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REVIEW ARTICLE

Ultrasound of the tongue as an uncommon site: a focus on technique and early diagnosis of lingual pathologies

Ecografía de la lengua como sitio inhabitual: un enfoque en la técnica y el diagnóstico precoz de patologías linguales

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Abstract

Tongue ultrasound, although less conventional in radiology, offers high-resolution images without ionizing radiation, allowing for accurate evaluation of superficial lesions. This article aims to increase awareness of its usefulness and promote its adoption in clinical practice. Characteristic findings of a variety of lesions are highlighted through clinical cases evaluated at our institution. This technique emerges as a safe and inexpensive alternative for the diagnosis and monitoring of lingual pathologies, being a promising tool for early detection and effective management of these conditions.

Keywords: *Tongue diseases. Ultrasound. Mouth. Diagnostic imaging. Review.*

Resumen

La ecografía de la lengua, aunque menos convencional en radiología, ofrece imágenes de alta resolución sin radiación ionizante, lo que permite una evaluación precisa de lesiones superficiales. Este artículo tiene como objetivo aumentar el conocimiento sobre su utilidad y promover su adopción en la práctica clínica. Se destacan los hallazgos característicos de una variedad de lesiones a través de casos clínicos evaluados en nuestra institución. Esta técnica emerge como una alternativa segura y económica para el diagnóstico y el seguimiento de patologías linguales, siendo una herramienta prometedora para una detección precoz y un manejo efectivo de estas condiciones.

Palabras clave: *Enfermedades de la lengua. Ecografía. Boca. Diagnóstico por imagen. Revisión.*

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Introduction

Tongue ultrasound is an unconventional technique in radiology, despite its great potential for the detection of various pathologies. It can be very useful for assessing the presence of infections and vascular malformations, among other differential diagnoses. It is an examination that allows us to obtain high spatial resolution two-dimensional images, in grayscale and without using ionizing radiation. In addition, some lesions can be better characterized with the color Doppler mode.

Advantages of ultrasound

It offers greater spatial resolution, speed and safety compared to other imaging techniques, which make it a valuable tool in the evaluation and management of lingual pathologies.

Technique

The main thing is not to limit yourself to just one type of transducer for the examination, since depending on the situation each one can provide different and complementary information. For example, if the lesion to be characterized is more external, linear transducers can be used to avoid geometric deformation of the superficial planes and improve proximal resolution, but if depth is required, it is also advisable to use a curved transducer with a lower frequency to evaluate the involvement of the more distant planes.

Lingual or oral approach

Most lingual lesions studied with ultrasound are rather superficial, so the oral approach is the most useful (Fig. 1).

Sterile protector

A sterile protector for the ultrasound probe can be used (Fig. 2). In the oral approach, saliva may be sufficient to avoid air interface, but in the submandibular approach, a conductive gel is necessary.

Transducers

All available tools should be used. As in other body segments, higher frequency transducers will be used for superficial lesions (Fig. 3), and lower frequency transducers will be used to evaluate deeper planes (Fig. 4).

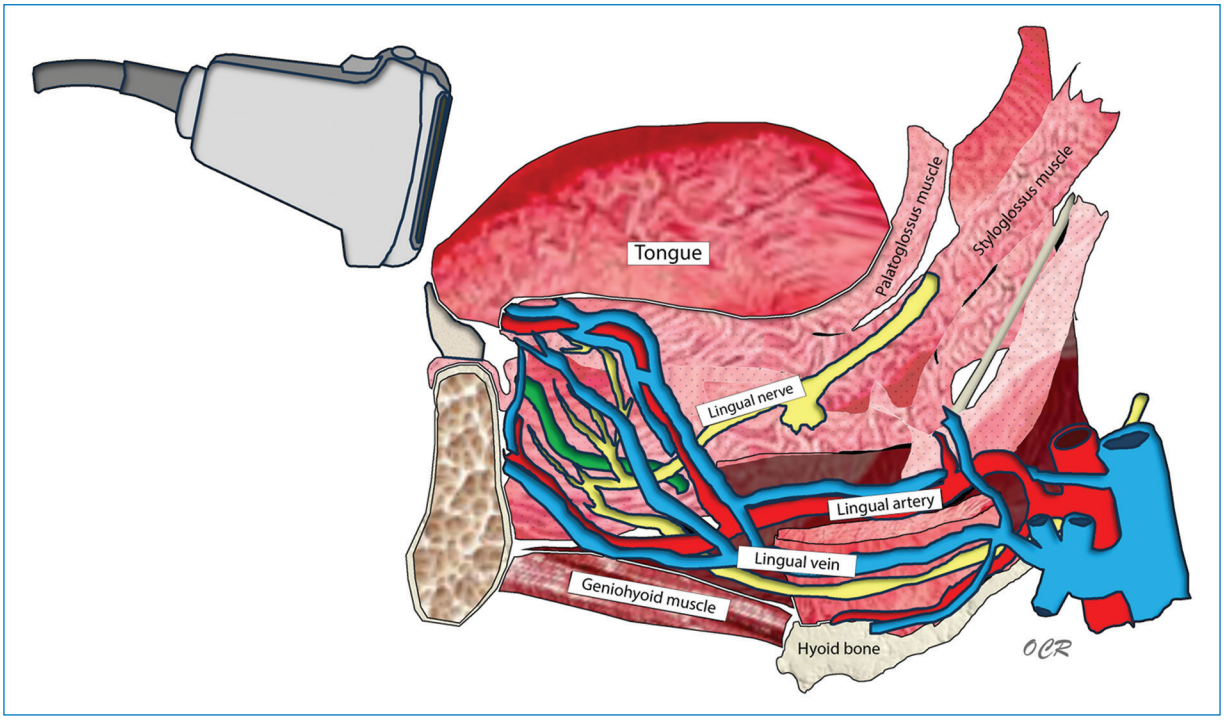

Figure 1. Anatomical diagram of the tongue in its intraoral ultrasound examination.

Figure 2. Sterile protector, generally marketed for transvaginal ultrasound, which can be used perfectly in lingual ultrasound. Some are made of latex and others are made of transparent plastic (**A**). **B**: ultrasound probe with protector. **C**: smaller transducers, such as this "hockey stick" type, allow for a better evaluation of specific sectors by providing high-resolution images (22 MHz).

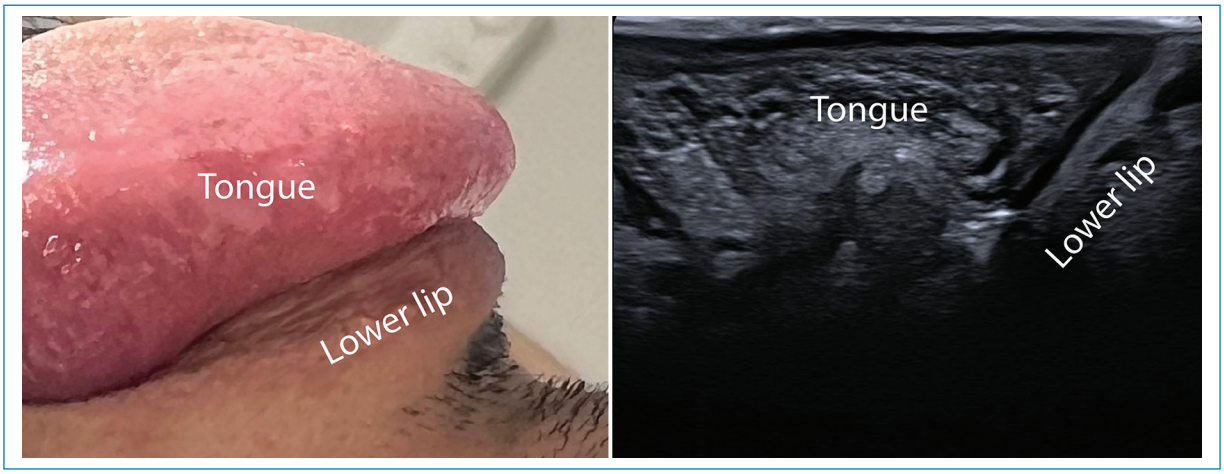

Figure 3. Comparative images from a lateral view of the tongue by photography and in a cross section by ultrasound with the "hockey stick" type transducer.

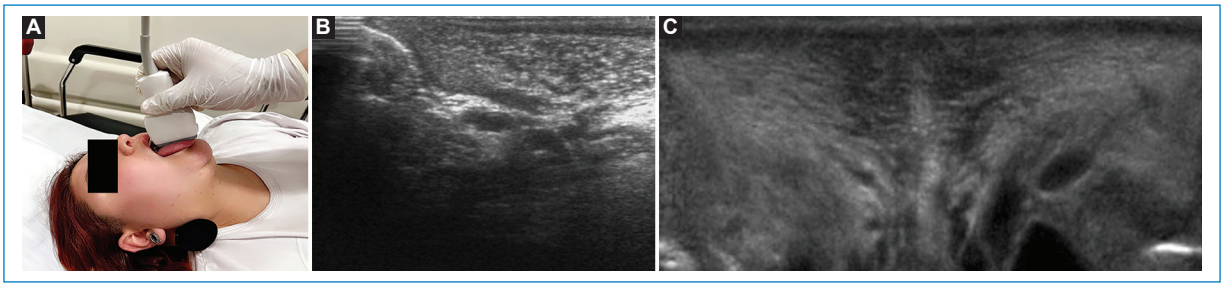

Figure 4. **A**: intraoral approach with 11 MHz transducer. **B**: longitudinal slice. **C**: transverse slice.

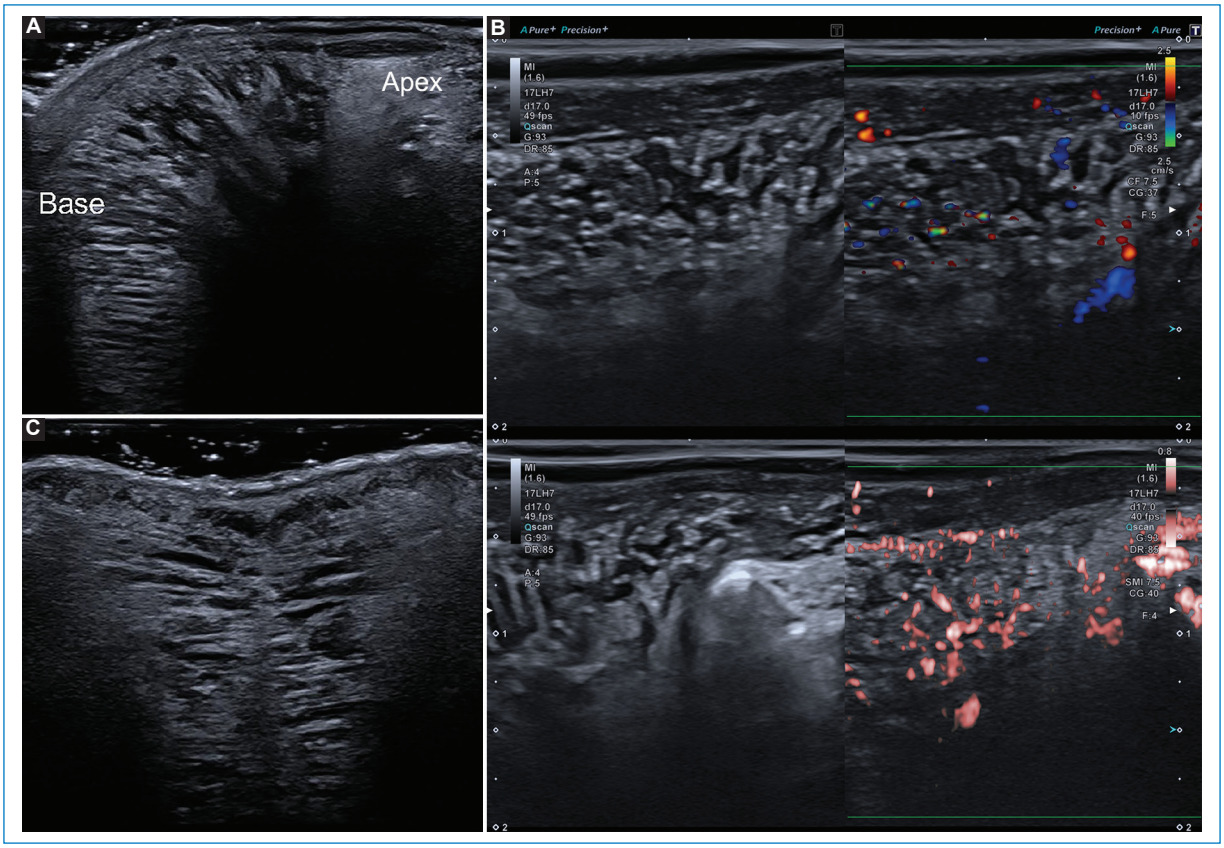

Figure 5. Evaluation with a 24 MHz linear transducer. In this patient, the entire tongue was visualized almost to its base (**A**), the vascularization of the superficial planes of the tongue was evaluated with Doppler color mode and Superb Micro-vascular Imaging (SMI) (**B**), and a transverse slice with the transducer is shown (**C**).

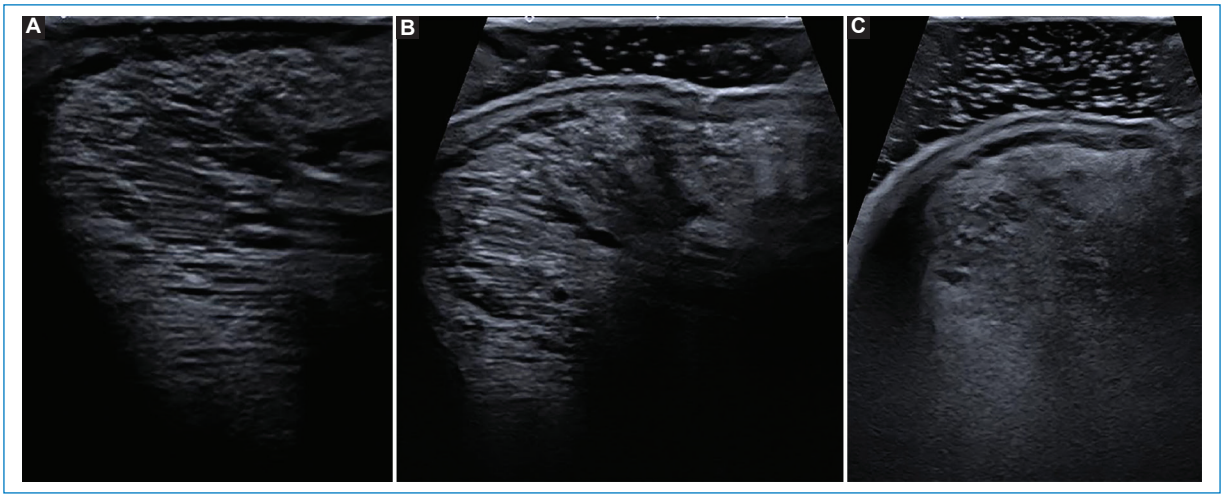

Figure 6. Images taken with a "hockey stick" type transducer using the patient's saliva (**A**), gel (**B**) and water retained within the oral cavity (**C**) as conductors.

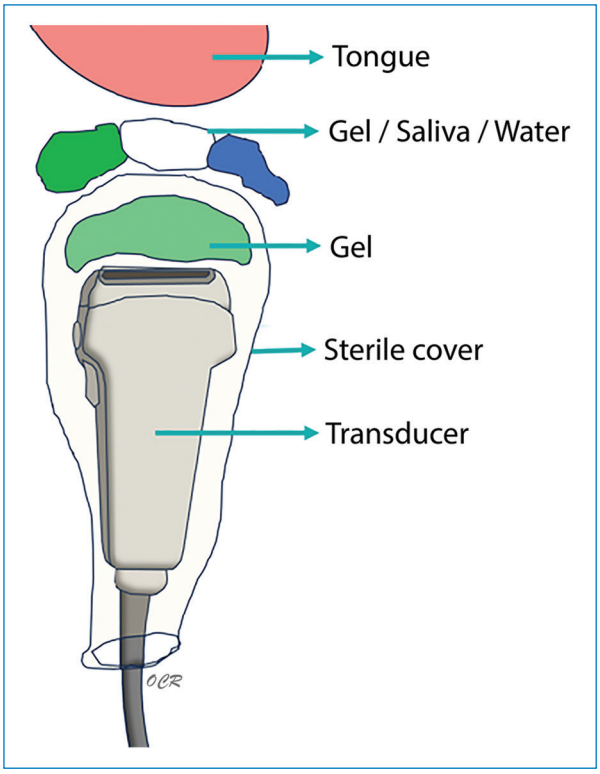

Figure 7. Diagram of a transducer with its respective protector and the three conductors that can be used (saliva, gel or water).

When examining the surface planes, a smaller number of structures are seen, but in greater detail, and it is even possible to evaluate their vascularization (Fig. 5).

In general, transducers with a maximum frequency between 11 and 24 MHz are used.

Conductor

To eliminate the air interface, it is suggested to use whatever best suits the situation. Conductive gel, the patient's own saliva, or water (without swallowing it) can be used to generate an acoustic window (Figs. 6 and 7).

Submandibular approach

It is not the most useful in the evaluation of the tongue, but it can be used to explore the base of the tongue (Fig. 8).

Tongue pathology

The tongue can present multiple pathologies and it is always necessary to place it in the clinical context to suggest an etiology. With this information and the ultrasound findings, the lesions can be classified[1,2] (Fig. 9).

Tumors

Ultrasound can help characterize lingual tumors. Although tongue cancer is the most common neoplasia of the oral cavity[3], ultrasound is not the main examination in these cases, since other imaging techniques of greater utility will be required in the extension study. However, it should be noted that tongue ultrasound could also be useful in malignant lesions; for example, its use has been reported as intraoperative support to define the resection margins of some tumors[4].

What ultrasound is very useful for, is characterizing other tumor lesions of benign etiology; an example is lipomas, whose location within the oral cavity is rare, but the tongue is the most frequent site in the mouth[5].

This etiology also includes tumors that contain blood vessels, such as hemangiomas and pyogenic granuloma.

Hemangiomas

These are usually observed as heterogeneous lesions that may present echogenic areas, especially if they contain fat, and sometimes cystic areas with a serpiginous morphology. With color Doppler mode, abundant blood flow and a positive response to compression can be observed[6] (Fig. 10).

Pyogenic granuloma

A frequent tumor lesion is the telangiectatic or pyogenic granuloma, and within the oral cavity the most frequent appearance site is the tongue. It corresponds to an epithelial neoplasia that contains blood vessels, which is why it has also been classified within vascular lesions. It is fast-growing and its etiology is attributed to local irritants of any origin; that is, it is a reactive lesion[7] (Fig. 11).

Vascular lesions

These are lesions derived from blood and lymphatic vessels that present variable histology and special imaging characteristics. In general, vascular anomalies are usually divided into tumors and malformations. Vascular tumors have already been addressed when explaining the tumor etiology. Vascular malformations

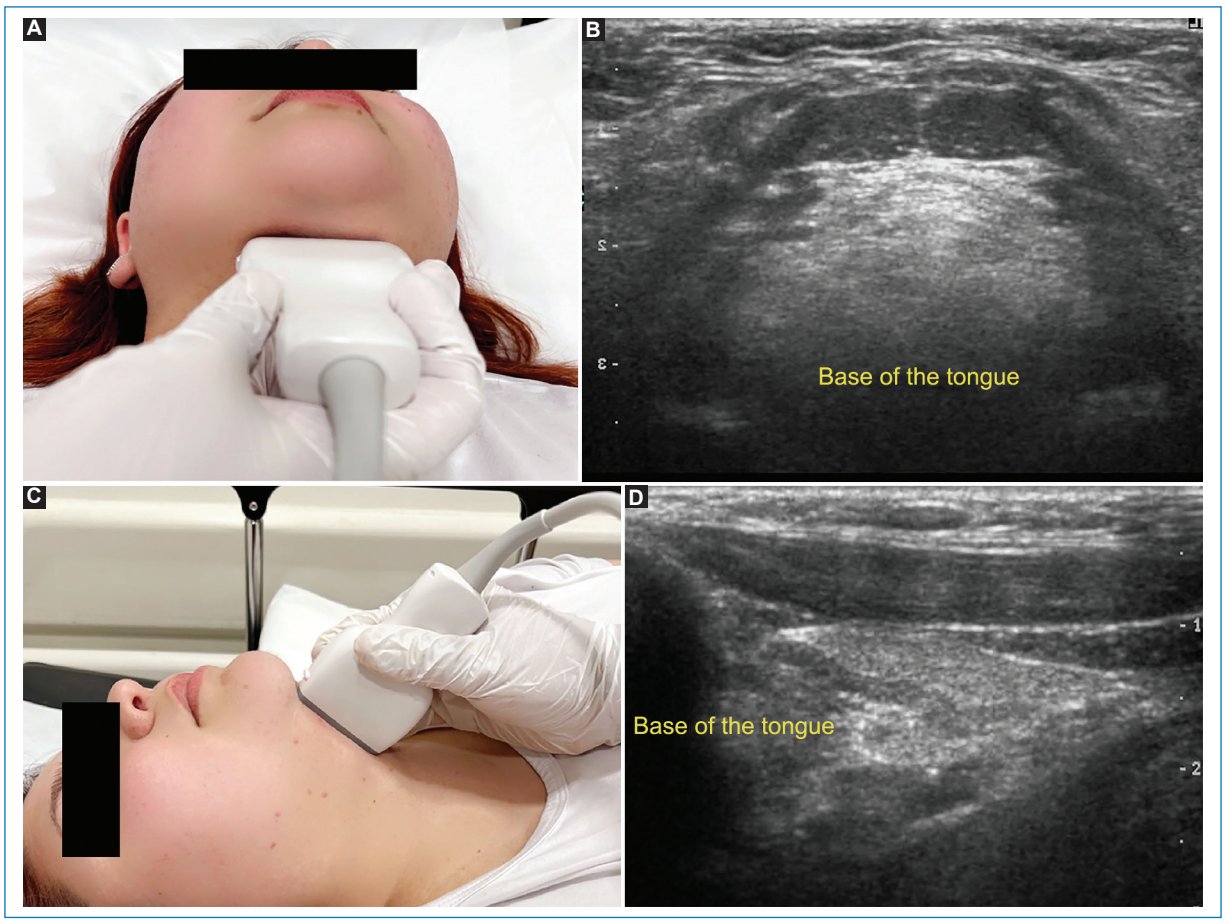

Figure 8. Example of a submandibular approach with an 11 MHz transducer. The transducer is shown positioned transversely on a patient (**A**) with the respective ultrasound image (**B**), and also positioned longitudinally (**C**) with its ultrasound representation (**D**).

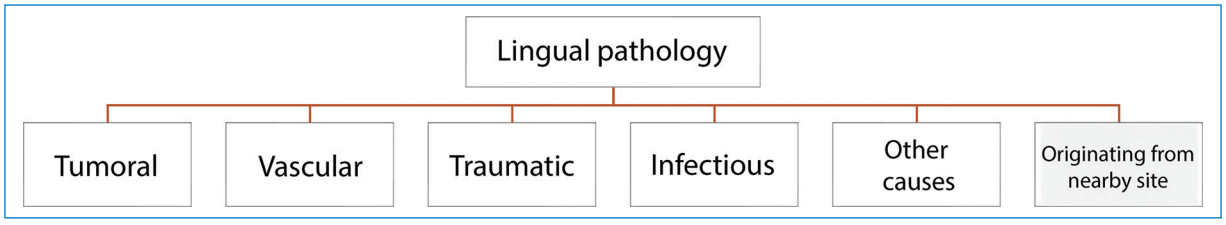

Figure 9. Simple conceptual map that classifies the possible etiologies of lingual pathology that can be explored with ultrasound.

include capillary, venous, lymphatic, and arteriovenous malformations[8].

Venous malformations

These are the most frequent benign anomalies of the vascular system, they are caused by defective vascular development and usually present as symptomatic voluminous lesions that tend to persist over time, they can cause notable deformities, and grow over time (Fig. 12).

Lymphangiomas

These are abnormalities of the lymphatic vessels, usually congenital, that can affect various sites,

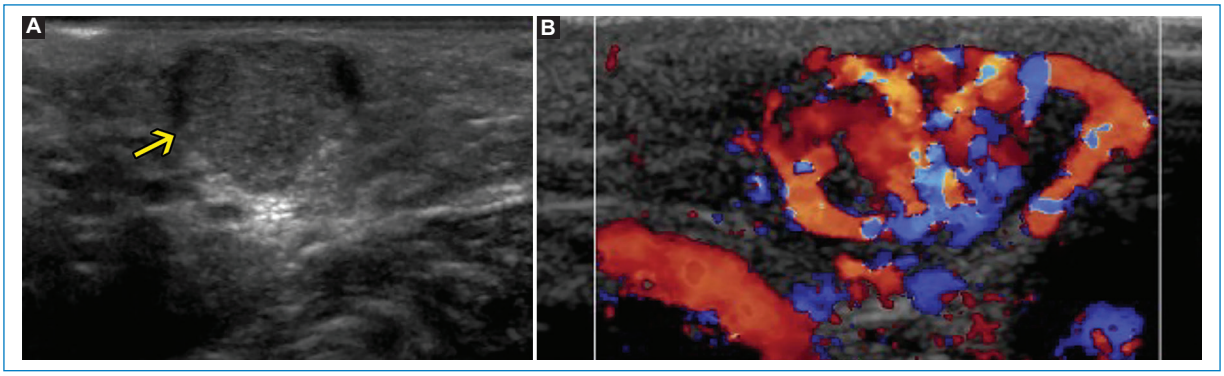

Figure 10. In this patient, a hypoechoic nodule (**A**) with a solid appearance, well delimited, is observed. With color Doppler (**B**) it shows multiple vascular structures (there is no soft tissue hypertrophy, unlike arteriovenous malformations).

proliferate considerably and present as large masses of soft tissue[9,10] (Fig. 13).

Arteriovenous malformations of the tongue

Arteriovenous malformations are defined as high-flow lesions and are identified by the presence of a central tangle of low-resistance arteriovenous connections (resembling a "nest"), which are connected to inflow arteries and outflow veins. These anomalous connections between arteries and veins result in the diversion of blood flow within an organ or tissue, preventing normal circulation through the capillary network and generating hemodynamic deregulation. Although the oral cavity is one of the most frequent presentation sites, the tongue is not the most common site, but it should be suspected if it presents with characteristics that suggest it, such as bulging, pulsating lesions, with increased area temperature or palpable thrill[8] (Fig. 14).

Cysts

Cystic lesions correspond to pathological cavities with content that may be liquid, thick or gaseous. In general, this content is secreted by the cells that line the cavity or is the result of tissue fluid.

The etiology of these lesions is very diverse, from developmental abnormalities to residual cavities due to other causes.

Thyroglossal duct cyst

The thyroglossal duct cyst is one of the most frequent pathologies in the development of the thyroid gland. It occurs due to the persistence of the thyroglossal duct's epithelium in the glandular descent pathway from the base of the tongue to the anteroinferior portion of the neck, which normally tends to regress[11] (Fig. 15).

Ranula

A ranula is a cystic lesion, although for many authors it corresponds to a pseudocyst, since it is the result of mucus retention or saliva leakage. It develops due to trauma or an obstruction of the excretory duct of a salivary gland, and in some cases it can generate nonspecific symptoms in the oral cavity due to the mass effect, or it can present as a frank increase in volume[12] (Fig. 16).

Traumatic lesions

Trauma to the tongue is common and can have a variety of causes, including sharp object lesions, self-injury by biting, and even iatrogenic lesions from dental procedures or the use of supraglottic airway devices. Examination of the tongue with ultrasound after trauma will primarily look for hematomas and foreign bodies[13,14]. A hematoma is the accumulation of blood in tissue due to rupture of a blood vessel[6,9] (Fig. 17).

Infectious lesions

Infectious glossitis is usually the result of poor oral hygiene and imaging is not necessary; however, when an abscess is suspected, it is. Although abscesses are rare due to the numerous natural barriers of the tongue, such

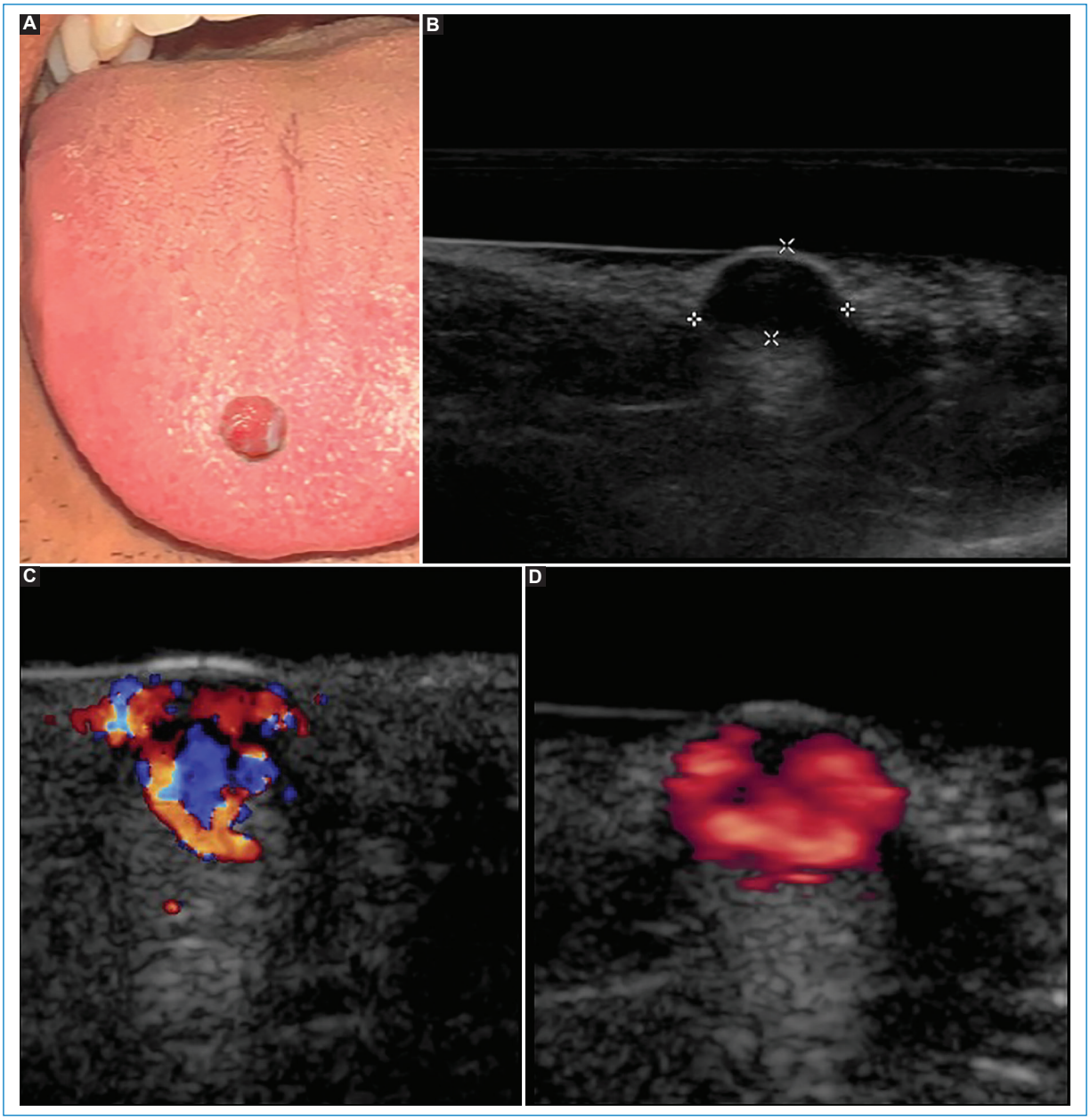

Figure 11. Telangiectatic granuloma visible on physical examination (**A**). On ultrasound (**B**) it is observed as a superficial hypoechoic nodule with multiple internal vascular structures, represented in color Doppler (**C**) and power Doppler (**D**) modes.

as muscle resistance and saliva, it has been observed that the previous presence of trauma with foreign objects, such as fish bones, predispose to their presentation and raise the clinical suspicion of lingual abscesses[15,16] (Fig. 18).

Other causes

It is important to recognize that, in addition to the aforementioned causes, there may be other causes that produce lingual pathology. Therefore, it is essential to question the patient as much as possible and make an effort to locate the main region where the discomfort is experienced. Likewise, when evaluating lingual pathologies, it is crucial to consider the possibility that the symptoms may originate in nearby anatomical areas, such as the lips, salivary glands, lymph nodes or nerves, among others[2,17].

Lingual ectopic thyroid corresponds to a failure in the descent of the thyroid from the blind foramen at the

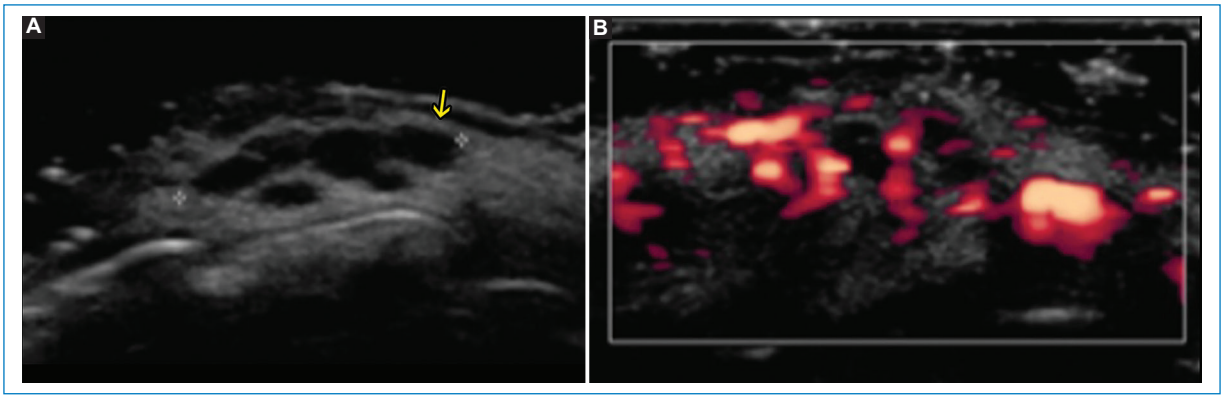

Figure 12. In this patient, the discomfort radiated toward the tongue, but the lesion was found on the lower lip, composed of multiple cavities (**A**) with heterogeneous hypoechoic content, compressible and presenting phleboliths (**B**), a common finding in this type of anomaly.

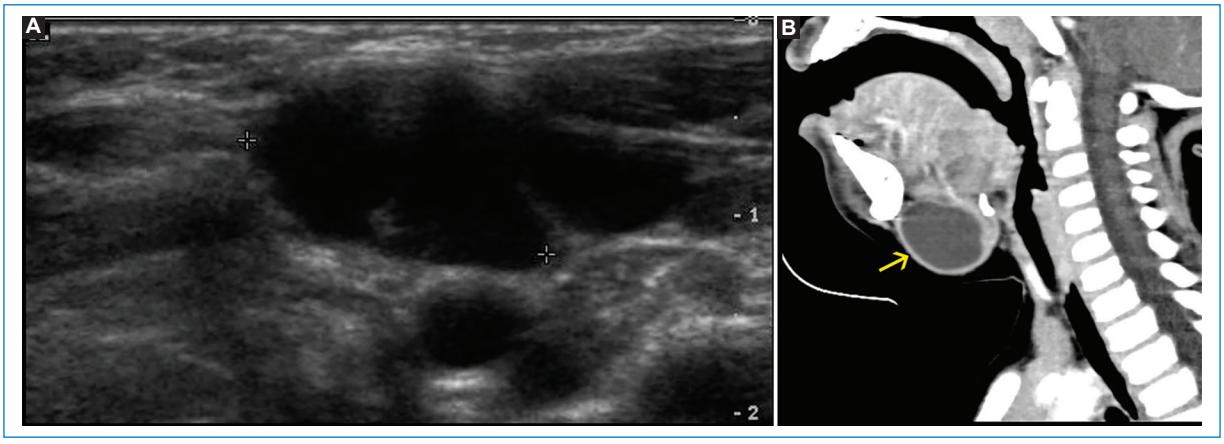

Figure 13. Sublingual volume increase corresponding to sublingual cystic lesions visible on ultrasound (**A**) and computed tomography (**B**), which corresponded to lymphangiomas.

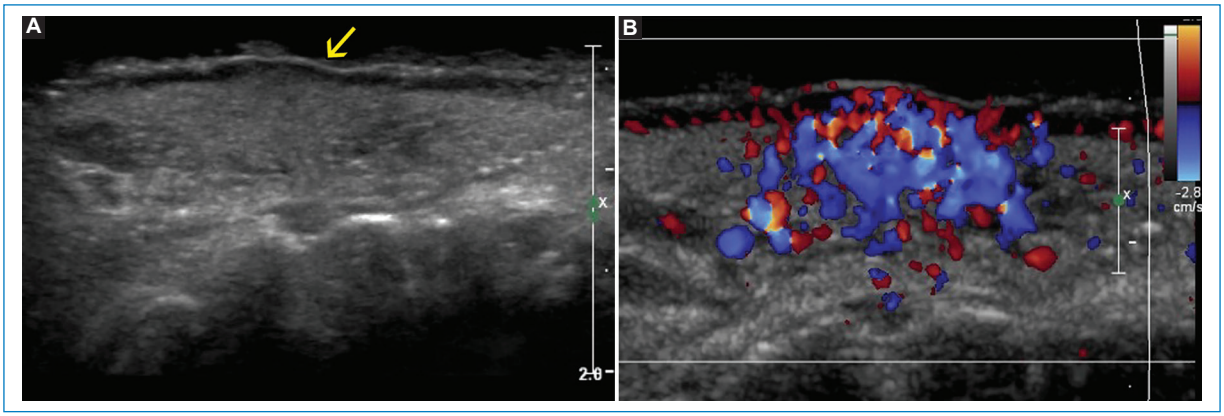

Figure 14. This patient had a lump that was examined with ultrasound. A hypertrophy of the soft tissues was seen in the grayscale image (**A**), a frequent characteristic of this type of lesion, and a vascular tangle with arterial and venous flow was seen in color Doppler mode (**B**).

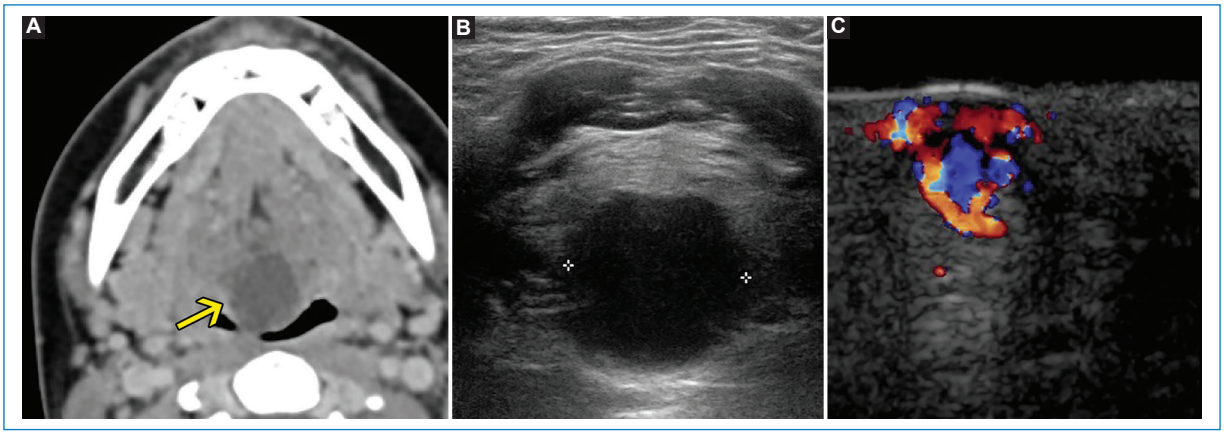

Figure 15. This patient reported persistent discomfort at the base of the tongue, so it was decided to study it. The computed tomography identified a 2 × 2 cm hypodense lesion (**A**), which was better characterized on ultrasound (**B**), where it is observed that it originates in the blind foramen of the posterior region of the tongue (origin of the thyroglossal duct).

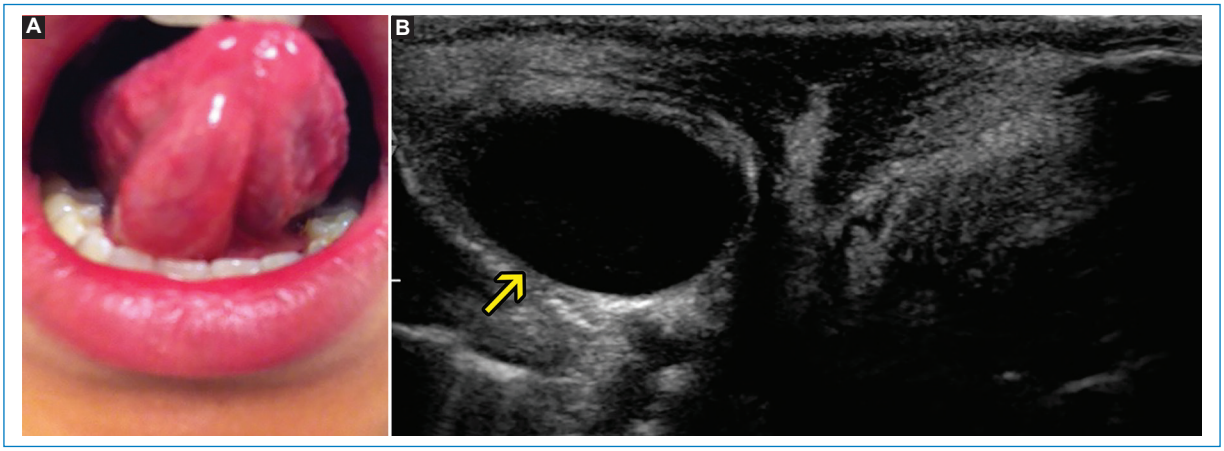

Figure 16. A: Photograph of a patient who presented this increase in volume. **B**: In the transverse ultrasound slice obtained from the upper surface of the tongue, a cystic formation of up to 8 mm of sublingual origin, with a thin and anechoic wall is observed.

base of the tongue to its final location in front of the trachea[18] (Fig. 19).

Discussion

Tongue ultrasound is emerging as a valuable tool in the early diagnosis and characterization of a wide range of lingual pathologies. Its accessibility, the absence of ionizing radiation and its capacity to offer high spatial resolution images make it an attractive method in clinical practice. Its usefulness lies in the possibility of differentiating between cystic, solid, vascular or infectious lesions, among others. It also allows a detailed and precise evaluation of the lingual anatomy, unlike other imaging techniques.

The intraoral approach offers a direct and detailed perspective of the tongue, which facilitates the identification of superficial lesions and their characterization. This could be particularly useful to guide procedures such as diagnostic punctures, so it could be a tool to be used in the approach to abscessed and tumorous lesions, in which precision in the location and evaluation of the extent of the lesion is crucial for planning treatment.

In addition to its role in early detection and differential diagnosis, lingual ultrasound also offers the advantage

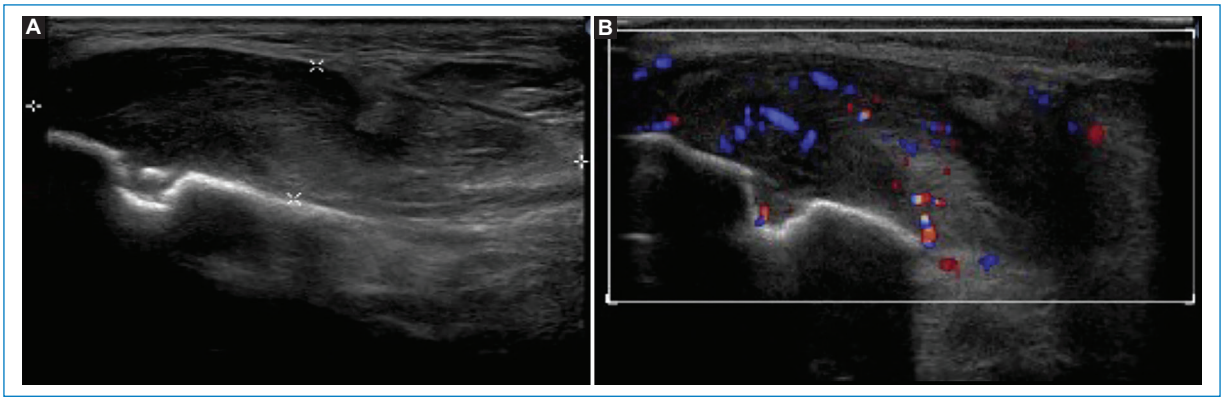

Figure 17. Foreign body lesion. **A**: the ultrasound shows an irregular, poorly defined, heterogeneous collection with cystic and other echogenic areas. **B**: color Doppler also shows a foreign body (hypoechoic with shadow), with the presence of bubbles (hyperechoic path) and perilesional hyperemia with hyperflow.

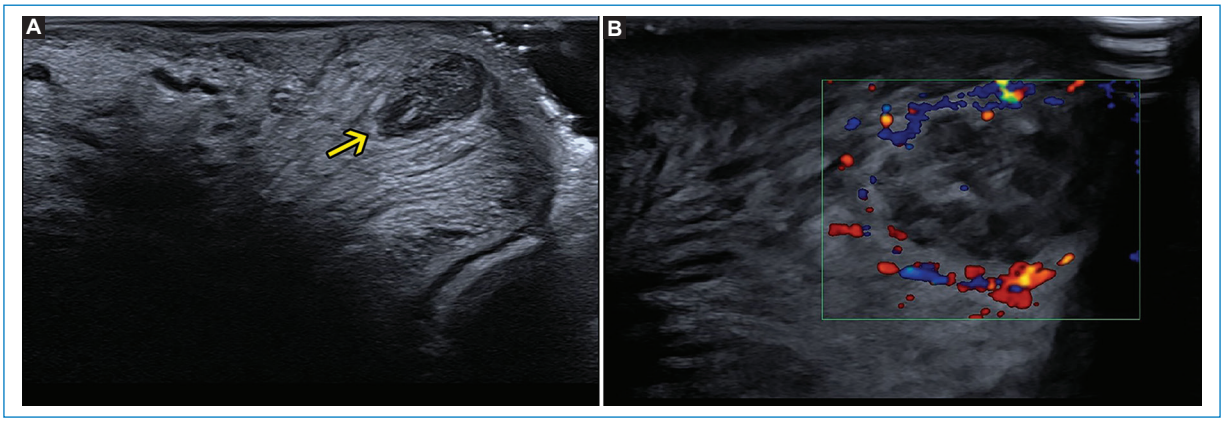

Figure 18. Patient who reported a localized and progressive increase in volume after having eaten fish with bones 10 days earlier. The ultrasound showed the increase in volume correlated with a collection with heterogeneous hypoechoic content (**A**), partially delimited, avascular and with peripheral hyperemia (**B**).

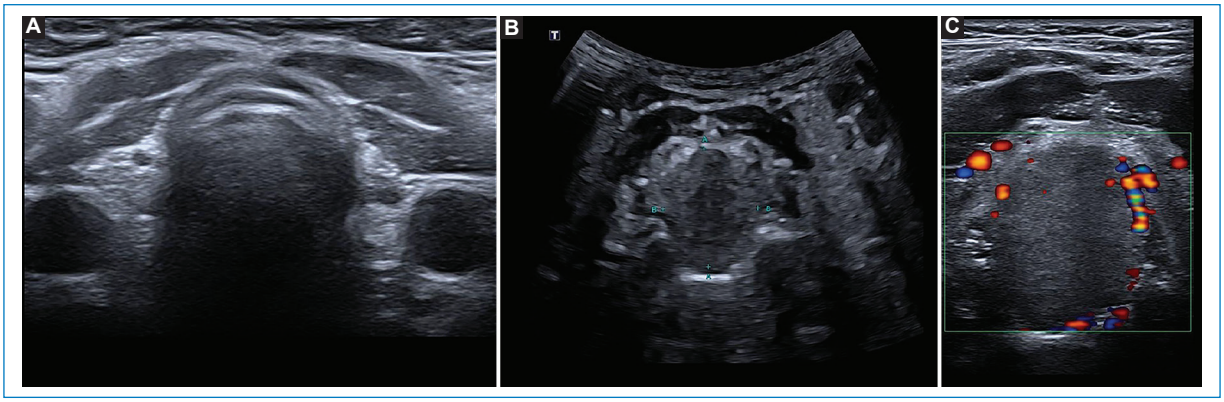

Figure 19. A: absence of thyroid in the cervical bed. At the base of the tongue, homogeneous tissue (**B**), vascularized (**C**) and without nodules, corresponding to an ectopic thyroid gland, is identified.

of being a dynamic technique, which allows the evaluation of the response of the lesions to maneuvers such as compression, thus offering additional information on their nature and behavior.

Conclusion

Tongue ultrasound is a promising technique in the field of radiology, offering a safe, fast and low-cost alternative for the diagnosis and monitoring of various lingual pathologies. Its ability to provide high-resolution images and its versatility in the characterization of lesions make it an invaluable tool in daily clinical practice. However, greater knowledge and more experience in its application are required to maximize its usefulness and clinical benefit.

This article aims to increase knowledge of this modality and promote the adoption of the technique in clinical practice.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical considerations

Protection of people and animals. The authors declare that no experiments involving humans or animals were conducted for this research.

Confidentiality, informed consent and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Statement on the use of artificial intelligence. The study does not involve patient personal data nor requires ethical approval. The SAGER guidelines do not apply.

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