Diazepam and Intracranial Pressure

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In neurosurgical anesthesia, drugs which decrease cerebral blood flow (CBF) are assumed to decrease intracranial pressure (ICP) probably as a result of a decrease in cerebral blood volume (CBV).1,2 Diazepam is known to decrease CBF in both humans and animals,3,4 and hence may decrease ICP. However, in dogs, Campan et al.5 observed no significant change in ICP with diazepam. The effect of diazepam on ICP in humans has not been described except for a case report by Phirman and Shapiro.6 Therefore, we measured ICP after intravenous injection of diazepam in neurosurgical patients.

METHODS

The study was approved by the Human Experimentation Committee of the Hospital and was performed during the induction of general anesthesia on ten neurosurgical patients who were divided into two groups of five patients each: hypertensive (ICP > 15 torr) and normotensive (ICP < 15 torr). Their age ranged from eleven to seventy-six years old. Four cases of intracranial hematoma, three cases of brain tumor, two cases of hydrocephalus and one case of subarachnoid hemorrhage were included. Glasgow coma scale7 was 15 in five patients, 14 in two patients, and 13, 11, and 10, respectively, in the remaining three patients. An intraventricular catheter or a subdural balloon, which was connected to a transducer (Statham* P231D), was installed one or two days before surgery, under local anesthesia. On the day of surgery, a central venous catheter was inserted from the basilic vein, and a catheter inserted in the radial artery. Direct arterial pressure, ICP, ECG, and rectal temperature were monitored continuously. Arterial pressure, central venous pressure (CVP) and ICP were zero-referred to the level of external auditory canal. Cerebral perfusion pressure (CPP) was calculated as the difference between mean arterial pressure (MAP) and mean ICP. After monitoring was started, at least 10 min elapsed to permit the measured variables to become constant. The measurements were performed before, and for 15 min after diazepam (0.25 mg/kg for one min) administration. CVP was measured by open manometry before, 5, 10, and 15 min after diazepam. Arterial blood gases, heart rate, and hematocrit were measured before and 10 min after diazepam was given. After the measurements, all the patients were hyperventilated and neuroleptanesthesia was started. The subsequent course of anesthesia in all cases was uneventful. Results were analyzed statistically using a Student's t test for paired data to compare the values before and after diazepam in each group, and for unpaired data to compare the values before diazepam between both groups. P < 0.05 was considered to be significant.

RESULTS

Figure 1 shows individual ICP before and after diazepam. Table 1 shows mean values of ICP, MAP

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The Glasgow coma scale consists of points for the best possible responses to vocal or noxious stimuli as characterized by eye opening, verbalization, and motor activity. Normal responses result in a score of 15, with 3 being the lowest possible value.
and CPP in both groups. In the hypertensive group, ICP did not change, while MAP and CPP decreased significantly after diazepam to 82 and 77 per cent of control values at 5 min, respectively. In the normotensive group, ICP significantly decreased only at 5 min while MAP and CPP remained unchanged. There were no significant differences of the values before diazepam between the two groups in MAP, CPP, CVP, blood gases, heart rates, hematocrit and body temperature. $P_{a}CO_{2}$ values before and after diazepam were $37 \pm 1$ (mean $\pm$ SEM) and $39 \pm 1$ torr in the hypertensive group, and were $40 \pm 2$ and $39 \pm 3$ torr in the normotensive group, respectively.

**Table 1. Effect of Diazepam on Intracranial Pressure (ICP), Mean Arterial Pressure (MAP) and Cerebral Perfusion Pressure (CPP)**

<table>
<thead>
<tr>
<th></th>
<th>ICP (torr)</th>
<th>MAP (torr)</th>
<th>CPP (torr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hypertensive</td>
<td>Normotensive</td>
<td>Hypertensive</td>
</tr>
<tr>
<td>Before diazepam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After diazepam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 min</td>
<td>$21 \pm 3^\dagger$</td>
<td>$9 \pm 1^\dagger$</td>
<td>$104 \pm 6$</td>
</tr>
<tr>
<td>3 min</td>
<td>$22 \pm 4$</td>
<td>$8 \pm 1$</td>
<td>$93 \pm 6\dagger$</td>
</tr>
<tr>
<td>5 min</td>
<td>$22 \pm 4$</td>
<td>$8 \pm 1$</td>
<td>$90 \pm 8\dagger$</td>
</tr>
<tr>
<td>10 min</td>
<td>$21 \pm 4$</td>
<td>$8 \pm 1$</td>
<td>$85 \pm 7\dagger$</td>
</tr>
<tr>
<td>15 min</td>
<td>$20 \pm 4$</td>
<td>$9 \pm 1$</td>
<td>$88 \pm 7\dagger$</td>
</tr>
</tbody>
</table>

*Values are mean $\pm$ SEM.
†Significantly different between the groups ($P < 0.05$).
‡Significantly different from the values of before diazepam ($P < 0.05$).
patients who have impaired autoregulation due to intracranial pathology, a more pronounced reduction of CBF may occur than that found in our study. Therefore, MAP must be carefully maintained in these patients. The present result does not mean that diazepam is unsuitable for neurosurgical anesthesia. In fact, Phirman and Shapiro stated that prior induction of anesthesia with diazepam and thiopental was capable of blocking an increase in ICP due to nitrous oxide, suggesting the usefulness of this combination in those patients with decreased intracranial compliance. In summary, a clinical dose of diazepam does not increase ICP.

REFERENCES

Evaluation of a Disposable Humidifier for Use during Anesthesia

D. B. Weeks, M.D.*

The provision of humidity during prolonged endotracheal anesthesia has been recommended to prevent changes in ciliary cellular morphology and activity and in pulmonary mechanics. The method employed should reproduce the natural process and provide inspired humidity at temperatures to which the upper trachea is accustomed. This paper reports a laboratory and clinical investigation of the Servo Humidifier® 150† with a disposable element, which appears to satisfy these physiologic needs.

**Materials and Methods**

The Servo Humidifier® 150 (SH 150), a condenser humidifier that has a heat and moisture trap (cellu-

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Key words: Equipment: humidifier.
† Siemens-Elema Ventilator System, 1765 Commerce Drive, Elk Grove Village, Illinois 60007.

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