Mini Review
Volume 10:1, 2023

International Journal of Neurorehabilitation

ISSN: 2376-0281 Open Access

Pupillometry and Neurosonography for Neuromonitoring in a Unit for Weaning and Early Rehabilitation

Fumiko Enchi*

Department of Neurology, University of Regensburg, Center for Vascular Neurology and Intensive Care, Regensburg, Germany

Abstract

Background and purpose: Because neuroimaging is rarely readily available, long-term monitoring of intracranial pressure (ICP) in neurological/neurosurgical patients during ventilator weaning and early neurorehabilitation currently relies on clinical observation. Pupilometry and multimodal neurosonography are evaluated for follow-up monitoring in this prospective study.

Methods: During weaning and early neurorehabilitation, sonographic neuromonitoring was used to noninvasively examine the ICP of patients. It made it possible to measure the width of the third ventricle, the possibility of a midline shift, the flow velocities of the middle cerebral artery, and the diameters of the bilateral optic nerve sheaths. The size and reactivity of the pupils were measured with quantitative pupillometry. As controls, we used data from clinical follow-up, ICP measurements from a spinal tap, and other neuroimaging results.

Results: During a mean observation period of 21 days, 17 patients-11 with intracranial hemorrhage, four with encephalopathies, and two with ischemic stroke-were examined for ICP changes using neurosonography and pupillometry. 354 out of 980 analyses, or 36.1%, produced pathological findings. Pathological values without a clear clinical correlate were found during follow-up in 15 of 17 patients (88.2%). Neurosonography was used to identify clinically relevant changes in ICP in two patients (11.8%). The absence of clinical improvement was highly predicted by abnormal pupillometry results.

Conclusion: Pupilometry can only detect rapid ICP changes in acute neurointensive care, whereas multimodal neurosonography may be a noninvasive method for long-term ICP assessment. With a large number of pathological but nonsignificant findings, the study also demonstrates typical pitfalls in neuromonitoring. The effect of detected subtle changes in ICP on neurological outcome should be confirmed by additional controlled studies.

Keywords: Neuromonitoring • Neurosonography • Pupillometry • Neurorehabilitation

Introduction

In dedicated ventilator weaning and early neurorehabilitation units (WENRUs), also known as "neurorehabilitation intensive care units" in Germany, repeated invasive measurements of intracranial pressure (ICP) (such as measurements of intraparenchymal or intraventricular pressure obtained using a probe or ventricle drainage, or lumbar puncture [LP]) and neuroimaging with magnetic resonance imaging (MRI) and computed tomography (CT) are not possible. ICP surveillance is a diagnostic challenge in the WENRU, especially in patients in whom pathological changes in ICP may be relevant or have to be considered due to a particular brain injury such as following ventriculoperitoneal shunt placement. The average hospital stay in a WENRU is 44.6 days.1 It is still unclear whether there is an evidence-based benefit of routine invasive ICP measurements, and long-term implantable monitoring devices have not yet advanced beyond the experimental stage [1].

***Address for Correspondence:** Fumiko Enchi, Department of Neurology, University of Regensburg, Center for Vascular Neurology and Intensive Care, Regensburg, Germany, E-mail: enchifu321@gmail.com*

Received: 03 January, 2023, Manuscript No. ijn-23-88505; **Editor assigned:** 04 January, 2023, PreQC No. P-88505; **Reviewed:** 16 January, 2023, QC No. Q-88505; **Revised:** 21 January, 2023, Manuscript No. R-88505; **Published:** 30 January, 2023, DOI: 10.37421/2376-0281.2023.10.504

Literature Review

At the patient's bedside, automated quantitative pupil measurement and transcranial and orbital sonography can be used to conduct a noninvasive ICP assessment. During the acute phase, single sonographic parameters such as the third ventricle width, midline shift (MLS), flow velocities of the middle cerebral artery (MCA), or optic nerve sheath diameters (ONSD), as well as pupil size and reactivity, are established.7-11 On the other hand, the combination of these various parameters may increase an examination's sensitivity and specificity for changes in ICP, resulting in more effective care for patients in the intensive care unit [2].

Multimodal neurosonography and pupillometry as a noninvasive real-time bedside method for the long-term treatment of WENRU patients was the focus of this study. For a reference study, any routine cerebral imaging, LP puncture with pressure measurement, or clinical follow-up can be used [3].

Strengths and weaknesses of the study

Sonography remains a technique dependent on the examiner, and TCCS, not TCS, is dependent on the presence of a sufficient temporal bone window, making it susceptible to related inaccuracies, particularly in elderly women. However, early neurorehabilitation surveillance strategies should make use of the high-quality brain scans that are made possible by trepanation bone defects more often. Possible solutions include the use of an archive system for second opinions, standardized protocols, and educational efforts. The use of reference values in patients who have suffered a severe brain injury and are currently receiving prolonged acute intensive care medicine is another limitation. Neurosonographic monitoring should be normalized promptly in

conjunction with the most recent cCT and/or ICP measurements from the transferring acute clinic for these patients, who frequently have abnormal baseline values. However, there are limitations to clinical evaluation of patients in a coma for an extended period of time or with severe brain injury. We did not use standardized assessment indicators, such as the Barthel Index or the Extended Barthel Index, because they proved to be too vague to identify rapid ICP changes at an early stage. In contrast to cCT, MRI, or even direct ICP measurements, this study uses a pure bedside and noninvasive diagnostics technique that has no apparent side effects and is widely available in neurorehabilitation. This kind of follow-up is ideal for patients who have significant bone defects. Our small, diverse patient population and the absence of blinding are relevant limitations; However, the treating team did not include the investigator. To confirm our findings, larger observational studies should be carried out in the future [4-6].

Discussion

In this study, we demonstrated that multimodal neurosonography can be used to characterize short- and long-term changes in ICP during early neurorehabilitation, including weaning patients from mechanical ventilation. This is, to our knowledge, the first study to use multimodal neurosonography and pupillometry to investigate the noninvasive long-term follow-up of ICP in a WENRU. In contrast to an acute neurology and neurosurgery intensive care unit, a WENRU does not have invasive ICP measurements, cCT is frequently unavailable, and sudden and acute changes in ICP are uncommon [7].

We were able to identify and measure the third ventricle in all 131 TCS examinations using the well-established sonographic method. According to the report by Kiphuth et al., minimal deviations can be explained by (1) a time interval between the CT and TCS examinations and (2) the higher resolution of TCS compared to CT. These findings are consistent with the clinical findings that ICP elevations with concurrent changes in third ventricle width could be measured, and ICP decreases could be monitored following a successful ICP-lowering therapy. However, these differences were not clinically significant because they were smaller than 1 millimeter. In addition to the follow-up of patients with chronic intracranial pathologies, bedside TCS for an MLS is very important, especially in acute neurology; When an MLS was present, we were able to detect it and follow its course using TCCS in good agreement with CT findings. However, it can be repeated numerous times. Sonographic MLS evaluation is appropriate not only for the acute stage of brain injury but also for long-term monitoring throughout the disease's progression [8].

An important addition to sonographic ICP measurements is blood flow analysis. Based on this assumption, we were also able to demonstrate a correlation between ICP and the PI of the MCA. Bellner et al. were able to demonstrate a strong correlation between ICP measured with an intraventricular catheter and the PI of the MCA. Fortunately, none of the patient's experienced ICP elevation to the point where cerebral blood flow was seriously compromised—the usual strength of this method. However, neither the PI nor the other measurements—third ventricle width, MLS, ONSD, or NPiTM—had a direct (time-related) correlation with one another [9].

An ONSD of >5.8 mm correlates well with an elevated ICP, and both increases and decreases in ICP are immediately measurable in the ONSD. Using TOS, we detected pathological changes in the ONSD and measured increases or decreases in the diameter during follow-up. The reliability of sonographic ONSD measurements has been consistently rated according to published data in healthy individuals. Although our study did not have a blinded review, the supervising experienced neuro However, a previously elevated ICP of >45 mmHg (acute hydrocephalus from acute severe subarachnoid hemorrhage) can cause structural changes in the ONSD and false-positive findings, highlighting the significance of a baseline TOS examination upon patient admission33. Using pupillometry, Chen et al. were able to demonstrate a correlation between decreasing pupil response and increasing ICP, which proved to be a useful method for early assessment of patients with elevated ICP. These manual pupil measurements—also known as the "swinging flash light"—are important in acute neurology and can be objectified with the assistance of a pupillometer [10].

Conclusion

Our findings demonstrate that multimodal neurosonography can be a useful alternative to CT and LP for detecting complications from raised ICP and is suitable for noninvasive, repetitive assessment of ICP, particularly in a WENRU. Multimodal neurosonography may also be able to provide a deeper understanding of a variety of aspects of the pathophysiology of neurological diseases. When it comes to identifying ICP changes that occur quickly, pupillometry currently has a greater significance; it may in the future be used as a marker to predict the patient's clinical course. Changes in pressure could be detected more precisely and the sensitivity of individual measuring methods could be increased by combining various methods of measurement. During follow-up, normal values should not be evaluated as absolutes, especially in cases of complex brain diseases. Instead, they should be evaluated as comparative values within individuals so that complications can be detected earlier and therapy can be started. As a result, we suggest that, prior to WENRU admission, multimodal neurosonography should be validated using established imaging techniques to establish a baseline profile.

Acknowledgement

None.

Conflict of Interest

None.

References

1. Rollnik, Jens D. and Uwe Janosch. "Current trends in the length of stay in neurological early rehabilitation." *Dtsch Arztebl Int* 107 (2010): 286-292.
2. Talving, Peep, Efstathios Karamanos, Pedro G. Teixeira and Dimitra Skiada, et al. "Intracranial pressure monitoring in severe head injury: compliance with Brain Trauma Foundation guidelines and effect on outcomes: A prospective study." *J Neurosurg* 119 (2013): 1248-1254.
3. Chan, Agnes S., Yim-Chi Ho and Mei-Chun Cheung. "Music training improves verbal memory." *Nature* 396 (1998): 128.
4. Wade, D. T., R. Langton-Hewer, Victorine A. Wood and C. E. Skilbeck, et al. "The hemiplegic arm after stroke: Measurement and recovery." *J Neurol Neurosurg Psychiatry* 46 (1983): 521-524.
5. Cuff, Derek J and Derek R. Pupello. "Prospective randomized study of arthroscopic rotator cuff repair using an early *vs.* delayed postoperative physical therapy protocol." *J Shoulder Elbow Surg* 21 (2012): 1450-1455.
6. Galatz, Leesa M., Craig M. Ball, Sharlene A. Teefey and William D. Middleton, et al. "The outcome and repair integrity of completely arthroscopically repaired large and massive rotator cuff tears." *J Bone Joint Surg* 86 (2004): 219-224.
7. Flurin, P.H., P. Landreau, T. Gregory and P. Boileau, et al. "Arthroscopic repair of full-thickness cuff tears: A multicentric retrospective study of 576 cases with anatomical assessment." *Rev Chir Orthop Reparatrice Appar Mot* 91 (2005): 31-42.
8. Ghodadra, Neil S., Matthew T. Provencher, Nikhil N. Verma and Anthony A. Romeo. "Open, mini-open, and all-arthroscopic rotator cuff repair surgery: Indications and implications for rehabilitation." *J Neurol Neurosurg Psychiatry* 39 (2009): 81-A6.
9. Brown, Steven, Michael J. Martinez and Lawrence M. Parsons. "Music and language side by side in the brain: A PET study of the generation of melodies and sentences." *Eur J Neurosci* 23 (2006): 2791-2803.

10. Bush, George, Phan Luu and Michael I. Posner. "Cognitive and emotional influences in anterior cingulate cortex." *Trends Cogn Sci* 4 (2000): 215-222.

How to cite this article: Enchi, Fumiko. "Pupillometry and Neurosonography for Neuromonitoring in a Unit for Weaning and Early Rehabilitation." *Int J Neurorehabilitation Eng* 10 (2023): 504.