Letters to the Editor

Optic Nerve Ultrasound Evaluation in Acute High Altitude Illness

To the Editor:

We read with great consideration the valuable and interesting case report by Wipplinger et al concerning the use of ultrasound as a diagnostic tool to identify acute high altitude illness.¹ Particularly, we focused on the optic nerve sheath diameter (ONSD) ultrasound evaluation, and we would like to point out some considerations on this helpful method.

The authors used B-scan ultrasonography to assess the ONSD increase between Day 7 and Day 8, as shown in Figures 3 and 4 of their paper.¹ However, these 2 figures seem not to be comparable with each other. Regardless of a small methodological bias related to the difference of 0.01 cm in the ONSD measurement distance between the 2 figures,¹ which would not significantly alter the ONSD results, the optic nerve sections evaluated and depicted in the 2 figures are not the same. Figure 4 seems to show the optic nerve insertion, but the same could not be said for Figure 3, where some scleral tissue appears to be present between the optic nerve and the retinal margin. This is due to the nonperpendicularity of the ultrasound beam to the optic nerve head in this scan, which could provide misleading data.

Furthermore, in this kind of measurement, to provide information regarding the gain used, the probe positioning on the eye and the echographic plane are required for repeatable and reliable results. Unfortunately, this information is missing from the presented case. Moreover, trustworthy and precise caliper positioning in ONSD measurements with B-scan ultrasonography is very difficult because it has been widely demonstrated that this technique is affected by the “blooming” effect, which makes such measurements inaccurate and unreliable.^{2–5}

For all the aforesaid limitations, it is advisable to use the standardized A-scan technique proposed in the 1970s,⁶ which is able to provide more objective measurements. This technique is free of the “blooming” effect to allow more precise optic nerve identification and evaluation through the visualization of easily discernible high reflective spikes from the interface between arachnoid and subarachnoidal fluid.^{7,8} Another important advantage of this ultrasound technique is the ability to perform the “30 degrees” test, a very useful test to

discriminate between an ONSD increase related to raised intracranial pressure and an ONSD increase due to a solid thickening of the optic nerve.^{9,10}

In conclusion, we would like to suggest the use of the standardized A-scan technique, instead of B-scan ultrasonography, to obtain a more complete, accurate, and reliable optic nerve evaluation.

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In reply to Vitiello, De Bernardo, Capasso, and Rosa

To the Editor:

We have received and read with interest the letter from Vitiello et al¹ regarding our article entitled “Point-of-care ultrasound diagnosis of acute high altitude illness: a case report,” recently published in *Wilderness & Environmental Medicine*.²

In their letter, the authors raised 2 issues with our use of B-scan ultrasonography to demonstrate an increase in optic nerve sheath diameter (ONSD) in a patient with suspected high altitude cerebral edema (HACE). They argued that the images used to evaluate the patient’s condition were not comparable and could have provided misleading information. They also proposed the use of A-scan ultrasonography as a more objective method for ONSD measurement.¹

The use of the A-scan technique for the diagnosis of ONSD enlargement in a patient with suspected HACE is an interesting suggestion. In eye ultrasonography, the A-scan is routinely used by ophthalmologists to determine eye biometrics in common sight disorders. The A-scan can also be used as an adjunct to the B-scan for the diagnosis of specific intraocular pathologies, such retinal detachments or uveal tumors.³ In the literature, we found a number of similar letters written by the same group of authors in response to other publications using B-scan ultrasonography for ONSD measurements to detect raised intracranial pressure. To our knowledge, however, there is no recent original research regarding the use of the A-scan for this particular indication. In contrast, the B-scan has been accepted as a useful method for the detection of ONSD enlargement and raised intracranial pressure in critical care medicine.^{4,5} The B-scan has also

been used reliably with portable ultrasound devices in high altitude environments.^{6–8}

In high altitude and expedition medicine, we consider B-scan ultrasonography to be the most evidence-based and practical method for ONSD measurement. B-scan ultrasonography is used in many other protocols for point-of-care ultrasound that can be useful in remote, high altitude settings. One example is lung ultrasound for the differential diagnosis of acute dyspnea.⁹ Other potential uses include cardiac, abdominal, and trauma protocols. Most physicians are familiar with B-scan techniques but have never been trained in the use of A-scan techniques. Additionally, A-scan probes are usually not included on standard devices used for point-of-care ultrasound, which means that a secondary device would have to be taken into the field. Furthermore, the A-scan technique relies on direct contact between the ultrasound probe and the cornea or sclera, which requires application of topical anesthetic. Although topical anesthetics have been used successfully in high altitude research, the participants in this study stayed in the protective environment of a mountain hut during the entire study.¹⁰ In the ever-changing environment of remote, high altitude expeditions, the use of topical anesthetics for repeated ONSD examinations can pose logistical problems and safety concerns.

We agree that B-scan measurement of ONSD can be subject to methodologic bias. In hospital environments, ONSD measurements are often performed on sedated patients, which minimizes spontaneous eye movement. In our experience, performing precise measurements on awake patients in remote, high altitude areas can be more difficult, especially if severe acute mountain sickness or HACE is present. Obtaining perfectly comparable images can also be technically challenging owing to unfavorable surroundings and varying clinical situations. To limit bias, ONSD measurements in high altitude environments for research purposes have in the past been based on the mean ONSD calculated from multiple measurements per patient.^{6–8}

For practical reasons, we used a completely handheld device because we were on a trekking expedition and moved to a different location every day. The ONSD measurements were made using a linear high-frequency probe, which provided high-quality images and allowed for accurate measurements. On this particular device, the electronic measurement calipers needed to be positioned using the touchscreen of the device. This accounts for the small imprecision of 0.01 cm when comparing the provided images. As Vitiello et al noted, this should not have significantly altered the ONSD results.¹ Considering our working environment, we believe that the possibility of methodologic bias was sufficiently limited and that our interpretations were correct.