Prediction of shunt dependency after intracerebral hemorrhage and intraventricular hemorrhage

Pao-Chun, Lin, Lu-Ting Kuo, M.D., Ph.D., Hsueh-Yi Lu, Ph.D., Jui-Chang Tsai, M.D., Ph.D., Yong-Kwang Tu, M.D., Ph.D.

Introduction

- Spontaneous intracerebral hemorrhage (ICH) is a disease with high morbidity and mortality. Extension of the hemorrhage into the ventricles is associated with development of acute hydrocephalus and a poor outcome.
- Although it can be managed by external ventricular drainage (EVD), a subset of these patients require placement of permanent ventricular shunts.
- This study aimed to examine the factors on admission that can predict shunt dependency after EVD management.

Method

- We reviewed the medical record in National Taiwan University Hospital, National Taiwan University, Medical College, Taipei, Taiwan.
- Inclusion criteria: age ≥18; spontaneous primary IVH with supratentorial origin or spontaneous ICH with extension into ventricles; admittance to Emergency Services within 12 hours after onset and EVD performed.
- Variables analyzed included age, intraventricular hemorrhage (IVH) score, bicaudate index, acute hydrocephalus, initial Glasgow Coma Scale scores, and blood volume in each ventricle.

Result

- 17 of 72 patients underwent placement of a ventriculo-peritoneal shunt (VP shunt).
- In univariate analysis, IVH score, bicaudate index, blood volume in lateral ventricles, blood volume in fourth ventricle, and the ratio of blood volume in lateral ventricles to that in third and fourth ventricles were significantly associated with persistent hydrocephalus.
- The best multiple logistic regression model included blood volume parameters and bicaudate index as predictors with the area under a receiver operating characteristic curve of 0.849.

Table 1. Demographic, clinical and radiographic variables in 72 patients

<table>
<thead>
<tr>
<th></th>
<th>Overall (n=72)</th>
<th>No VP shunt, n=55 (76.4%)</th>
<th>VP shunt n=17 (23.6%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVH score</td>
<td>13.1 (4.9)</td>
<td>12.4 (5.1)</td>
<td>15.7 (3.0)</td>
<td>0.020</td>
</tr>
<tr>
<td>Bicaudate index (abnormal)</td>
<td>22 (30.6%)</td>
<td>11 (20.0%)</td>
<td>11 (64.7%)</td>
<td>0.000</td>
</tr>
<tr>
<td>IVH, lateral ventricles (cm³)</td>
<td>8.1 (6.5)</td>
<td>9.0 (6.9)</td>
<td>4.8 (3.9)</td>
<td>0.025</td>
</tr>
<tr>
<td>IVH, 4th ventricle (cm³)</td>
<td>1.1 (1.1)</td>
<td>0.96 (1.1)</td>
<td>1.6 (0.97)</td>
<td>0.038</td>
</tr>
<tr>
<td>Lateral / (3rd + 4th)</td>
<td>2.1 (1.9)</td>
<td>2.5 (1.9)</td>
<td>0.79 (0.79)</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Table 2. Performance of the VP shunt dependency prediction

<table>
<thead>
<tr>
<th></th>
<th>Calibration</th>
<th>Discrimination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C &amp; S R²</td>
<td>N R²</td>
</tr>
<tr>
<td>IVH score, bicaudate index</td>
<td>0.178</td>
<td>0.276</td>
</tr>
<tr>
<td>Lateral, 3rd, 4th IV, bicaudate index</td>
<td>0.235</td>
<td>0.360</td>
</tr>
<tr>
<td>3rd IVH, 4th IV, Lateral IVH / (3rd IVH + 4th IVH), bicaudate index</td>
<td>0.241</td>
<td>0.374</td>
</tr>
</tbody>
</table>

Table 3. IVH volume associated with acute hydrocephalus and IVH score

<table>
<thead>
<tr>
<th>IVH volume</th>
<th>Acute Hydrocephalus</th>
<th>OR</th>
<th>95%CI</th>
<th>IVH score†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>95%CI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral IVH</td>
<td>logistic regression, hydrocephalus as outcome variable (0:no, 1:yes)</td>
<td>0.910*</td>
<td>0.834-0.993</td>
<td>0.651**</td>
</tr>
<tr>
<td>3rd IVH</td>
<td>Pearson correlation test</td>
<td>3.174**</td>
<td>1.353-7.447</td>
<td>0.396**</td>
</tr>
<tr>
<td>4th IVH</td>
<td>OR odds ratio; CI: confidence interval</td>
<td>2.126*</td>
<td>1.190-3.797</td>
<td>0.451**</td>
</tr>
</tbody>
</table>

Conclusion

- Blood volume parameters and bicaudate index can predict shunt dependency after EVD management.
- These findings may promote more aggressive monitoring and earlier interventions for persistent hydrocephalus after intraventricular hemorrhage in patients at risk.