CARDIAC ARRHYTHMIA DURING OUTPATIENT DENTAL ANAESTHESIA: THE ADVANTAGES OF A CONTROLLED VENTILATION TECHNIQUE

V. J. E. THOMAS, W. J. W. THOMAS AND A. C. THURLOW

SUMMARY
Two techniques for endotracheal anaesthesia in dental outpatients have been compared: a spontaneous ventilation technique using nitrous oxide, oxygen and halothane, and a controlled ventilation technique using nitrous oxide and oxygen, with tubocurarine and fentanyl. The latter technique has several advantages: abolition of arrhythmias induced by surgery, more rapid and hence safer recovery, avoidance of suxamethonium, and avoidance of atmospheric contamination with and possible sensitization to halothane.

A high incidence of cardiac arrhythmia during dental anaesthesia has been described (Kaufman, 1966; Tolas et al., 1967; Tuohy, 1968; Thurlow, 1969, 1972; Rollason and Dundas, 1970; Alexander, 1971; Ryder, 1971). These arrhythmias appear to be attributable to catecholamines acting on a myocardium sensitized by halothane (Katz and Bigger, 1970). The majority of the arrhythmias occur during the surgical procedure (A. C. Thurlow, 1975, personal observation). Their significance remains in doubt, but they may account for several cases of unexplained death in the dental chair. It has been shown that, when halothane is avoided, arrhythmias are rare in dental anaesthesia (Shafto, 1969; Rollason and Dundas, 1970; Ryder and Townsend, 1974). It has been our clinical impression that the incidence of arrhythmia has been reduced significantly by using an i.v. rather than an inhalation induction technique. Therefore we have studied a method of endotracheal anaesthesia for dental outpatients using an i.v. induction, excluding the use of halothane, and maintaining anaesthesia with nitrous oxide, oxygen and fentanyl with the use of controlled ventilation. This method was compared with a spontaneous ventilation technique using nitrous oxide, oxygen and halothane. The criteria studied were the incidence of cardiac arrhythmia during anaesthesia, the speed of recovery and patient acceptability.

METHODS
One hundred patients attending the outpatient department of the Royal Dental Hospital, Tooting, for dental extractions under general anaesthesia, were studied. The majority of these extractions were of impacted wisdom teeth. The patients' ages ranged from 9 to 57 yr, the majority being young adults. All were fit and free from cardiovascular or respiratory disease. They were divided into two groups of 50 by previous random selection and allocated to a spontaneous ventilation (Group A) or controlled ventilation (Group B) technique. The two groups were comparable in age, weight and sex. No premedication was given and all the patients were anaesthetized in the dental chair in a 45° head-up tilt position with the legs elevated.

The patients in Group A were anaesthetized with an i.v. injection of thiopentone 5–6 mg/kg followed by suxamethonium 1 mg/kg to facilitate intubation with an uncuffed nasotracheal tube. The throat was packed and anaesthesia was maintained with halothane in nitrous oxide (5 litre/min) and oxygen (3 litre/min) delivered from a Salisbury continuous flow machine, with spontaneous ventilation via a Mapleson A circuit. Halothane was delivered from a temperature-compensated vaporizer in concentrations of 1.0–2.0% as necessary.

The patients in Group B were anaesthetized with an i.v. injection of fentanyl 1.0 μg/kg followed by tubocurarine 30 mg and thiopentone 5–6 mg/kg. A cuffed nasotracheal tube was passed, the throat was packed and anaesthesia was maintained with nitrous oxide (6 litre/min) and oxygen (3 litre/min) using intermittent positive pressure ventilation (IPPV). Tubocurarine was antagonized at the end of the procedure with neostigmine 2.5–5.0 mg and atropine 1.2–1.8 mg. Ventilation was controlled with an Autovent (East) miniature ventilator, which was strapped on the patient's head (fig. 1).
TABLE I. Incidence of cardiac arrhythmia

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of patients</th>
<th>Frequency of arrhythmia</th>
<th>Arrhythmia during intubation and packing only</th>
<th>Arrhythmia during surgery only</th>
<th>Arrhythmia during intubation, packing and surgery</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>50</td>
<td>24</td>
<td>7</td>
<td>12</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>50</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

In Group B, arrhythmia occurred in five patients (10%). In four patients they occurred during endotracheal intubation and packing (8%), and in one patient nodal rhythm occurred after antagonism of tubocurarine with neostigmine and atropine. No arrhythmias occurred in association with surgery (table I). The difference between the incidence of surgically induced arrhythmia in Groups A and B is highly significant ($\chi^2 = 18.14; P<0.0001$).

An analysis of surgically induced arrhythmias in Group A (table II) showed a predominance of premature ventricular beats, many of which were multifocal in origin and were frequent. Some of the patients exhibited more than one arrhythmia, and, in some, nodal rhythms occurred. One patient required treatment with practolol 2 mg i.v. which abolished a serious arrhythmia (prolonged continuous multifocal premature ventricular beats at a frequency greater than 30/min).

The electrocardiogram was monitored throughout using Standard Lead I, via an oscilloscope (Wakeling, BOC) connected in series with an electrocardiograph (Cardiopan, Philips). Monitoring was commenced before induction and all the arrhythmias that occurred were recorded.

The speed of recovery from anaesthesia was assessed as the time until the patient opened his eyes, answered direct questions and became ambulant. Recovery was assessed also, using the Maddox Wing (Hannington-Kiff, 1970). The frequency of nausea, vomiting and pain in the recovery period was also studied.

RESULTS

In Group A, 24 patients developed arrhythmia (48%). Twelve exhibited arrhythmia associated with surgery alone (24%), and seven associated with intubation and packing (14%); five patients had separate arrhythmias during both of these phases (10%) (table I).

The mean duration of anaesthesia in Group A was 31 min (SD 8.8), and in Group B was 36 min (SD 9.8). Applying the Mann–Whitney test, recovery, as measured by the time taken to open the eyes and answer direct questions, was found to be significantly more rapid in Group B than Group A ($P<0.0001$ for opening eyes; $P<0.0001$ for answering questions); the ambulant time in both groups was similar ($P = 0.12$) (table III).
CONTROLLED VENTILATION DURING DENTAL ANAESTHESIA

Table III. Mean recovery periods (min)

<table>
<thead>
<tr>
<th>Group</th>
<th>Time to open eyes (min)</th>
<th>Time to answer questions (min)</th>
<th>Ambulant (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>11</td>
<td>17</td>
<td>124</td>
</tr>
<tr>
<td>B</td>
<td>0.8</td>
<td>3</td>
<td>122</td>
</tr>
</tbody>
</table>

The Maddox Wing was used as an objective test of recovery. The results did not correlate well with clinical assessment of patient recovery and they will be reported in a later communication.

Thirty-one patients in Group A complained of pain after operation (62%), compared with 34 patients in Group B.

Nine patients in Group A complained of nausea (18%) and four of these vomited (8%). In Group B, three patients complained of nausea (6%) and two of these vomited (4%). The differences were not significant statistically.

DISCUSSION

The use of a controlled ventilation technique using tubocurarine with nitrous oxide, oxygen and fentanyl has been shown to be effective in reducing the incidence of cardiac arrhythmia during dental anaesthesia. In fact, there were no arrhythmias during the surgical procedure when this technique was used. The absence of halothane is a strong possibility in explaining the reduction in arrhythmia. Plowman, Thomas and Thurlow (1974) have shown that the blocking of afferent surgical stimuli with a local anaesthetic agent is effective in reducing the incidence of cardiac arrhythmias and it is possible that the use of fentanyl or other potent analgesics may confer similar protection. Airway obstruction and resulting hypoxaemia and hypercarbia have been implicated in such cardiac arrhythmia. However, respiratory obstruction is unlikely in this study as the trachea was intubated in both groups. Carbon dioxide concentrations were not measured in this study. Previous studies of this type (Tolas et al., 1967) have shown that unpremedicated, fit dental patients who breathe halothane spontaneously, do not usually develop hypercarbia. There remains the possibility that the ventilated group had reduced carbon dioxide values although it is unlikely that such differences in carbon dioxide concentration played a major role in the widely differing rates of arrhythmia seen in the two groups.

Other factors which have been implicated in the causation of arrhythmias in dental anaesthesia include the method of premedication, posture and depth of anaesthesia. None of the patients in Group A or B were premedicated, and posture was the same in all cases. Previous studies have suggested that, at deeper planes of anaesthesia, there is no reduction in the incidence of arrhythmia, but that they tend to be nodal rhythms rather than premature ventricular beats (Ryder, 1970). One nodal rhythm occurred in Group B but this was at the end of the procedure after reversal with neostigmine and atropine.

The pattern of surgically induced arrhythmias in Group A was in agreement with previous reports (Kaufman, 1966; Tuohy, 1968; Thurlow, 1969, 1972; Ryder, 1971), namely a predominance of premature ventricular beats which were often multifocal in origin, and nodal rhythms (table II).

The initial recovery time in Group B was significantly shorter than in Group A. However, the overall recovery times were similar in the two groups. There were no significant differences between the groups in respect of the incidence of postoperative pain, nausea and vomiting in the two groups. There had been hoped that fentanyl might confer some degree of analgesia after surgery, but this was not so. This is probably a result of the short duration of action of this drug.

Apart from the obvious success in reducing the incidence of arrhythmias in Group B, the other advantages of the controlled ventilation technique include the avoidance of suxamethonium and atmospheric contamination with halothane and the possible sensitization of patients to this agent.

The controlled ventilation technique is open to several theoretical criticisms, including the possibility of technical difficulties in endotracheal intubation, central respiratory depression, difficulties in antagonizing tubocurarine, and awareness. We experienced no intubation problems in the 50 patients in Group B. We consider that in cases in which it is considered safe to use a depolarizing relaxant to facilitate endotracheal intubation, this method is equally safe and effective.

One patient in Group B exhibited signs of respiratory depression after operation, which was treated successfully with nalorphine hydrobromide 5 mg i.v. We experienced no difficulties in antagonizing the tubocurarine which was given, even when the procedure lasted only 15-20 min.

One patient may have been partially aware during the procedure. She described having heard loud banging noises in her sleep, but she was not disturbed by this and volunteered the information only after close questioning.
In our experience, and providing there are adequate recovery facilities, we have no hesitation in recommending this controlled ventilation technique for outpatient dental anaesthesia.

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REFERENCES


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ARYTHMIE CARDIAQUE PENDANT L’ANESTHESIE DENTAIRE DE PATIENTS NON HOSPITALISES: AVANTAGES D’UNE TECHNIQUE DE VENTILATION CONTROLEE

RESUME

On a compare deux techniques d’anesthésie endotrachéale utilisées sur les patients non hospitalisés subissant un traitement dentaire: une technique de ventilation spontanée à l’aide de protoxyde d’azote, d’oxygène et d’halothane et une technique de ventilation contrôlée à l’aide de protoxyde d’azote et d’oxygène avec la tubocurarine et le fentanyl. Cette dernière technique présente plusieurs avantages: suppression de l’arythmie provoquée par la chirurgie; récupération plus rapide et de ce fait pratiquement sans danger et on évite ainsi le suxaméthonium, la contamination atmosphérique par l’halothane et une sensibilisation éventuelle à l’halothane.

HERZ-ARRHYTHMIEN BEI ZAHNNARKOSE AN AMBULANTEN PATIENTEN: VORTEILE EINER KONTROLLIERTEN BELÜFTUNGSMETHODE

ZUSAMMENFASSUNG


ARRITMIAS CARDIACAS DURANTE LA ANESTESIA A PACIENTES DENTALES EXTERNOS: VENTAJAS DE UNA TECNICA DE VENTILACION CONTROLADA

SUMARIO

Se han comparado dos técnicas para la anestesia endotraqueal en pacientes dentales externos. Una técnica de ventilación espontánea usando óxido nitroso, oxígeno y halotano, y una técnica de ventilación controlada usando óxido nitroso y oxígeno, con tubocurarina y fentanilo ("Innovar", "Sublimaze"). La segunda técnica posee varias ventajas: abolición de arritmias inducidas por la cirugía; restablecimiento más rápido y por tanto más seguro, hace innecesario el uso de suxametonio, y evita la contaminación ambiental con halotano y posible sensibilización al mismo.