OXYGEN SATURATION DURING INHALATION INDUCTION WITH HALOTHANE AND ISOFLURANE IN CHILDREN: EFFECT OF PREMEDICATION WITH RECTAL THIOPENTONE

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SUMMARY
Anaesthesia was induced by inhalation in 100 children using nitrous oxide in oxygen supplemented by either halothane or isoflurane, with or without rectal thiopentone premedication. Respiratory problems occurred more frequently in the unpremedicated isoflurane group, resulting in significant reductions in oxygen saturation. Premedication reduced the frequency of these complications, and oxygen saturation was usually maintained.

KEY WORDS

Induction of anaesthesia using an inhalation technique is appropriate in young children who may become distressed by repeated attempts at venous cannulation. Halothane is used commonly for this purpose, with induction usually being rapid and smooth [1]. However, this agent is associated with myocardial depression and arrhythmias [1, 2]. Isoflurane is metabolized to a lesser extent and tends to maintain cardiac output and rhythm [3, 4]. Two recently published studies [5, 6] have shown that isoflurane is associated with a greater incidence of hypoxia during inhalation induction of unpremedicated children compared with halothane. We wished to determine if premedication alters the incidence of respiratory complications and hypoxia during inhalation induction of anaesthesia with either of these agents.

PATIENTS AND METHODS
We studied 100 healthy children weighing less than 20 kg, aged between 1 and 6 yr, who had not been exposed to halothane within the previous 6 months. Institutional Ethics Committee approval was given for the study and informed parental consent was obtained in each case.

Children were randomly allocated to one of four groups. Group NH (n = 24) received no premedication and halothane was used for induction. Group NI (n = 25) received no premedication and isoflurane. Groups TH (n = 27) and TI (n = 24) were given 40% thiopentone suspension 30 mg kg\(^{-1}\) per rectum 30 min before induction with halothane or isoflurane, respectively. Premedication was administered in a paediatric surgical ward, the buttocks were taped together, and the child was transferred immediately to the adjacent theatre suite to be observed continuously by an experienced member of the nursing staff.

In each patient the anaesthetist was administered by the same anaesthetist (D.W.) who had experience of use of both agents for inhalation induction in children for some years. Recordings were made by an independent observer (S.R.) who was blinded to the anaesthetic used.

Before induction, each patient's sex, age, weight and demeanour were noted. Preoperative arterial oxygen saturation (\(Sa_0\)) was recorded for 1 min after steady readings were obtained using a Critikon Oxyschute pulse oximeter probe attached to the hallux. The anaesthetist was unaware of the oximeter display and audio signals, but was informed if \(Sa_0\) decreased to less than 80%.
Anaesthesia was induced with 60% nitrous oxide and the anaesthetic in oxygen. An Ayre's T-piece with Jackson-Rees modification was used with a fresh gas flow sufficient to prevent rebreathing. The initial inspired concentration of the vapour was 0.5%, and this was increased by 0.5% every 10 breaths up to a maximum of 4%. Initially, the anaesthetic mixture was administered with the aid of a cupped hand over the child's mouth and nose; when the eyelash reflex had disappeared, an anaesthetic face-mask of appropriate size was applied. Induction was judged to be complete when the child was unconscious and breathing regularly, with eyes fixed and central, and pupils constricted.

$S_aO_2$, heart rate, inspired anaesthetic concentration and stage of anaesthesia were recorded every 15 s. Any events of bradycardia, struggling, breath-holding, coughing or laryngospasm were recorded, together with the lowest associated $S_aO_2$. Time taken to induce anaesthesia was noted.

Parametric data (age, weight) were tested for statistical significance by analysis of variance; if a difference in the means was found, further analysis was carried out with Student's unpaired t test. The Kruskal-Wallis and Wilcoxon Rank Sum tests were used for non-parametric data ($S_aO_2$, induction time). The chi-square test with Yates' correction and Fisher's exact test were used for nominal data (sex distribution, incidence of complications). $P < 0.05$ was taken as significant.

## RESULTS

The four groups were similar in age, weight and sex distribution (Table I). The premedicated children were almost all asleep or drowsy on arrival in the induction room, while those unpremedicated were all either calm and cooperative or crying ($P < 0.005$). Premedicated children had a lower $S_aO_2$ than unpremedicated ($P < 0.005$) (Table II). Group NI children displayed lower minimum oxygen saturation than those in any of the other groups ($P < 0.005$). There was no significant difference between the other three groups with regard to minimum $S_aO_2$ (Table III).

Laryngospasm occurred in nine patients, all in group NI ($P < 0.005$), and in seven of these $S_aO_2$ decreased to less than 91%. Isoflurane induction...
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TABLE IV. Incidence (n) of complications in those children whose $S_aO_2$ decreased to less than 91%, and associated median trough $S_aO_2$ (in parentheses). † P < 0.05 for n, compared with group NI. * P < 0.05 for $S_aO_2$, compared with pooled groups NH and TH.

<table>
<thead>
<tr>
<th>Event</th>
<th>NH</th>
<th>NI</th>
<th>TH</th>
<th>TI</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>3 (86)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Laryngospasm</td>
<td>-</td>
<td>7 (63)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Breathholding</td>
<td>-</td>
<td>1 (89)</td>
<td>1 (86)</td>
<td>2 (64)</td>
</tr>
<tr>
<td>Coughing</td>
<td>1 (88)</td>
<td>2 (80)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* † † †

TABLE V. Time taken to induce anaesthesia (median (range)). *Median time different from group NH (P < 0.005).

<table>
<thead>
<tr>
<th>Group</th>
<th>Induction time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH</td>
<td>7.25 (4.5-12)</td>
</tr>
<tr>
<td>NI*</td>
<td>10.25 (6.25-18)</td>
</tr>
<tr>
<td>TH</td>
<td>5.5 (3.5-7.75)</td>
</tr>
<tr>
<td>TI</td>
<td>6.75 (4.25-14.5)</td>
</tr>
</tbody>
</table>

97% or greater, 10 of the premedicated subjects had an $S_aO_2$ less than 97%. It must be concluded, therefore, that use of rectal thiopentone requires experienced supervision and immediate availability of resuscitation equipment.

The major finding of our study was that premedication with rectal thiopentone reduced the incidence of hypoxic episodes in children in whom anaesthesia was induced with isoflurane. $S_aO_2$ decreased during airway complications such as laryngospasm or coughing, but in three patients (in group NH) hypoxia occurred in the absence of such complications. There was no significant difference in $S_aO_2$ during induction between the premedicated isoflurane group and both halothane groups. The reduction in the number of hypoxic episodes in group TI was related possibly to the reduction in frequency of airway complications (table III).

We conclude that the frequency of hypoxia associated with inhalation induction of anaesthesia with isoflurane in children may be reduced by premedication with rectal thiopentone, at the cost of borderline hypoxia before induction. If isoflurane is to be used for inhalation induction of anaesthesia in young children, we recommend that consideration should be given to the use of sedative premedication in order to reduce the incidence of hypoxia seen with this agent.

REFERENCES