Interhemispheric Gradients in Head-Injured Patients: Their Evidence in Epidural Intracranial Pressure Measurement

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Introduction

Intracranial pressure (ICP) in clinical use is monitored by epidural sensors. From subarachnoidal measurement, pressure gradients between different intracranial compartments are known, mainly transtentorially and on both sides of the falx cerebri. While the transtentorial differences are well known, the interhemispheric gradients in brain-injured patients so far have not sufficiently been quantified, especially for epidural evaluation.

Material and Methods

In 15 patients ICP was monitored by epidural, frontal measurements on the right and left sides, in reference to the foramen of Monro. We used the sensor of the Geltec company. For calculation of the cerebral perfusion pressure (CPP), we cannulate the radial artery for continuous blood pressure recording by a Statham transducer. Measurement started 22 h after the accident and was performed on average of 79 h. It was performed until ICP was in a normal range (12 patients) or brain death occurred (3 patients). For analysis we divided the total time of measurement for each patient into 3-h intervals. The average ICP and CPP values of these intervals were used as our main criteria for evaluating study results.

Results

Of our 15 patients 12 showed an ICP gradient between the right and left hemispheres: in 7 cases the gradient was noticed once in the clinical course and in 5 cases twice. The gradient in these 12 patients averaged 15 mmHg, with a maximum of 30 mmHg maximally, due to 3-h intervals. When it occurred, we always noticed significant differences for longer than 24 h – a maximum of 3 days in one course.

In cases of an cerebral contusion, the side of the high or low ICP corresponded to CT criteria. Figure 1 shows the ICP course of a 37-year-old patient with

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bifrontal contusion areas. The ICP on the right side is up to 30 mmHg higher than on the left. This gradient occurred twice during the measurement period. In the case of this patient, we temporarily also measured the intraventricular pressure, which was lower than ICP on both sides and led to completely different evaluations of the patient's situation. On the other hand, the CPP in cases of mainly a traumatic brain swelling showed significant gradients up to 20 mmHg, although computed tomography revealed no differences concerning formation of the right/left edema.

When an acute ICP rise was induced (for example, upon coughing against the respirator; Fig. 2), we observed a characteristic pressure curve in all patients. The side of the primarily higher ICP showed a proportionally higher mounting, and the plateau was reached earlier on this side. In the phase of the final ICP fall, the higher side showed a delay in reaching the basic pressure again.

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Fig. 1. ICP course after bifrontal contusion (37-year-old man, measurement starting 6 h after the accident). Each column is the average ICP for 3 h. R, Right side; L, left side; VP, intraventricular pressure.

Fig. 2 A–D. ICP course in acute crisis in case of a traumatic brain swelling. A Before coughing against the respirator. B 1 min after coughing. C 5 min after coughing. D normalization.