ICP-Monitoring in the Middle Cranial Fossa. A Comparison Between the Intraventricular Method and the Introduction of a Catheter Tip Transducer into the Parasellar Cistern via the Foramen Ovale

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Introduction

In cases of brain edema after closed head injuries it is often impossible to puncture the lateral ventricles for the purposes of ICP monitoring. The epidural pressure gives less accurate results depending on baseline shift as Gobiet et al. (1972) found, and difficulties with the coplanar implantation as many investigators published. Another reason lies in the non-homogeneous transmission of increased intracranial pressure within the supratentorial space, as Langfitt et al. (1964) stated. This forced us to look for another approach. When looking through the “retrospectoscope” as Evans (1972) told us during the First International Symposium on ICP we could not find any paper dealing with intracranial pressure monitoring through the foramen ovale. Based on our own experience with more than 1200 electrocoagulations of the Gasserian ganglion, published by Hensell and Miltz (1974) with the method of Kirschner (1933), today's thermocoagulation and the neuroradiological findings of Hakanson (1979) we tried this route via the foramen ovale into the subarachnoid space of the middle cranial fossa. From our operations in trigeminal neuralgia we knew that sometimes the trigeminal cistern was reached by the Kirschner method as well as with the approach of Härtel. It is well known anatomically and proven by Hakanson (1979), that the trigeminal cistern opens into the subarachnoid space of the posterior fossa. In cases of a normal ICP this location could give useful data, but in patients with raised ICP, in whom a continuous monitoring is indicated, there could be some limitations in the accuracy of posterior fossa ICP, as Langfitt (1964) mentioned. Secondly, the canal from Meckel’s cave into the posterior fossa can be obstructed by brain swelling. In order to avoid these difficulties a catheter tip pressure transducer is pushed forward into the subarachnoid space of the parasellar cistern of the middle cranial fossa. Here a satisfying ICP record can be obtained.

Method

In patients with severe head injuries a 14 gauge teflon coated needle is introduced under local anesthesia or controlled respiration. Under fluoroscopic control it is pushed forward through the foramen ovale into the subarachnoid space of the parasellar cistern in the middle cranial fossa. Often CSF can be aspirated. After removing the inner needle a Millar micro-tip catheter pressure transducer of 4 or 5 French is inserted just in front
of the petrous bone. As seen in Fig. 1, the tip lies some mm below its edge. The proper position can be checked on the fluoroscope or by X-rays. Secondly on a monitor the pulse and respiratory changes of ICP can be seen precisely. The tip will not penetrate the brain as when Clark (1975) used these transducers, but will reach the parasellar cistern. In the first patients parallel recordings were done in order to test the method. In most cases the intraventricular method of Lundberg (1960) was performed, in a few cases epidural measurements were done simultaneously. Clinically, the patients were treated aggressively with controlled ventilation and barbiturates if ICP reached 25 mm Hg. In addition, corticosteroids such as dexamethasone and triamcinolone-acetonide were administered.

Results

Until now, nine patients underwent this method of ICP-monitoring subdurally via the foramen ovale. According to the severity of the underlying brain damage the mortality rate was high. Six patients survived and one remained in a vegetative state. There was no meningitis, but in one patient a small increase of CSF cells appeared after five days of implantation. She survived her severe brain trauma well. In the survivors the puncture of the Gasserian ganglion caused no irritation of the trigeminal nerve, but there are no late results. On the cheek there appears only a tiny puncture. The recordings show a close correlation when measuring at the same site. The differential pressure of both methods shows this best and gives reliable data for evaluation as seen in Fig. 2. The correlations between the described method and the IVP was excellent. As shown in Fig. 3, the correlation coefficient is \( r = 0.997 \) and \( y = 0.977x - 0.078 \). In these 60 points the mean CSFP \( \bar{x} \) was 7.39 and the mean subdural pressure \( \bar{y} \) was 7.15. The standard deviation was \( S_x = 6.381 \) and \( S_y = 6.259 \). In this patient the error at a CSFP of 100 mm Hg was calculated to be \( -2.29\% \). When comparing the subdural pressure in the middle cranial fossa with the epidural pressure, less accurate results could be obtained. In a series of 61 points the correlation coefficient was \( r = 0.980 \) and the line of identity was \( y = 0.756x - 2.56 \). The mean epidural pressure was \( \bar{x} = 30.96 \) and the mean subdural one \( \bar{y} = 20.86 \). The standard deviation was \( S_x = 23.74 \) and \( S_y = 18.33 \). The calculated error at 100 mm Hg EDP was \(-27.89\%\). On the other hand the calculated error of the epidural pressure, which is much more likely, lies in the range of \(+35.52\%\) in this series. This is in accordance with the literature.

Discussion

In our opinion there is no doubt that one can obtain reliable data on the intracranial pressure with the catheter tip pressure transducer in the subdural space of the middle cranial fossa. Advantages are the quality of measured data, the ease of introduction to those neurosurgeons, who are familiar with the treatment of trigeminal neuralgia and the possibility of aspirating CSF during the measurement through the outer teflon cannula. The disadvantages are the possibility of an infection in the subarachnoid space, the eventuality of slight brain damage or hematoma and that there are no late results.