Child's Nervous System (2020) 36:47–48
https://doi.org/10.1007/s00381-019-04326-6

FOCUS SESSION

ICP-based decision-making in pediatric neurosurgery

Llewellyn Padayachy[1] · Martin Schuhmann[2]

Received: 13 July 2019 / Accepted: 28 July 2019 / Published online: 7 August 2019

Abstract
Decision-making in pediatric neurosurgery routinely involves assessing intracranial pressure (ICP). The level of injury and severity of disease play an important role in determining which method of ICP measurement is preferred. Invasive and non-invasive techniques have described indications, advantages and shortcomings. This collection of papers from some of the world's leading thinkers in this field is a refreshing perspective on some mundane techniques and a few innovative and promising advances.

Keywords Intracranial pressure · Ultrasound · Non-invasive techniques

Preface

Monitoring and assessment of intracranial pressure (ICP) and ICP-based decision-making are mainly relevant in intensive care medicine. In the pediatric context, this will be mostly, but not limited to children with traumatic brain injury, thus also including hydrocephalus, brain tumors, craniosynostosis, and infection.

Outside of the acute and critical care setting, the value of ICP-based decision-making is not as well established. Routine use in most departments is therefore quite limited, apart from snapshot CSF pressure measurements via lumbar puncture or shunt tap.

A well established limitation for the widespread used of ICP-based decision-making is the requirement for invasive placement of ICP sensors and the associated complications. Whereas invasive ICP assessment is less of an obstacle in the intensive care environment, given the severity of disease, it is considered too invasive as an adequate screening tool for less threatening conditions like chronic hydrocephalus, insidious shunt malfunction, craniostenosis, or pseudotumor cerebri. A computerized analysis, however, delivers much more information than static ICP values alone and may better inform objective decision-making, possibly justifying its use in this context.

Furthermore, lumbar CSF infusion studies or shunt infusion studies instead of punctures only are elegant and less invasive alternatives which provide quantitative data on intracranial CSF or shunt dynamics. Telemetric techniques utilizing invasive sensor implantation, which provide a continuous stream of near real-time data which may be analyzed offline, are especially useful in complicated patients.

An appealing approach as an alternative to invasive ICP analysis is non-invasive techniques for qualitative or quantitative estimation of ICP or derived parameters like CPP. Non-invasive techniques should be relatively easy to use, portable, reproducible, and applicable in smaller children. Ultrasound applications like transcranial Doppler or measurement of the optic nerve sheath diameter (ONSD) are excellent options, poised to position non-invasive ICP assessment as an attractive first-line assessment tool to aid decision-making.

In this special issue, we aim to highlight viable options in invasive and non-invasive ICP-based decision-making in a variety of pathological conditions in pediatric neurosurgery, where ICP assessment is an essential part of unraveling the underlying pathophysiology. We have collected an impressive spectrum of work from leading experts in the field describing invasive ICP-based diagnosis of secondary craniostenosis, shunt malfunction, hydrocephalus, and pseudotumor cerebri including a telemetric approach, to highlight where computerized ICP-based analysis can contribute to our understanding of the underlying pathophysiology or shunt function.

✉ Llewellyn Padayachy
LC.Padayachy@up.ac.za

[1] Department of Neurosurgery, School of Medicine, Faculty of Health Sciences, University of Pretoria, Steve Biko Academic Hospital, Pretoria, South Africa

[2] Department of Pediatric Neurosurgery, University Hospital, Tuebingen, Germany

Non-invasive ONSD determination is one of the most promising and ready for use techniques, still currently grossly underused in pediatric neurosurgical practice. The Doppler assessment of ICP and CPP might help to identify ICU patients requiring invasive ICP monitoring. Advances in acquisition and analysis of both these techniques may well serve to enhance the diagnostic accuracy of non-invasive ICP assessment as a screening and monitoring tool.

We hope that this collection of papers will stimulate readers to use and include invasive computerized and non-invasive ICP analysis in their daily practice to expand the diagnostic armamentarium for ICP-based decision-making in children.

Spring 2019
Llewellyn Padayachy/Martin U. Schuhmann
Pretoria, South Africa/Tübingen, Germany

Compliance with ethical standards

Conflict of interest MS–no conflict of interest. LP–patent application pending for novel technique for non-invasively assessing ICP.