

Standardized Echography in the Diagnosis of Orbital Tumors

The ultrasound-based technique has not been supplanted by newer imaging technologies.

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With the availability of advanced forms of imaging such as computed tomography (CT) and magnetic resonance imaging (MRI), does standardized echography (SE) still have a role in the diagnosis of ocular tumors? The answer is yes, this technology is still helpful, and it can reveal the internal structure of lesions better than some of the more advanced imaging technologies.

Fundoscopy is of limited use in assessing ocular tumors. Successful funduscopy depends on clear ocular media, and it is further limited by the fact that it is mostly a 2-dimensional view of the retinal surface. The extent of an exophytic tumor with a large mass behind the globe can be underestimated if the clinician sees only the surface area through a fundoscopic contact lens, potentially leading to an incorrect diagnosis or prognosis.

SE adds another dimension to the assessment of tumors, so to speak: the dimension of depth. It is especially useful in determining tumor volume and extent. It allows the clinician to characterize the tissue visualized in ultrasound images. In a manner analogous to voice-recognition software, SE recognizes the patterns generated on ultrasound imaging by specific types of tissue, and facilitates differentiation of, for example, a malignant from a benign tumor.

The diagnostic technique of SE was pioneered by Karl C. Ossoinig, MD, in the 1960s.¹ With the use of specific equipment, including standardized ophthalmic ultrasound A-scan, contact B-scan, and Doppler instrumentation, a well-trained examiner can detect and

characterize multiple types of intraocular tumors and other conditions with high reliability.² SE allows the clinician to perform tissue differentiation in the eye, orbit, and ocular adnexa.

The ability to differentiate tissue depends on correct interpretation of the images that sound (ie, ultrasound) produces as it travels through a particular type of tissue. In SE, ultrasound images are correlated with internal structures through the use of well-validated, established patterns. Topographic, quantitative, and kinetic examination techniques are used to establish the location, size, and acoustic characteristics of the tissues in question.

This article reviews some of the capabilities of SE and the types of tumor differentiation that are possible with use of this technology.

ROLES OF STANDARDIZED ECHOGRAPHY

SE plays several roles in screening for and identifying space-occupying lesions (SOL) in the orbit.

Orbital screening with SE can be used to rule out mass lesions in the presence of proptosis, and to assess conditions suggestive of secondary changes due to SOL, such as optic atrophy of unknown origin, chronic conjunctivitis or lid edema, or alterations of ocular motility.

SE is a time-tested, highly reliable, noninvasive tool for assessing patients with signs or symptoms suggesting an orbital lesion. More than 60 orbital and periorbital conditions can be detected and differentiated with high reliability, especially when the technique is used by an experienced examiner.

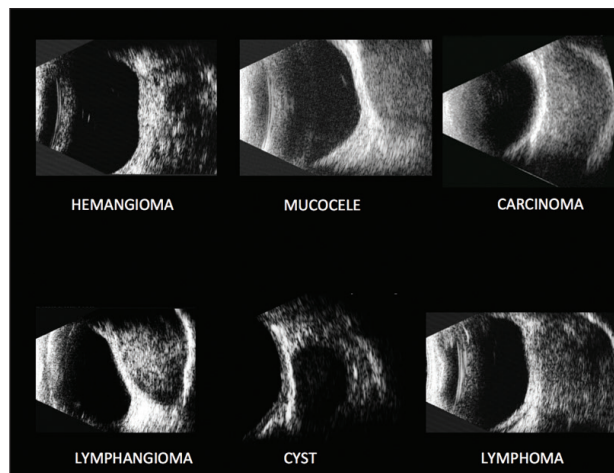


Figure 1. Typical patterns on contact B-scan for different types of intraocular tumors.

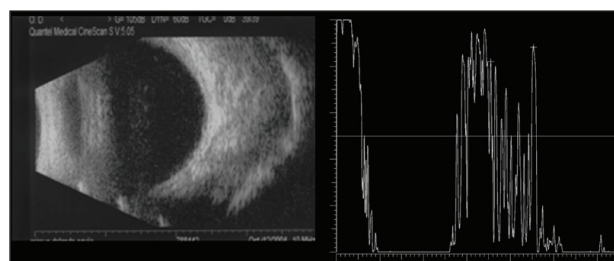


Figure 3. Typical B- (left) and A-scan (right) images for pseudotumor orbita.

One component of SE is the use of standardized A-scan ultrasound of the orbit. A-scan imaging is useful to assess numerous structures of the orbit and adnexa, offering helpful information regarding extraocular muscle pathology, orbital tumors, optic nerve pathology, preseptal lesions, and the lacrimal glands. Most of the remarks in this article are devoted to its oncologic applications.

Standardized A-scan imaging can detect lesions of 2.0 to 3.0 mm in the anterior and mid orbit and of 1.0 to 5.0 mm in the posterior orbit. Lesions are seen as low reflective images included in high reflective echoes.

Figures 1 and 2 show typical patterns on B-scan and standardized A-scan, respectively, for different types of intraocular tumors.

Standardized tumor patterns on SE have been shown to correlate with histology. SE is also helpful for dynamic tissue assessment such as vascular flow detection, and compression testing (hard or soft tissue). SE allows detection and diagnosis of optic nerve sheath distention due to increased subarachnoid fluid (as in benign intracranial hypertension). This technique also has high sensitivity for detecting mild extraocular muscle thickening (as in

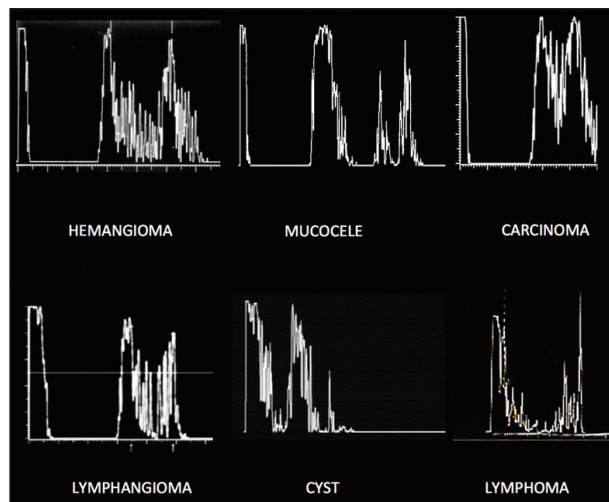


Figure 2. Typical patterns on standardized A-scan for different types of intraocular tumors.

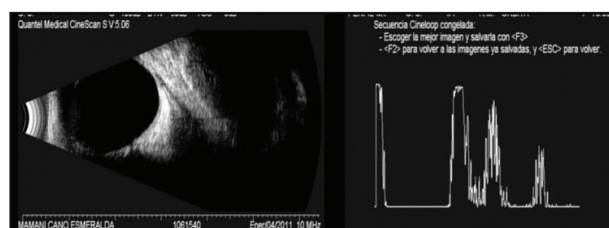


Figure 4. Typical B- (left) and A-scan (right) images for pseudotumor musculii.

Graves disease). The noninvasive nature of the procedure, the avoidance of radiation use, and the inexpensive nature and portability of the equipment are additional advantages of this imaging modality.

CHARACTERISTICS OF SOME LESION TYPES ON SE

Pseudotumor

This common lesion shows low reflectivity, a homogeneous internal structure, and moderate sonic absorption on SE. It tends to be multifocal, with poorly defined limits. The lesions are immobile and have a soft consistency on depression. Typical A- and B-scan images for pseudotumor orbita and pseudotumor musculii are seen in Figures 3 and 4, respectively.

Orbital Varix

Orbital varices are low-reflective, regular, internal structures with no sound attenuation (Figure 5). They typically appear like dilated blood vessels with well-differentiated borders. They have a soft consistency, collapsing on compression and increasing with Valsalva maneuver.

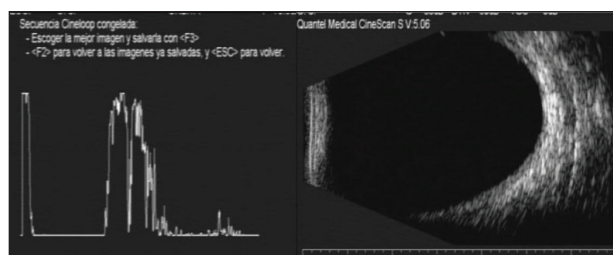


Figure 5. Typical A- (left) and B-scan (right) images for orbital varix.

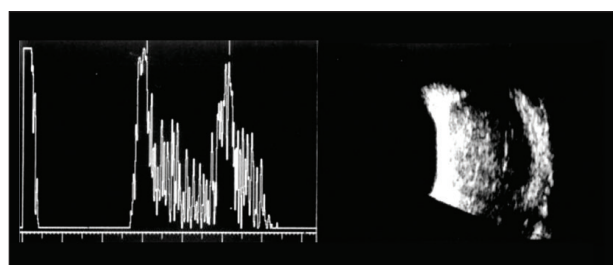


Figure 7. Typical A- (left) and B-scan (right) images for cavernous hemangioma.

Arteriovenous Fistula

Fistulas have low to very low reflectivity and a regular, internal structure consistent with blood movement (Figure 6). They typically take the shape of blood vessels with well-differentiated borders and are located in the nasal superior quadrant or superior orbit. These structures are not compressible. In our experience, low-flow arteriovenous fistulas are not well diagnosed with CT or MRI.

Cavernous Hemangioma

These lesions typically present images indicating sonic absorption. They have well-defined, precise limits and exhibit signs of vascularization (Figure 7).

CONCLUSIONS

If one compares CT, MRI, and SE, each imaging modality has pluses and minuses. In topography—localizing the SOL, determining its morphology and limits—MRI and CT are superior to SE. In quantification—the ability to characterize internal structure, reflectivity, and attenuation—SE is unique. In kinetic examination—assessing compressibility and vascularization—SE is better than the other 2 techniques.

SE, CT, and MRI all achieve high rates of tumor detection, although SE is not good for lesions in the orbital apex. MRI is more effective than SE or CT in demonstration of the posterior extension of tumors. For revealing the internal structure of lesions, SE is better than CT or MRI. SE shows the acoustic interfaces of lesions, while MRI and CT show the outlines of a lesion.

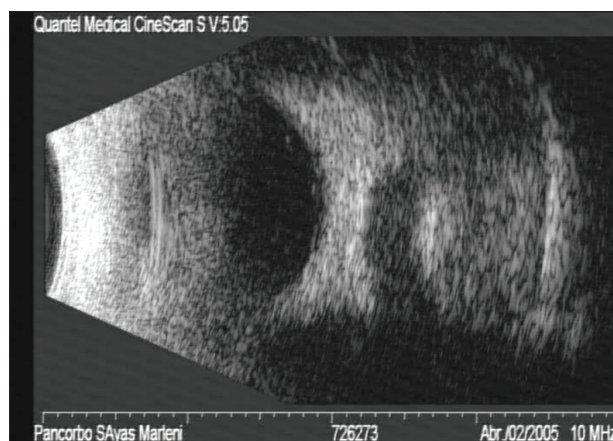


Figure 6. Typical B-scan image for arteriovenous fistula.

In the characterization of lesions, SE presents a representation of the histologic structure, while CT and MRI show secondary changes resulting from the lesion. For localization, MRI and CT are superior to SE.

A careful SE examination can demonstrate the relationship between a tumor and the optic nerve. This is also true for MRI, but CT does not perform this task well. SE can detect separation between a mass and the optic nerve that CT does not detect.

The dynamic features of ultrasound allow good diagnosis of vascular masses (the sound attenuation typical of cavernous hemangioma, the enlargement of the varix lesion during Valsalva maneuver, etc.).

Orbital CT and MRI are widely accepted and commonly used imaging techniques for the identification and characterization of ocular SOLs. However, it should not be forgotten that SE is another important imaging modality for this purpose. The potential advantages of SE include its simplicity and low cost and its ability to provide dynamic information in real time.

There is a learning curve for the SE technique, and the value of the results is relative to the experience of the echographist. This valuable technique should not be overlooked as an essential tool for clinical assessment of intraorbital masses. ■

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1. Ossoinig KC, Till P. Ten-year study on clinical echography in orbital disease. *Bibl Ophthalmol*. 1975;(83):200-213.
2. Byrne SF. Standardized echography of the eye and orbit. *Neuroradiology*. 1986;28(5-6):618-640.