Supplementary

Response to "Systematic use of standardized A-scan technique in neurosurgical intensive care unit"

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We thank Fioretto *et al*. (1) for their interest in our work and appreciate their comments on our article published recently in *Quantitative Imaging in Medicine and Surgery* (2). First described by Karl C. Ossoinig (3) in 1979, our fellow researchers from University of Salerno, Italy have enriched the science in using ultrasound (US) A-scan to measure optic nerve sheath diameter (ONSD). They have elaborated on this modality in an open eye position and have correctly highlighted the importance of having the patient in the primary gaze. This is the same reason we keep the patient's head straight with eyes looking towards the ceiling when performing the study with the eyes closed.

Our study (2) detailed how US B-scan can be used systematically in intensive care unit (ICU) as a part of point of care ultrasound (POC-US) and focused on key technical aspects rather than claiming to be comprehensive. Personally, I scan the eye in an axial plane moving from lateral to nasal direction, fixing at a point where optic cup appears on the retina. Then, I use doppler mode to see the central retinal vessels travelling into the optic nerve. On the frozen image, I then use the methods of measurements as dictated in the article (2) to measure the ONSD.

Most of the neurosurgical patients in ICU are ventilated and, due to trauma, may have swollen eyes, with some having wounds over eyelids. The general prescription of using clear covering over the eyes is to allow the physician to perform the scan without causing any harm even in scenarios where the patients do not cooperate. Keeping the eyes open is difficult to achieve in such patients. Moreover, we avoid anesthetic eye drops unless medically indicated, in neurosurgical patients, particularly those in coma or on medical paralysis. These patients have less frequent eye-blinking which predisposes them to corneal xerosis. These anesthetic eye drops may increase the risk of corneal ulceration by numbing the cornea and weakening the remaining protective corneal reflex.

We rather routinely place artificial tears in such patients which also helps prevent sound attenuation. Certainly, the authors' suggestion of measuring with eyes open is helpful in co-operative patients attending out-patient departments.

Though B-scan has its limitation, it is the most familiar ultrasound modality. US B-scan permits dynamic visualization and assessment of structures, while A-mode is restricted to a single line of measurement. US B-scan has been shown to have excellent correlation with MRI-based measurement of ONSD and has least variation on repetition and least inter-observer variability (4). Besides, it is not just a single high value but a change in value which is important in neurosurgical scenario.

In their comments as well as in their other publications, authors do accept US A-scan studies being more difficult to perform and requires cooperative patients. This makes its use in routine regular monitoring in ICU setting difficult. Besides, US A-scan is contradicted in conditions like corneal ulceration, perforating eye injury or discharge from eye, where B-scan can still be performed over closed eyes.

Regarding their comments on blooming effect and inaccuracy in measurement using US B-scan, there is not enough literature to support this view (5-7). It is however necessary to use standardized protocol to avoid errors. We believe both US A- and B-scans can complement each other and can be used after supervised training to validate the

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findings. However, this modality needs further validation and if possible, a direct comparison with the traditional method. We look forward to more research on this aspect of ONSD measurement.

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