hypervascularization, which can be similar to the "thyroid inferno" described in Graves' disease albeit in a less intense form and with lower systolic velocity peak in the thyroid arteries. In the latter stages of Hashimoto's thyroiditis Doppler ultrasound findings are usually of diffusely hypovascularization and sometimes even with no detectable blood flow (Figure 7). In chronic thyroiditis the systolic peak velocities in the lower thyroid artery are usually less than 40cm/s [17].

In the latter chronic phase of Hashimoto's thyroiditis ultrasound findings include a small and ill-defined gland, with diffusely heterogeneous parenchyma and no flow on Doppler ultrasound, due to extensive fibrosis (Figure 8). The appearance of a rapidly growing nodule should raise the suspicion of a primary thyroid lymphoma, because this is 60 to 80 times more likely in patients with Hashimoto's disease than in the general population [23] Hashimoto's disease also is associated, although less strongly, with papillary carcinoma. A fine-needle aspiration of the nodule should be evaluated for histologic diagnosis.

Hashimoto's disease may coexist with other autoimmune diseases such as Graves' and in these cases Doppler ultrasound will demonstrate an increase in thyroid blood flow, with systolic velocity peaks in the thyroid arteries over 40 cm/s [5].

Riedel's fibrosing thyroiditis:

Riedel's fibrosing thyroiditis is a rare, chronic inflammatory condition of the thyroid, which courses with progressive gland fibrosis and destruction, ultimately leading to a fixed, hard and painless goiter. The inflammation and fibrosis may progress to nearby structures and symptoms related to tracheal, esophageal and parathyroid involvement may occur [24].

The exact cause of Riedel's fibrosing thyroiditis is still unknown but there is association with other fibrosing related to IgG4 diseases such as retroperitoneal fibrosis, mediastinal fibrosis, sclerosing cholangitis, orbital pseudotumor and other organ fibrosis [25].

Ultrasound findings reports are rare, and is usually described as a hypoechoic ill-defined and hypovascularized mass that infiltrates adjacent muscles.

Tuberculous thyroiditis

Tuberculous thyroiditis is extremely rare, which can have three distinct presentations, focal (least common), diffuse and miliary (most common). Despite often presenting as a subacute thyroiditis, clinical presentation can vary from a more acute form with abscess and fistula formation to a more indolent and asymptomatic form [26].

Focal presentation can mimic a malignant tumor as it usually presents as a chronic abscess and rarely as a more acute and reactive abscess.

Ultrasound findings include solitary hypoechoic nodule or with cystic content. Tuberculous adenitis is frequently associated and fine needle aspiration is useful in diagnostic confirmation (figure 9).



Figure 4: Focal thyroiditis. Ultrasound shows ill-defined hypoechogenic nodule (A), with peripheral vascularization to color Doppler.

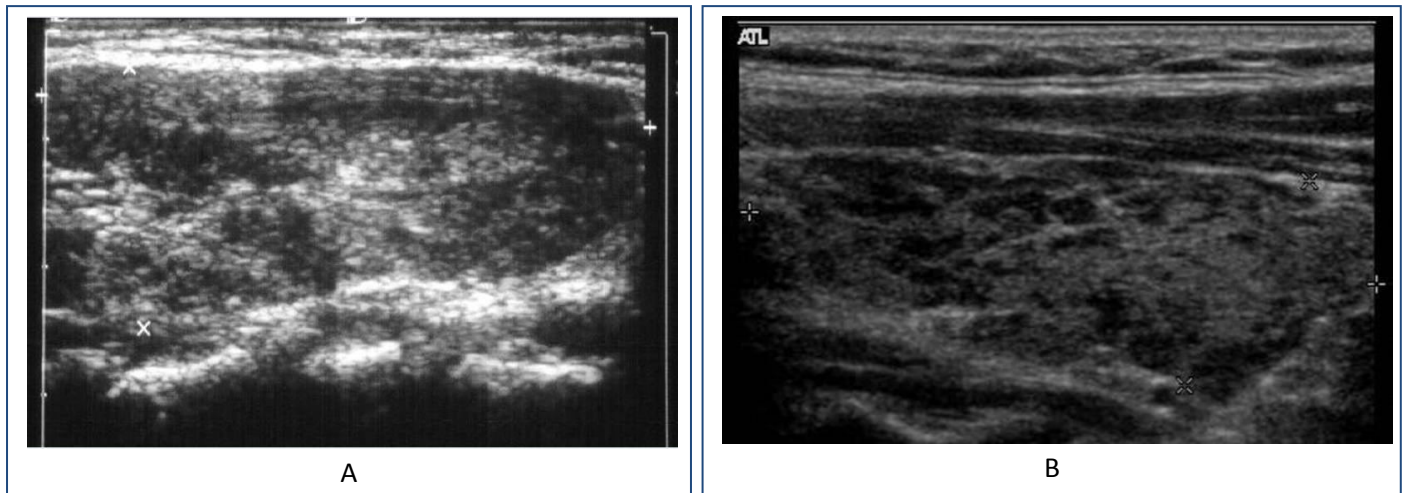


Figure 5: Autoimmune thyroiditis. In (A) thyroid of normal dimensions, presenting reduced echogenicity and diffusely heterogeneous texture with pseudo nodular areas, consistent with lymphocytic infiltrate. In (B) enlarged thyroid, presenting hypoechoic areas with hyperechoic lines of permeation, consistent with fibrosis. This pattern is similar to a giraffe hide.

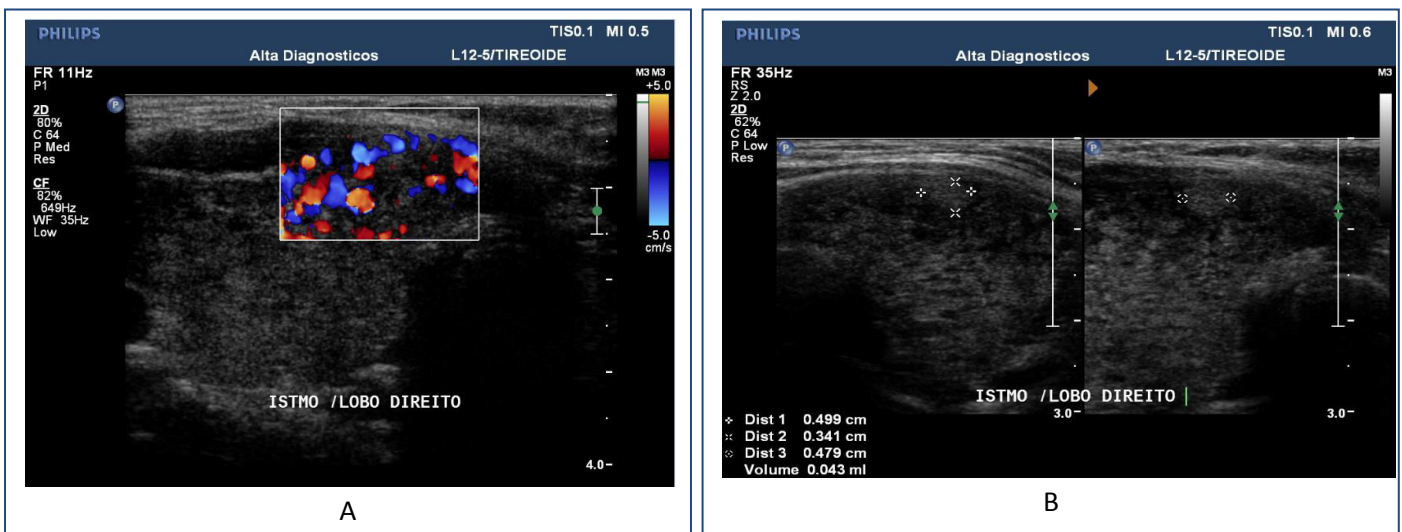


Figure 6: Another pattern observed in Hashimoto's thyroiditis. In (A) hyperechoic ("white knight") nodular area interspersed with hypoechoic areas of lymphocytic infiltrate. In (B) peripheral vessels to this area observed due to the increased vascularization of the adjacent parenchyma in chronic thyroiditis.

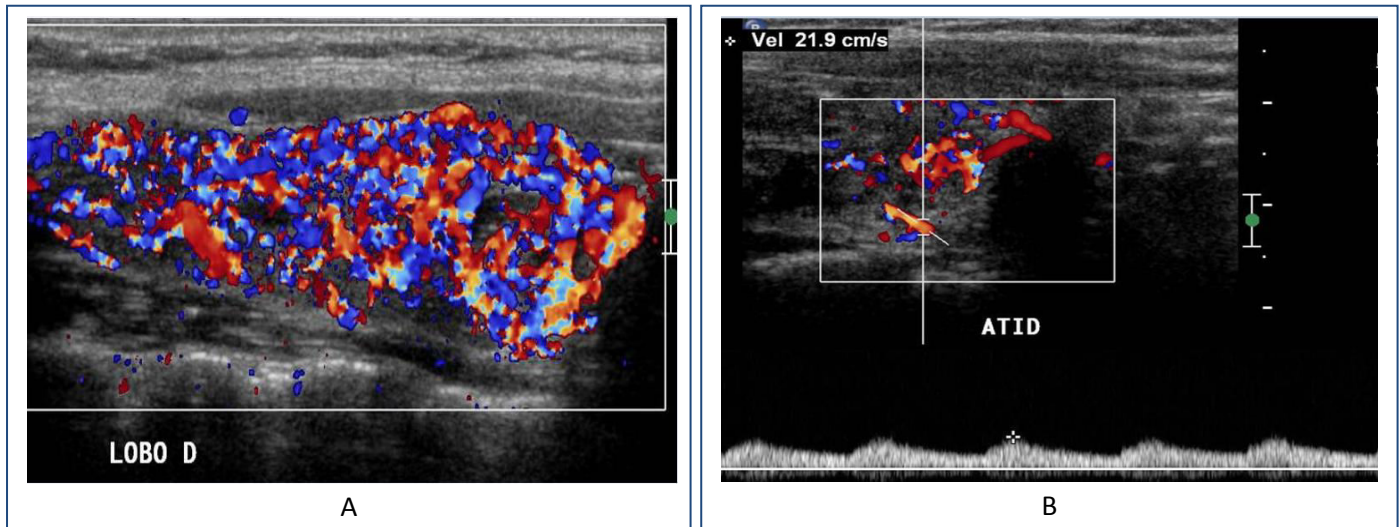


Figure 7: Lymphocytic thyroiditis. Longitudinal cut of the thyroid lobe, demonstrating diffuse increase of the parenchymal vascularization (A) and with normal systolic peak velocity of the inferior thyroid artery (B).

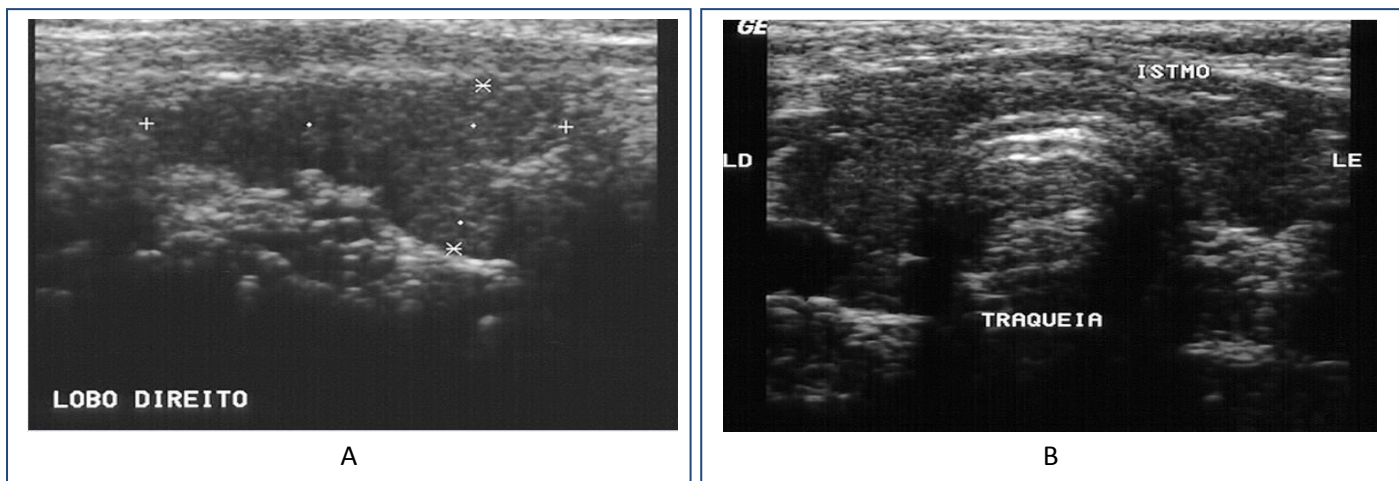


Figure 8: Atrophic thyroiditis. B-mode ultrasound shows reduced dimensions gland, and diffusely hypoechoogenic compared to normal pattern. (A) transverse section of the gland and in (B) right lobe in longitudinal section.

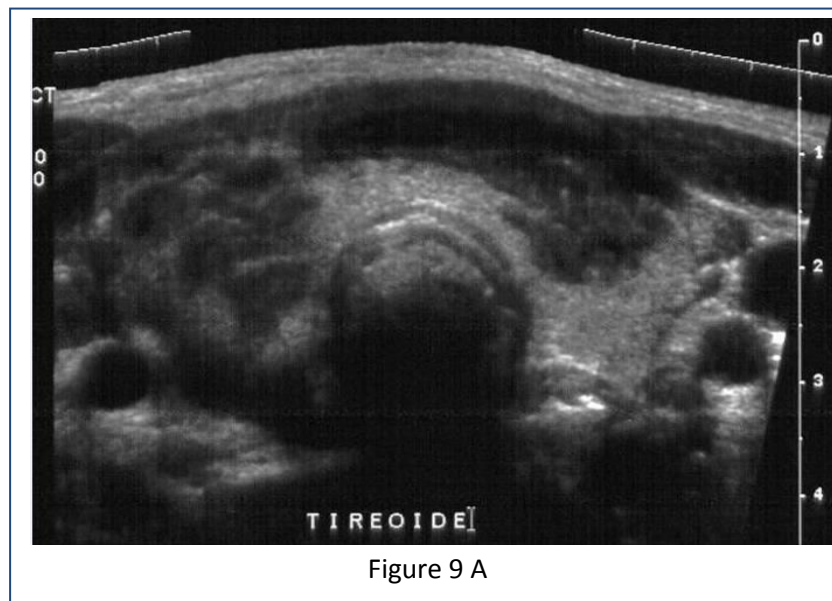
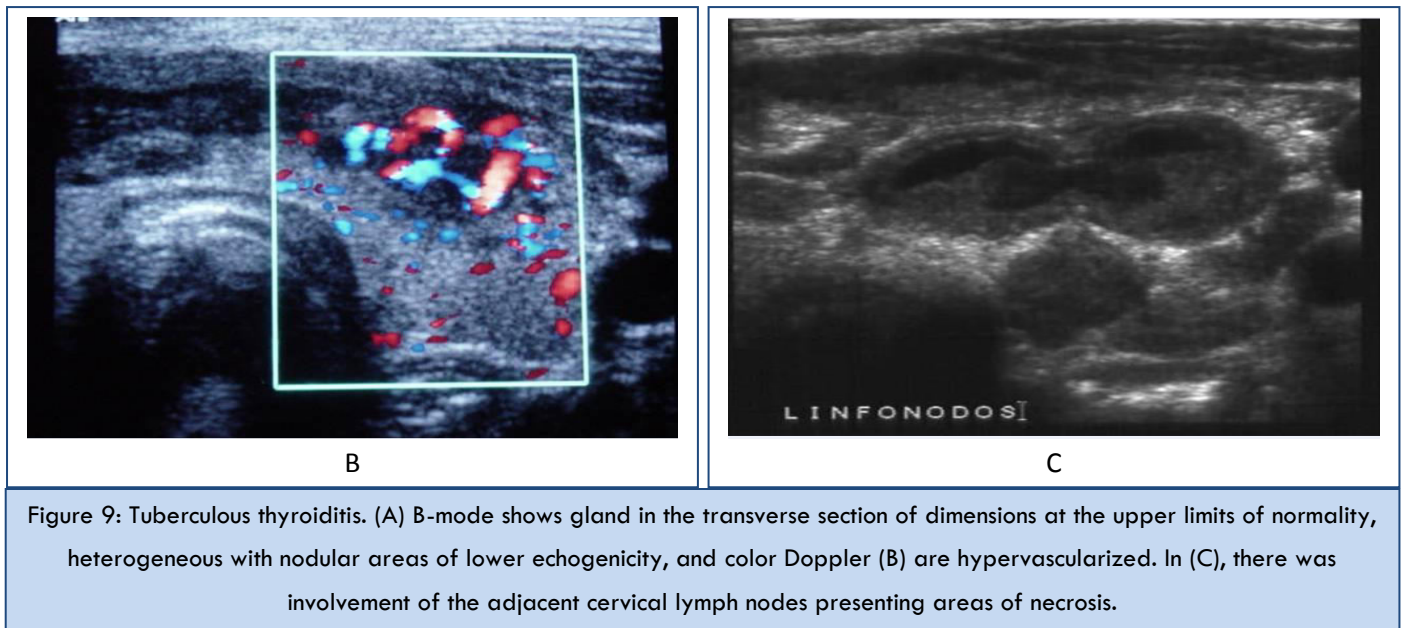


Figure 9 A



CONCLUSION

We conclude that ultrasound is an excellent tool in the evaluation of thyroiditis and offers additional information so that the correct treatment is performed according to the type of thyroiditis found. With the help of historical information, a physical examination and diagnostic tests, physicians can classify the type of thyroiditis and manage clinical treatment as well as follow-up of the disease over the years.

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