HEADACHE FOLLOWING HALOTHANE ANAESTHESIA

BY

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SUMMARY

The frequency of headache occurring in the postoperative period following three common anaesthetic techniques is described. The incidence following anaesthesia with halothane and controlled ventilation was found to be significantly higher than in a similar group in which halothane was not used. The two groups were otherwise comparable in all respects. A third technique employing halothane and spontaneous respiration showed a still higher incidence of headache when compared with the halothane and controlled ventilation method, but this difference was not statistically significant. In ten patients (20 per cent of those receiving halothane) headache was the main postoperative complaint. The possible relationships between the headaches after halothane and the effect of this drug on the cerebral vasculature and cerebrospinal fluid pressure are discussed.

Headache is usually considered a minor sequel of anaesthesia (Edmonds-Seal and Eve, 1962; Thomas, 1963) other than when occurring after deliberate or inadvertent subarachnoid tap. However, headache assumes greater importance in the immediate postoperative period in an out-patient or in early ambulant patients after relatively minor procedures. This study was designed to investigate the influence of halothane on the incidence of postoperative headache.

MATERIAL AND METHODS

Patients, of both sexes, undergoing routine dental in-patient treatment, commonly extraction of impacted molar teeth, were selected for this investigation. The age range was 16 to 56 years (mean 25 ± 9 years) and all were in good health. Premedication was atropine 0.6 mg intramuscularly ½ to 1 hour pre-operatively. Induction consisted of thiopentone 6 to 8 mg/kg intravenously, followed by suxamethonium 50–100 mg to facilitate nasotracheal intubation. The pharynx was packed with vaseline gauze.

The patients were divided into three groups according to the techniques used to maintain anaesthesia.

Group I. Spontaneous respiration, using nitrous oxide, oxygen and halothane (1–1.5 per cent) (SR halothane).

Group II. Controlled ventilation using nitrous oxide, oxygen and tubocurarine (0.5 mg/kg) only (CV no halothane).

Group III. Controlled ventilation, using nitrous oxide, oxygen and tubocurarine (0.5 mg/kg) and halothane (1–1.5 per cent) (CV halothane).

A semiclosed circuit was employed with carbon dioxide absorption; the fresh gas supply always contained at least 30 per cent oxygen. Moderate hyperventilation was aimed at in Groups II and III and checked using a Wright anemometer (Wright, 1955; Nunn and Ezi-Ashi, 1962). Halothane was delivered to the circuit from a Fluotec Mark II vaporizer (in the “outside circuit” position). Patients over 65 kg in weight received 1.5 per cent halothane; patients under 65 kg received 1 per cent halothane. At the end of the operation atropine 0.6 mg and neostigmine 2.5 mg were administered intravenously to all patients receiving tubocurarine.

Any patient exhibiting coughing, straining or cyanosis during the anaesthetic was excluded from the trial. The pulse, blood pressure and minute volume were recorded in all patients and the duration of anaesthesia and concentration of halothane administered were noted. In no case did the systolic blood pressure fall below 100 mm Hg. All patients were anaesthetized in the supine, horizontal position.
Arterial carbon dioxide tensions ($Pa_{co2}$) were estimated in seven patients randomly chosen from each group, samples being taken towards the end of the procedure. Samples were taken from the radial artery over a 2-minute period into heparinized syringes, iced and estimated as soon as possible by the Astrup technique (Astrup et al., 1960). No correction factors were applied.

Postoperatively the patients were returned to the recovery ward until fully awake. The environments were very similar and the patients were left undisturbed as far as possible. The patients were interviewed 1 to 5 hours postoperatively by one of us (M.F.T.) and any complaints noted. Direct enquiry was made for pain at operation site, sore throat, nausea, muscle stiffness, as well as headache, if these were not complained of spontaneously. If headache was present, the site, nature and duration were noted, as was the main complaint. The phrasing of each question was identical for each patient and no prominence was given to the query concerning headache. Postoperatively analgesia was given as necessary and, in all but three patients, after interview rather than before. Quantal data were analyzed using chi-square; quantitative using Student's $t$ test.

**RESULTS**

**Group I** (SR halothane). Of 25 patients, 15 (60 per cent) developed headache in the postoperative period. Headache was the main complaint in seven cases.

**Group II** (CV no halothane). Of 25 patients, 3 (12 per cent) developed headache.

**Group III** (CV halothane). Of 25 patients, 11 (44 per cent) developed headache and this was the main complaint in three cases. Headache was complained of spontaneously by 8 patients.

The difference in the incidence of headache in Groups II and III is significant ($P<0.02$). These groups are comparable in all respects (sex distribution, age, duration of procedure, $Pa_{co2}$ and conduct of anaesthesia), other than the use of halothane as an adjuvant in Group III. The difference in the incidence of headache in Groups II and I is also significant ($P<0.001$). However, the maintenance of anaesthesia differed in these groups and is reflected in the significant difference in $Pa_{co2}$ ($P<0.01$) and no direct comparison may be made. There was no correlation between $Pa_{co2}$ and headache within the groups.

<table>
<thead>
<tr>
<th></th>
<th>Numbers</th>
<th>Males</th>
<th>Females</th>
<th>Age (years) (mean + SD)</th>
<th>Duration (min) (mean + SD)</th>
<th>$Pa_{co2}$ (mm Hg) (mean and range)</th>
<th>Headache</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (SR halothane)</td>
<td>25</td>
<td>10</td>
<td>15</td>
<td>24 + 7.4</td>
<td>45 + 20.2</td>
<td>45 (39-54)</td>
<td>15 (5M, 10F)</td>
</tr>
<tr>
<td>Group II (CV no halothane)</td>
<td>25</td>
<td>10</td>
<td>15</td>
<td>25.6 + 7.2</td>
<td>45.2 + 17</td>
<td>33.4 (23-40)</td>
<td>3 (1M, 2F)</td>
</tr>
<tr>
<td>Group III (CV halothane)</td>
<td>25</td>
<td>9</td>
<td>16</td>
<td>28.3 + 11.3</td>
<td>44 + 18</td>
<td>30 (23-40)</td>
<td>11 (3M, 8F)</td>
</tr>
</tbody>
</table>

**Statistical observations**

1. Sex, age of patients and duration of anaesthesia: no significant difference between groups.

2. Frequency of headaches

   | I and II | $\chi^2 = 12.5$ ($v=1$) | $P<0.001$ | Significant |
   | I and III | $\chi^2 = 1.2$ ($v=1$) | $P>0.2$ | Not significant |
   | II and III | $\chi^2 = 6.35$ ($v=1$) | $P<0.02$ | Significant |

3. $Pa_{co2}$

   | I and II | $t = 3.6$ ($v=12$) | $P<0.01$ | Significant |
   | I and III | $t = 5.1$ ($v=12$) | $P<0.001$ | Significant |
   | II and III | $t = 1.0$ ($v=12$) | $P=0.3$ | Not significant |
The halothane headache was characteristic. It was frontal, situated above or behind the eyes (commonly described in these terms) and continuous, occasionally throbbing, in nature. It was most severe on waking, then slowly improved. The duration varied from 2 to 8 hours, but was obviously modified in those patients requiring postoperative analgesia. Two of the three headaches occurring in the control Group II were described in vague terms unlike the specific, localized halothane headaches.

**DISCUSSION**

In Groups I and III, the incidence of headache was 60 per cent and 44 per cent respectively. These figures at first sight seem remarkably high in the light of clinical experience, but the patients were unpremedicated save for atropine, had undergone relatively short and minor procedures, and were seen in the immediate postoperative period. In Group II, where no halothane was used, the frequency of headache was 12 per cent.

It is possible that the headaches were a result of a direct effect of halothane on the brain. Halothane causes a reduction in cerebral oxygen uptake, directly related to the concentration of the agent, and thought to be due to a depression of the oxidative mechanisms of the brain (McHenry et al., 1965; McDowall, 1966, 1967). It is more probable that they are secondary to alterations in cerebral haemodynamics. Halothane produces an increase in cerebral blood flow due to cerebral vasodilatation (Wollman et al., 1964; McHenry et al., 1965; McDowall, 1966, 1967) and this increase is again directly related to the concentration of halothane in the inspired gases up to 4 per cent concentration; with higher concentrations, the hypotensive effects predominate and cerebral perfusion falls (McDowall, 1966, 1967). A rise in cerebrospinal fluid pressure follows the vasodilatation, this increase occurring even when changes in PaO2 are avoided (Hunter, 1964; McDowall, Barker and Jennett, 1966). This rise is minimized by hyperventilation and reduction of PaO2 below 35 mm Hg (McDowall, Barker and Jennett, 1966). Halothane has a significant effect on cerebral vasculature, blood flow and intracranial tension; these relationships may form the basis of the headaches observed in this investigation. The relationship between cerebral vasodilatation and the production of pain and headache is well documented (Brain, 1962; Walton, 1966).

In Group I, both halothane administration and the higher PaO2 produce cerebral vasodilatation. Further, spontaneous respiration through a relatively narrow-bore nasotracheal tube may produce a rise both in central venous and cerebrospinal fluid pressures. The frequency of headache in this group (60 per cent) is higher than in Group III, but the difference is not significant.

In the postoperative period halothane is eliminated from the tissues and lungs in an exponential fashion with respect to time. In rats anaesthetized with 1.5 per cent halothane in oxygen for 2 hours, elimination of halothane from the expired air was complete in 9 hours, and the rate of clearance from the arterial blood was approximately 50 per cent in 14 minutes (Duncan and Raventós, 1959). The duration of the headaches may represent the continuing effects of subanaesthetic concentrations of the drug.

**ACKNOWLEDGEMENTS**

We are indebted to the oral surgeons at Queen Mary's Hospital, Roehampton, for permission to study patients under their care. It is with pleasure we acknowledge the advice of Dr. A. G. Doughty and the technical assistance of Mr. J. Hughes.

**REFERENCES**


**CEPHALEES APRES ANESTHESIE L’HALOTHANE**

**SOMMAIRE**

Le fréquence est décrite des céphalées se manifestant durant la période postopératoire, après trois différentes techniques fréquemment appliquées d’anesthésie. L’incidence après anesthésie à l’halothane et respiration artificielle fut significativement plus élevée que dans un groupe similaire, où l’halothane ne fut pas administré. Les deux groupes furent autrement comparables de tous points de vue. Une troisième technique, nécessitant l’emploi d’halothane sous respiration spontanée, causa une fréquence encore plus élevée de céphalée, comparativement à la méthode avec halothane et respiration contrôlée, mais cette différence ne fut pas statistiquement significative. Chez dix patients (soit 20 pourcent de ceux recevant halothane), la céphalée constitua la plainte postopératoire principale. La relation possible entre la céphalée après halothane et l’effet de ce médicament sur la vascularisation cérébrale et la pression du liquide cérébrospinale, est discutée.

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