Will the Real Optic Nerve Sheath Please Stand Up?

To the Editor: We applaud Hamilton et al[1] for their recent contribution to the study of the retrobulbar optic nerve sheath diameter as a noninvasive surrogate for intracranial pressure. However, although its science appears sound, this article brings to light what we believe is an important limitation to the study of this topic in general: the lack of uniformity in how exactly the optic nerve sheath is identified and measured.

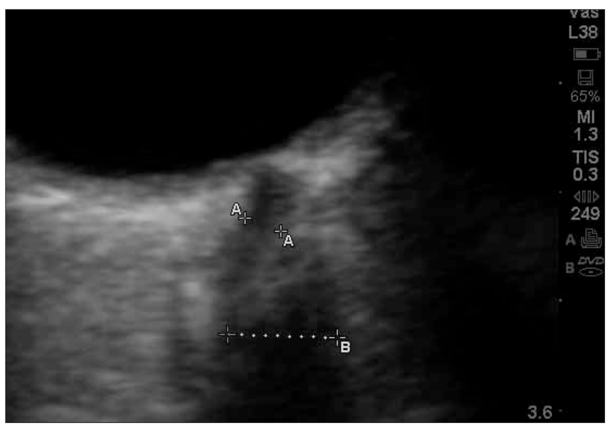
In practice, using a high-frequency transducer placed horizontally over a closed eyelid, two distinct structures are visible just posterior to the optic disc. The anterior component of the optic nerve itself is seen as a hypoechoic crescent, which arcs medially and is normally 2.5 to 3.5 mm in width (Figure 1, A). A second thicker, linear or pyramid-shaped anechoic column projects directly backward from the posterior surface of the eye to the end of the screen (Figure 1, B). Most recent literature on this topic ignores the presence of the nerve and focuses solely on the latter structure, which is assumed to represent the optic nerve sheath.[2–6] Other authors clearly differentiate between the nerve and the dural sheath and include measurements of both structures in their published data.[7,8]

However, is this latter structure in fact the real optic nerve sheath? Anatomically, the optic nerve and its sheath are not directly orthogonal to the surface of the lid, nor are they rigidly attached to the back of the globe, nor do they take a direct, backward path from the globe to the optic canal. Instead, they take a somewhat meandering, S-shaped, generally medial path through the orbit. Furthermore, the optic nerve sheath tapers to a thinner, not thicker, width as it courses posteriorly. Considering these factors, it is apparent that this sonographic structure could not possibly represent the entirety of the actual optic nerve sheath. It is plausible, however, that it may be an acoustic shadow created by the distal-most edges of the dural sheath of the nerve, a point argued by one investigator.[9] If the perineural dural sheath bulges outward due to elevated intracranial pressure, then a measurement of this artifact may be a reliable substitute for the diameter of the sheath itself. However, despite this explanation, some have expressed doubt that this structure is indeed the true optic nerve sheath and have argued that it may represent an unrelated artifact, possibly a shadow cast by the lamina cribrosa or another structure.[10,11]

In the study by Hamilton et al, the mystery of the identity of the optic nerve sheath deepens. The authors provide an image that appears to display both the optic nerve and the optic nerve sheath as distinct structures, although the shadowlike, linear, hypoechoic stripe (ie, what is typically called the optic nerve sheath) is conspicuously absent. The authors describe the measurement of "a perpendicular intersection from the leading edge to the leading edge of the optic nerve sheath" at specified distances behind the globe. On the published image, the measurement begins in the near field at a subtle, hairlike, gently curving anechoic structure running parallel to the nerve and then traverses what appears to be the perineural subarchnoid space, then the nerve itself, then the subarachnoid space on the far side of the nerve, finally ending at a second thin, sloping anechoic structure, which is labeled the optic nerve sheath. Of interest, this image of the optic nerve sheath is reminiscent of work published in the 1990s by Helmke and Hansen,[12] who showed the sonographic appearance of this structure in cadaveric perioptic dural sheaths that had been injected with gelatin.

Do Hamilton et al finally provide the correct method for measurement of the optic nerve sheath with point-of-care sonography? We believe that theirs may be the most convincing pictures of this structure in a living organism, but we would like to see that similar images could be obtained in humans. More importantly, however, we feel that clarification is needed to explain the discrepancy between these images and the appearance of what is typically claimed as the optic nerve sheath. As strong proponents of point-of-care sonography, we are enthusiastic about this application. However, after nearly a decade of clinical experience with the technique, we remain alarmed at the lack of a rigorously defined, easily obtained, and reliable definition of the sonographic optic nerve sheath.

Figure 1. The anterior component of the optic nerve is seen as a hypoechoic crescent, which arcs medially and is normally 2.5 to 3.5 mm in width (**A**). A second thicker, linear or pyramid-shaped anechoic column projects directly backward from the posterior surface of the eye to the end of the screen (**B**).



We believe that agreement among researchers studying this question is needed before meaningful data can be obtained, shared, and taught to future learners of sonography.

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