SHORT REPORT

Computed tomographic evidence of cerebral swelling in benign intracranial hypertension

P M Rothwell, R J Gibson, R J Sellar

Abstract

Computed tomography of 30 patients presenting acutely with benign intracranial hypertension was compared with that of 30 normal controls matched for age and sex. Qualitative and quantitative assessments showed smaller cranial CSF spaces in the cases of benign intracranial hypertension, suggesting that cerebral swelling is involved in the pathogenesis of benign intracranial hypertension.

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The pathogenesis of benign intracranial hypertension is unknown. There have been conflicting reports of cerebral oedema,1 cerebral hyperaemia,2 and increased resistance to CSF drainage,3 but it remains unclear which element of the cerebral contents is increased in volume. The aim of this study was to examine the size of the cranial CSF spaces on CT of patients with benign intracranial hypertension compared with age and sex matched normal controls to determine whether raised intracranial pressure in benign intracranial hypertension is associated with an increase in volume of the cerebral tissues or the CSF.

Methods

Thirty consecutive patients with newly diagnosed benign intracranial hypertension who presented to the Departments of Medical and Surgical Neurology in Edinburgh between 1985 and 1992 were studied. Inclusion criteria comprised papilloedema; a CSF pressure greater than 25 cm of water; normal CSF constituents; and no evidence of intracranial mass lesion or hydrocephalus. Computed tomography was performed on a General Electric 8800 scanner at the initial presentation with suspected benign intracranial hypertension. The 30 control CT scans were derived from scans of a cohort of 62 patients with peripheral sensory symptoms, in whom detailed inpatient investigation showed no pathology of the CNS. Cases were paired with controls according to sex and nearest date of birth. No other criteria were used and matching was blind to the CT appearance.

On two occasions, three months apart, the 60 scans were shown independently to two neuroradiologists (RJG and RJS) who were blind to the clinical diagnosis. They were asked to grade the lateral ventricles as small, normal, or large, the third ventricle as normal, slit, or absent, and the cerebral sulci as normal or effaced. Each scan from a patient with benign intracranial hypertension was then presented with an age and sex matched control scan and the neuroradiologist was asked to indicate which scan suggested the lower cranial CSF volume. The size of the third and lateral ventricles, the sulci, and the basal cisterns were each taken into account in this qualitative assessment.

Three previously validated quantitative indices of ventricular size—the Huckman Index,4 the inverse cella media index,5 and the third ventricular diameter6—were also measured on the 60 scans by a single observer (PMR) who was blind to the clinical details.

Results

Only abnormal CT scan findings on which both radiologists agreed are reported. Small lateral ventricles, a slit or absent third ventricle, and effaced cerebral sulci were each significantly more frequent in cases of benign intracranial hypertension than in controls (table 1). The radiologists agreed on which scan showed the smaller cranial CSF spaces in 28 of the 30 case and control pairs (93%), choosing the benign intracranial hypertension scan in 24 (86%). The between observer and within observer agreements of the radiologists for each of the CT assessments were high (table 2). The mean values of each of the three quantitative indices of ventricular size were significantly lower in cases of benign intracranial hypertension than in controls.

Table 1 Qualitative assessments on CT of 30 cases of benign intracranial hypertension and 30 controls about which both radiologists agreed

<table>
<thead>
<tr>
<th></th>
<th>Small lateral ventricles</th>
<th>Shrunken 3rd ventricle</th>
<th>Effaced Sulci</th>
<th>Smaller cranial CSF spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases (n = 30)</td>
<td>9</td>
<td>15</td>
<td>13</td>
<td>24</td>
</tr>
<tr>
<td>Controls (n = 30)</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Odds ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% CI</td>
<td>12·4</td>
<td>14</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>(1·5–105)</td>
<td>(3·0–70)</td>
<td>(2·7–185)</td>
<td>(1·8–20)</td>
</tr>
</tbody>
</table>
Assessment agreement A

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Between observer agreement</th>
<th>Within observer agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of third ventricle</td>
<td>0.7 (0.09)</td>
<td>0.85 (0.06)</td>
</tr>
<tr>
<td>Size of lateral ventricles</td>
<td>0.70 (0.11)</td>
<td>0.60 (0.07)</td>
</tr>
<tr>
<td>Effacement of sulci</td>
<td>0.68 (0.1)</td>
<td>0.91 (0.06)</td>
</tr>
<tr>
<td>Smaller cranial CSF spaces</td>
<td>0.76 (0.08)</td>
<td>0.82 (0.07)</td>
</tr>
</tbody>
</table>

**Table 3** Mean (SD) values of three quantitative measures of ventricular size in 60 CT brain scans

<table>
<thead>
<tr>
<th>CT:</th>
<th>Third ventricle diameter (mm)</th>
<th>Huchman index</th>
<th>Inverse cilia media index</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIH cases (n = 30)</td>
<td>0.70 (0.46)</td>
<td>49 (21)</td>
<td>0.074 (0.02)</td>
</tr>
<tr>
<td>Controls (n = 30)</td>
<td>1.44 (0.68)</td>
<td>73 (27)</td>
<td>0.124 (0.07)</td>
</tr>
</tbody>
</table>

BIH = benign intracranial hypertension.

(table 3), indicating a smaller ventricular size in patients with benign intracranial hypertension.

**Discussion**

Small lateral ventricles, a slit or absent third ventricle, and effaced cerebral sulci were often seen on CT in cases of benign intracranial hypertension, but rarely in controls. When age and sex matched case and control scans were compared directly, the benign intracranial hypertension scans showed consistently smaller cranial CSF spaces than controls. The high between and within observer agreements for these qualitative assessments support their validity. Indeed, such highly reproducible qualitative measures are likely to be more valid than arbitrary and technically difficult semiquantitative measures.4

Five previous studies have looked at cerebral ventricular size by CT of patients with benign intracranial hypertension.7-11 Only one found small ventricles, but CT of patients with multiple sclerosis and cerebrovascular disease, which may be associated with cerebral atrophy and ventricular enlargement, were used as controls.11 Of the remaining studies, three had no controls12-15 and all were limited by the small number of cases. The sizes of the other cranial CSF spaces, such as the basal cisterns and cerebral sulci have not been studied.

Small or slit lateral ventricles, a slit or absent third ventricle, and effaced basal cisterns and sulci are seen on CT after acute head injury and correlate with the severity of raised intracranial pressure and the degree of cerebral swelling at postmortem.16-19 The identical CT findings in this study raise the possibility that cerebral swelling is important in the pathogenesis of raised intracranial pressure in benign intracranial hypertension. This is supported by the finding that ventricular size on CT,14 and cranial CSF volume, measured with MRI,15 increase with resolution of benign intracranial hypertension.

It is possible that small cranial CSF spaces in patients with benign intracranial hyperten-
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