Inverse Relationship Between Plasma Vasopressin and Intracranial Pressure

N. Bohnen\(^1\), A. Twijnstra\(^2\), D. Terwel\(^1\) and J. Jolles\(^3\)

\(^1\)Department of Neuropsychology and Psychoepidemiology, University of Limburg, Maastricht.
\(^2\)Department of Neurology, University Hospital of Maastricht, Maastricht, The Netherlands

Introduction

Csf arginine-vasopressin (VP) levels have been found to be elevated in a number of conditions associated with raised intracranial pressure (ICP), such as subarachnoid hemorrhage and intracranial tumor (Sorensen, Gjerris and Hammer 1984). A positive correlation between the ICP and the concentration of VP in the csf has been demonstrated in patients with different degrees of elevated ICP (Sorensen, Gjerris and Hammer 1984). In addition to the levels of VP in the csf, plasma VP levels increased during low and high pressure perfusion in hydrocephalus patients (Sorensen, Gjerris and Hammer 1985).

It is unknown whether these changes in the release of VP are causally related to these conditions or whether they are simply secondary phenomena. Little is known about the dynamic pattern of VP in the csf and plasma of humans under conditions of intracranial hypertension, because most of the research on this topic has used only single measurements. We measured VP several times in the plasma and CSF of a patient under conditions of a relatively rapidly fluctuating ICP in order to gain more insight into the dynamics of VP.

Case report

A previously healthy 30-year-old man was admitted to the hospital following a history of gradual onset of headache, blurred vision, back pain and muscle cramps. A C.T. scan with contrast showed increased attenuation, which involved the basal, Sylvian and peri-mesencephalic systems, with diffuse enhancement along the gyri of both convexities. No masses were identified. A magnetic resonance scan revealed normal T1 and T2 signs. A lumbar puncture yielded cerebrospinal fluid under an initial pressure of 400 mm of water. The fluid was clear, colourless and contained 30 leucocytes per cubic millimeter and no erythrocytes. Cytological tests confirmed the presence of ependymoma tumor cells. Taken together with the clinical symptoms and the signs of increased intracranial pressure, the above-mentioned findings fulfill the diagnostic criteria of a leptomeningeal infiltration of a tumor with involvement of the brain and spinal roots.

A ventricular drain attached to a subcutaneous reservoir (Ommaya device) was placed for the intraventricular administration of cytotoxic drugs. This catheter was inserted into the right ventricle via a frontal drill-hole and clear CSF was obtained under increased pressure (30–500 mm water). Raised intracranial pressure was treated by repeated ventricular punctures from the reservoir (2–4 times a day). Routine laboratory screening of the blood did not indicate abnormalities.

CSF was collected by ventricular drainage from the Ommaya device with the patient in the lateral recumbent position. Plasma and CSF VP concentrations and plasma osmolality were measured on day 1 and three times on days 2, 3, and 4 (at 8 am, 4 pm and 11 pm). The patient underwent radiation therapy (200 Rad) on day 2. Although the punctures were performed for therapeutic reasons, the patient gave his informed consent. Intraventricular ICP was measured during 1 minute immediately before collecting the CSF (Optidynamic manometer). Because of the short half life of VP in the blood, blood was taken from a forearm vein immediately after each CSF drainage. The plasma and CSF were stored at −20 °C until the VP concentration was measured by radioimmunoassay (Ten Haafe, Van Wimersma Greidanus, Maigret and De Wied 1986). In short, the plasma was extracted with activated Yycorb (Corning Glass Works, New York). After extraction, the residues were resuspended in a Veronal buffer, pH 8, containing 3 mg human serum albumin per millilitre, and assayed. A specific C-terminal directed antiserum was used, and the cross-reactivity with oxytocin and DDAVP was < 0.01% and with lysine VP circa 10%. The inter- and intra-assay coefficients of variation were 11.3 and 13.5, respectively. Each sample was measured in triplicate. Plasma osmolality was measured by freezing point depression. The patient was not receiving drugs at the time of the study and did not experience nausea or pain during the measurements.

Results

As can be seen from the results the ICP was found to change rather rapidly. The concentration of VP in the csf was increased at all time points (normal range: 0.8–1.8 fmol/ml). With the exception of the first measurement the plasma levels of VP were also elevated (normal range: 1.0–2.0 fmol/ml). Although the concentration of VP in the CSF was increased, there was no positive correlation between this increase and the ICP (see Table 1). In contrast, the plasma VP concentration was inversely related to the ICP (Figure 1). Finally, there was no significant correlation between the plasma osmolality and the plasma VP concentration.

Table 1

<table>
<thead>
<tr>
<th>Measurement</th>
<th>ICP (mm water)</th>
<th>Csf VP (fmol/ml)</th>
<th>Plasma VP (fmol/ml)</th>
<th>Plasma osmolality (mosm/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>day 1 3 pm</td>
<td>320</td>
<td>2.47 ± 0.22</td>
<td>1.46 ± 0.26</td>
<td>290</td>
</tr>
<tr>
<td>day 3 10 am</td>
<td>140</td>
<td>2.32 ± 0.19</td>
<td>3.44 ± 0.23</td>
<td>290</td>
</tr>
<tr>
<td>day 3 3 pm</td>
<td>250</td>
<td>2.10 ± 0.28</td>
<td>2.29 ± 0.29</td>
<td>290</td>
</tr>
<tr>
<td>day 3 12 pm</td>
<td>120</td>
<td>2.51 ± 0.45</td>
<td>4.21 ± 0.18</td>
<td>283</td>
</tr>
</tbody>
</table>


Received: 28 Aug. 1991 Accepted: 9 Dec. 1991
Discussion

In contrast with former reports (Sørensen, Gjerris and Hammer 1984), no positive correlation between the csf VP concentration and the ICP was noticed in our patient. In addition, the concentrations of VP in the plasma were inversely related to the ICP. As we collected blood and csf from our patient at different times, it is possible that our results are biased because of diurnal variations in the concentration of VP. However, a diurnal variation of VP in the csf or plasma appears to be absent in man (Barroca, Franceschini, Siani, Messina, Francaviglia, Perrin and Rolandi 1988). It is not clear what the physiological significance of the inverse relationship between plasma VP and increased ICP is. Compensatory mechanisms might adjust the release of VP into the blood, e.g. via feed-back control from osmoreceptors and baroreceptors. For example, hemodynamic studies in animals suggest that VP interacts with the baroreceptor reflex to alter its feedback gain (Cowley, Merrill, Osborn and Barber 1984). It is unknown whether such a baroregulatory mechanism may contribute to the present finding of an inverse relationship between the concentration of VP in plasma and the ICP. Although it is not possible to make valid conclusions on a single case, the findings might at least indicate that the dynamic pattern of VP release under conditions of rather fluctuating ICP may essentially differ from that of conditions with more stable intracranial hypertension.

References


Requests for reprints should be addressed to:

N. Bohnen

Department of Neuropsychology and Psychobiology
University of Limburg
P. O. Box 616
6200 MD Maastricht (The Netherlands)