Alfentanil for intubation under halothane anaesthesia in children

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Summary
Intubating conditions under halothane anaesthesia aided with alfentanil 20 μg·kg⁻¹ were compared with suxamethonium 2 mg·kg⁻¹ in 40 children presenting for day dental procedures. The condition of vocal cords, jaw relaxation and presence of movement and coughing were scored to give the overall intubating conditions. Successful intubation was achieved in 100% of the suxamethonium group and 94.7% of the alfentanil group. The cardiovascular response to intubation was attenuated in the alfentanil group. Some 43.7% of those receiving suxamethonium developed myalgia the day after surgery compared with 0% in the alfentanil group ($P < 0.01$).

Keywords: alfentanil; suxamethonium; inhalational induction; halothane; intubation; myalgia

Introduction
Suxamethonium is acknowledged to be unequalled in providing ideal intubation conditions, but has many undesirable side-effects. Apart from the potentially fatal effects of triggering malignant hyperthermia, arrhythmias and hyperkalaemia, suxamethonium is also associated with myalgia (1) which is particularly undesirable in the day surgical patient. Despite this, suxamethonium is still widely used in some practices as seen from Mirakhur’s survey of the Anaesthetic Association of Great Britain (2) and more recently in Robinson’s survey of paediatric anaesthetic practice in the West Midlands region, UK (3), where 90% and 84% of respondents respectively routinely used suxamethonium in children. Nondepolarizing agents are an alternative but may delay recovery from anaesthesia after short procedures. Therefore, tracheal intubation without the use of muscle relaxants agents is an alternative. Intubation may be accomplished under deep halothane anaesthesia. Satisfactory intubating conditions were reported in 85% of children using this technique (4). However, there were significant decreases in both blood pressure and heart rate after induction. The pharmacokinetic and pharmacodynamic properties of alfentanil suggest that it may be suitable for facilitating tracheal intubation. Alfentanil has recently been shown to attenuate the haemodynamic response to tracheal intubation in children after induction with propofol, giving good intubating conditions in 80–100% (5, 6).

The aim of this study was therefore to investigate the quality of tracheal intubation provided by alfentanil compared to suxamethonium, in children under light halothane anaesthesia, by comparing intubating conditions and haemodynamic changes.

Patients and methods
The study design was a double blind randomized controlled trial comparing alfentanil-halothane
(n = 20) with suxamethonium-halothane (n = 20). The study was approved by the University Hospital Kuala Lumpur Ethics Committee and informed written consent was obtained from parents. Forty children, aged 2–10 years, ASA-I, presenting for day case dental procedures requiring nasotracheal intubation, were studied. Children with a suspicion or family history of muscular disorders were excluded from the study.

Protocol
None of the children received any premedication. The patients were induced by inhalation of incremental concentrations of halothane in 60% nitrous oxide and 40% oxygen, starting with 0.5% and increasing to a maximum of 2–3% via a Bain circuit by one anaesthetist (K.P.N.). After induction, intravenous access was established and the patients were then given either 2 mg·kg⁻¹ of suxamethonium (diluted to 5 ml of normal saline) or 20 μg·kg⁻¹ alfentanil (diluted to 5 ml of normal saline) when they were judged to have obtained an adequate depth of anaesthesia, i.e. when pupils were fixed, midline and small. After 60 s, during which the patient was manually ventilated gently with 2–3% halothane and 100% oxygen, a second anaesthetist (C.Y.W.) was called in to intubate the patient and assess the intubating conditions. The patients were intubated nasally with presoftened polyvinylchloride tracheal tubes with the aid of Magill’s forceps and subsequently had a throat pack inserted, when proper tube placement was verified by auscultation and appearance of the typical capnographic waveform on the monitor.

Throughout the induction sequence all patients were monitored using a peripheral pulse oximeter, automated blood pressure monitor, capnograph and electrocardiogram (Datex AS3, Division of Instrumentarium Corp., Helsinki, Finland).

Measurements
Measurements of mean arterial pressure (MAP) and heart rate were made at the following time points: before induction, after induction when depth of anaesthesia was judged adequate for intubation, 60 s after administration of alfentanil or suxamethonium and every minute after intubation for 4 min.

<table>
<thead>
<tr>
<th>Table 1 Patient data: mean (SEM)</th>
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<td></td>
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<tr>
<td>Age (years)</td>
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<tr>
<td>Body weight (kg)</td>
</tr>
<tr>
<td>Sex (M:F)</td>
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<tr>
<td>MAP (mmHg)</td>
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<tr>
<td>Pulse rate (b·min⁻¹)</td>
</tr>
</tbody>
</table>

Intubating conditions were scored with respect to three parameters: vocal cords: fully abducted = 0, slightly abducted = 1, partially abducted, moving = 2, closed = 3; jaw relaxation: fully relaxed = 0, slightly stiff = 1, stiff = 2, impossible to open = 3; and movement, coughing or bucking: nil = 0, slight = 1, moderate = 2, severe = 3. Overall intubating condition was assessed according to the total score: excellent = score of 0 in all 3 categories; good = score of 1 in any category; poor = score of 2 in any category; and impossible or requiring suxamethonium = score of 3 in any category.

The incidence of nausea and vomiting was recorded in recovery and the next day (after 24 h), the parents of the children were contacted by telephone where possible and enquiries were made for side-effects over the past day. The presence of myalgia was directly asked for.

Statistical analysis
Results are expressed as mean (SEM). Chi-squared test, t-test for unpaired samples and t-test for paired samples were used to analyse the data. P-values < 0.05 were considered statistically significant.

Results
A total of 40 children were studied. One patient was excluded from the study because he developed laryngospasm immediately after the injection of alfentanil before intubation. Thus 19 patients were randomized to the alfentanil group and 20 patients were randomized to the suxamethonium group. The study groups were well matched in terms of age, body weight, sex, MAP and pulse rate (Table 1).

Intubation was successful in 100% of the patients in the suxamethonium-halothane group, where the
intubating conditions were described as good or excellent in all. Intubation was accomplished in 18 patients (94.7%) in the alfentanil-halothane group and intubating conditions were described as good or excellent in all. This difference was not significant (Table 2). In one child in the alfentanil-halothane group, the cords were closed. In this child suxamethonium was given to facilitate intubation. This patient was also excluded from subsequent analysis of data involving haemodynamics.

The changes in MAP and heart rate in both groups during the induction sequence are presented in Figures 1 and 2. MAP did not decrease significantly from baseline after induction and there was no significant difference between the groups. There was a significant increase in MAP and heart rate from baseline after intubation in the suxamethonium-halothane group (P < 0.001). Alfentanil blunted the increase in MAP and heart rate after intubation (P < 0.001) compared to the suxamethonium-halothane group (Figures 1 and 2).

The incidence of myalgia was significantly less in the alfentanil-halothane group compared with suxamethonium-halothane group (P < 0.01). There was no difference in nausea and vomiting during recovery in both groups (Table 3).

Discussion

Suxamethonium is the best drug for providing ideal intubating conditions for short procedures. However, its use is associated with undesirable side-effects. Vecuronium and atracurium although of shorter duration of action than other nondepolarizing neuromuscular blockers in clinical use, may delay recovery from anaesthesia after short procedures. Tracheal intubation can be accomplished under deep halothane anaesthesia alone. Studies have shown that adequate conditions for tracheal intubation without the use of neuromuscular blockade can be obtained in 95–100% of children at an alveolar concentration of halothane of 1.8–2% (7, 8). However caution with

Table 2
Overall intubating condition assessment

<table>
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<tr>
<th></th>
<th>Excellent</th>
<th>Good</th>
<th>Poor</th>
<th>Impossible</th>
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<tbody>
<tr>
<td>Alfentanil (n = 19)</td>
<td>15</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Suxamethonium (n = 20)</td>
<td>15</td>
<td>5</td>
<td>0</td>
<td>0</td>
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</table>

Figure 1
Mean arterial pressure changes in response to laryngoscopy and intubation in the suxamethonium ○ and alfentanil □ groups; mean (SEM). B, baseline; I, injection; 1,2,3,4,5 = 1,2,3,4 and 5 min after injection. Significant changes within groups compared with baseline value. **P < 0.01; ***P < 0.001.

Figure 2
Heart rate changes in response to laryngoscopy and intubation in the suxamethonium ○ and alfentanil □ groups; mean (SEM). B, baseline; I, injection; 1,2,3,4,5 = 1,2,3,4 and 5 min after injection. Significant changes within groups compared with baseline value. *P < 0.05.

Table 3
Incidence of nausea and/or vomiting during recovery

<table>
<thead>
<tr>
<th></th>
<th>Present</th>
<th>Absent</th>
</tr>
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<tr>
<td>Alfentanil (n = 18)</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Suxamethonium (n = 20)</td>
<td>5</td>
<td>15</td>
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this technique is recommended because of the depression of myocardial contractility caused by halothane which is dose-dependent (9, 10).

More recently, other techniques of intubation without the use of neuromuscular agents have been investigated. The intravenous route using propofol with adjuvants such as alfentanil and lignocaine have been used successfully in children (6). Hansen et al. were successful in intubating 94% of the children during light halothane anaesthesia using propofol 3 mg·kg$^{-1}$ (11).

The results of this study showed that alfentanil and halothane afforded good to excellent intubating conditions in 94.7% of the children, with hardly any change in blood pressure and heart rate from preintubation values during and immediately after intubation, unlike in those children given suxamethonium where significant hypertension and tachycardia ($P < 0.001$) occurred. This is also an improvement over intubation under deep halothane alone where significant decrease in blood pressure before intubation was noted following by increases in blood pressure after intubation (4), highlighting the well known fact that clinical signs used to determine the endpoint for adequate depth of halothane anaesthesia are imprecise and unreliable. In addition to demonstrating the efficacy of alfentanil in obtunding laryngeal reflexes at intubation, alfentanil at 20 μg·kg$^{-1}$ also appears to allow for good intubating conditions at a lesser depth of anaesthesia compared without its use.

Respiratory side-effects associated with the use of alfentanil were not specifically monitored in this study. However, one patient out of the 40 was noted to have prolonged apnoea lasting approximately 20 min, who subsequently was found to have received 20 μg·kg$^{-1}$ of alfentanil. This may be of concern in cases of short duration and, in fact, studies determining the optimal intubating doses of alfentanil used with propofol suggest that alfentanil doses of 10 μg·kg$^{-1}$ are adequate for successful intubation while preserving spontaneous respiration (12). None of the patients developed any chest or muscle rigidity.

Generalized myalgia after suxamethonium administration is a frequent and troublesome complication. This study also showed that the suxamethonium-halothane group had a significantly higher incidence of suxamethonium myalgia (43.7%) compared with the alfentanil-halothane group (0%) ($P < 0.01$). These children were described by their parents as being lethargic and less active than usual.

In conclusion, we believe that, from our results, alfentanil before intubation of children under halothane anaesthesia offers an attractive alternative technique for children undergoing day surgical procedures, where good to excellent intubating conditions are obtained without the unpleasant side-effect of myalgia.

Acknowledgements

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References


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