The threshold of optic nerve sheath diameter by ocular ultrasonography for the detection of increased intracranial pressure in Korean adult patients with brain lesions

Jin Pyeong Jeon¹, Si Un Lee², Hannah Lee³, Ho Geol Ryu³

Department of Neurosurgery¹
Hallym University College of Medicine, Chuncheon, Korea

Department of Neurosurgery²
Seoul National University College of Medicine, Seoul, Korea

Department of Anesthesiology and Pain Medicine³
Seoul National University College of Medicine, Seoul, Korea
Case illustration

- M/47 with Alcoholic LC
- Liver transplantation
- Pre-op
  - Bleeding tendency
  - Hypovolemic shock
- GCS
  - E2M5
  - Intubated state
Post-operation

- EBL 6000ml
- SBP > 120mmHg
- Sedative state
- Transfer risk (+)

Which radiologic test should we use for ICH? How often?

PT INR

Platelet

POD #2 days
Serial CT scannings

Pre-op | POD#1 | POD#3 | POD#15
--- | --- | --- | ---
Rt. 5.9mm | 5.8mm | 6.0mm | 5.9mm
Lt. 6.0mm | 6.2mm | 6.4mm | 6.2mm

Optic nerve sheath diameter (ONSD)

Is it Feasible? Normal range?
Methods (1)

• Prospective design, 2013.4-2015.4
• Inclusion criteria
  – ICU or ER / MRI or CT for suspicious increased intracranial pressure (IICP)
  – Time interval between 2 tests < 3hrs.
• Exclusion criteria
  – Age<18 yrs.
  – Orbital trauma or tumor or Arachnoid cyst
Methods (2)
IICP

Hydrocephalus

Cistern obliteration

Sulci effacement

Midline shift
Baseline characteristics (n=78)

<table>
<thead>
<tr>
<th>Variables</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Female</strong></td>
<td>41 (52.4%)</td>
</tr>
<tr>
<td><strong>Age, years</strong></td>
<td>48.2± 13.2</td>
</tr>
<tr>
<td><strong>Presenting Symptoms</strong></td>
<td></td>
</tr>
<tr>
<td>Headache / vertigo</td>
<td>45 (57.7%)</td>
</tr>
<tr>
<td>Deteriorated conscious level</td>
<td>25 (32.1%)</td>
</tr>
<tr>
<td>Seizure, TIA</td>
<td>8 (10.2%)</td>
</tr>
<tr>
<td><strong>Diagnosis</strong></td>
<td></td>
</tr>
<tr>
<td>Hydrocephalus, tumor</td>
<td>15 (19.2%)</td>
</tr>
<tr>
<td>ICH, IVH, infarct</td>
<td>25 (32.1%)</td>
</tr>
<tr>
<td>EDH, SDH</td>
<td>21(26.9%)</td>
</tr>
<tr>
<td>Normal finding</td>
<td>17 (21.8%)</td>
</tr>
<tr>
<td><strong>Radiologic test</strong></td>
<td></td>
</tr>
<tr>
<td>CT</td>
<td>61 (78.2%)</td>
</tr>
</tbody>
</table>

TIA, transient ischemic attack; ICH, intracranial hemorrhage; IVH, intraventricular hemorrhage; EDH, epidural hemorrhage; SDH, subdural hemorrhage.
Result

- Intra- and inter observer agreement: $k = 0.87$ and $k = 0.82$
- Normal group: $5.22 \pm 0.28\text{mm}$
- IICP(+) group: $5.91 \pm 0.31\text{mm}$

$P < 0.001$

Area under the ROC curve: 0.947

IICP: >5.5mm

Sensitivity: 94.34% (95% CI: 84.3-98.8)
Specificity: 86.67% (95% CI: 59.5-98.3)
ONSD

• Normal range: 4.7~5.9mm
• Cut-off value for IICP: 4.8~7.0mm

Ultrasonography

3 Teslar MRI
ONSD for IICP

- 59 adult pts.
- IICP: >5mm
- Sensitivity 100%, specificity 63%

- 35 pts.
  - IICP (+): mean ONSD → 6.27mm
  - IICP (-): mean ONSD → 4.42mm

- 54 pts.
  - IICP(+): 6.4±0.7mm
  - IICP(-): 4.6±0.3mm

2003 Acad Emerg Med by Blaivas et al.
2007 Emerg Med J by Girisgin
Perioperative Estimation of the Intracranial Pressure Using the Optic Nerve Sheath Diameter During Liver Transplantation

Vijay Krishnamoorthy,1 Katharina Beckmann,2 Mark Mueller,2 Deepak Sharma,1,2 and Monica S. Vavilala1,3
Department of 1Anesthesiology and Pain Medicine, 2Neurological Surgery 3Radiology, University of Washington, Seattle, WA; and 4Department of Anesthesiology, University of Illinois, Chicago, IL

Ultrasonographic Optic Nerve Sheath Diameter Is Correlated With Arterial Carbon Dioxide Concentration During Reperfusion in Liver Transplant Recipients

H. Seo, Y.-K. Kim, W.J. Shin, and G.S. Hwang

Table 2. Optic Nerve Sheath Diameter and Clinical Parameters During Liver Transplantation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Preinduction phase</th>
<th>Preeanhepatic phase</th>
<th>Anhepatic phase</th>
<th>5 min after reperfusion</th>
<th>30 min after reperfusion</th>
<th>Neohepatic phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>ONSD (mm)</td>
<td>3.7 ± 0.4</td>
<td>3.8 ± 0.4</td>
<td>3.6 ± 0.4</td>
<td>4.1 ± 0.5†</td>
<td>3.7 ± 0.4</td>
<td>3.7 ± 0.3</td>
</tr>
<tr>
<td>PaCO2 (mm Hg)</td>
<td>37.8 ± 5.4</td>
<td>34.0 ± 3.4</td>
<td>33.2 ± 4.1</td>
<td>36.6 ± 6.2†</td>
<td>36.4 ± 4.8</td>
<td>36.0 ± 3.0</td>
</tr>
</tbody>
</table>
Noninvasive estimation of raised intracranial pressure using ocular ultrasonography in liver transplant recipients with acute liver failure
-A report of two cases-

Young-Kug Kim, Hyungseok Seo, Jihion Yu, and Gyu-Sam Hwang
Department of Anesthesiology and Pain Medicine, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

4.8mm
5.7mm
5.1mm
ONSD in Korean

- Axial CT scan
  - 214 pts. / mean 40 yrs. (11-76)
  - Mean ONSD: 4.1mm (2.9~5.3)
Conclusion

- IICP (+): 5.91±0.31mm in Korean
- Cut-off value: >5.5mm
  - Sensitivity: 94.34% (95% CI: 84.3-98.8)
  - Specificity: 86.67% (95% CI: 59.5-98.3)
- A clinical feasibility study
  - IICP monitoring