A TRIAL OF PRE-MIXED NITROUS OXIDE AND OXYGEN IN DENTAL ANAESTHESIA FOR CHILDREN

BY

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SUMMARY

Pre-mixed 50 per cent nitrous oxide and oxygen was used in 200 children for dental extraction, using simple apparatus, halothane in a Goldman vaporizer, and a constant fresh gas flow of 8 l./min. The method appeared to be economical and no complications were encountered. Induction of anaesthesia was smooth but somewhat prolonged, the average time taken being 2 minutes 45 seconds.

The introduction of halothane as a supplement to nitrous oxide (Goldman, 1960) and increasing awareness of the dangers of anoxia (Bourne, 1960) have greatly reduced the use of hypoxia in the induction and maintenance of dental anaesthesia. However, so long as anaesthetic machines capable of delivering less than 20 per cent oxygen are in use, there remains a temptation to employ hypoxia to reduce the time required for induction, or to "settle" a resistant patient. It is possible that many machines of the intermittent flow type are unreliable and inaccurate, particularly as the technicians who service them do not usually measure the oxygen concentrations delivered. Bourne (1960) examined five machines and found, for example, that with the controls set to deliver 10 per cent oxygen the concentrations actually delivered varied between 1.7 and 20.1 per cent.

The introduction of pre-mixed nitrous oxide and oxygen (Tunstall, 1961) has made possible great simplification in the apparatus used to deliver these gases in known concentrations. This report describes the results of 200 consecutive anaesthetics given to children in the dental chair using pre-mixed gases, halothane and simple apparatus.

METHOD

Apparatus (fig. 1).

A 50 per cent nitrous oxide and oxygen mixture was provided by Commonwealth Industrial Gases Pty. Ltd. of Australia. The cylinders used were of the 120 cubic feet bull-nosed oxygen type and were filled to a pressure of 1,800 Lb./sq.in. (126 kg/cm²).

The concentration of oxygen delivered was measured by the manufacturers and guaranteed to be between 45 and 55 per cent.

The gases were released through a standard reducing valve, at a pressure of 60 Lb./sq.in. (4.2 kg/cm²) and an oxygen flowmeter. The flowmeter error due to 50 per cent nitrous oxide is less than 0.5 l./min at a flow of 8 l./min. Distal to the flowmeter were fitted a Goldman halothane vaporizer (Mark 3) and reservoir bag. The gases were delivered to the patient through a
wide-bore corrugated tube and the standard narrow-bore twin tubes leading to an adult-size nosepiece. The halothane vaporizer control had three settings, delivering 0.1, 1.5 and 2.5 per cent halothane in a gas flow of 8 l./min (manufacturer's figures). The reservoir bag was open to the gas flow at all times.

Patients.

The youngest child was aged 22 months and the oldest 15 years (the minimum school-leaving age in Queensland). The age distribution is shown in table I.

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Number of patients</th>
<th>Average duration of induction (min, sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>107</td>
<td>2 25</td>
</tr>
<tr>
<td>6-10</td>
<td>58</td>
<td>2 49</td>
</tr>
<tr>
<td>11-15</td>
<td>35</td>
<td>3 42</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

A few of the older children had been referred for full mouth extractions and a small proportion of all age groups had been sent for the extraction of a single tooth overlying an apical abscess. The majority came for the extraction of between three and six severely carious deciduous molars and of adult pre-molars in a similar condition.

Every child was starved for at least 3 hours before induction. A brief medical history was taken from the child and its parents and as a result of this a small minority were referred for more comprehensive examination. No premedication was used. The children were brought into the anaesthetic room by a nurse and settled into the chair by the dentist, who made a brief confirmatory examination of the teeth to be extracted and then introduced the anaesthetist.

Induction of anaesthesia.

Using words appropriate to their age, the anaesthetist showed each child how the nosepiece would be used. The purpose of the procedure was explained to the older children, and they were asked to sit still and to listen to the anaesthetist.

Throughout the anaesthetic a fixed gas flow of 8 l./min was used, and the expiratory valve on the nosepiece was set to open at the minimum pressure. To begin induction the vaporizer control was set to position 1 and the mask held about 3 cm in front of the child's nose. After a few breaths, and with further explanation and reassurance, the mask was lowered on to the child's face and the vaporizer control moved to position 2. In small children the adult-sized facepiece was fitted over the nose and mouth at this stage, being moved up to the usual position when induction was completed. After about 60 seconds, the children usually appeared to be asleep, but not anaesthetized, and the vaporizer control was moved to position 3.

Induction of anaesthesia under these conditions is a more prolonged procedure than when high nitrous oxide concentrations and higher flow rates of gases are used. The signs of adequate depth of anaesthesia are:

1. Automatic respiration. That is, a respiratory pattern showing slight tachypnoea, regularity, absence of a pause at the end of expiration, and equal duration of expiration and inspiration.
2. Relaxation of the jaw.
3. Loss of eyelash reflex.

Automatic respiration was found to be the most consistently reliable sign but accurate assessment of the depth of anaesthesia in every case depended on experience in observation of all three signs. In most cases it became necessary to protrude the mandible in order to maintain the airway before the onset of automatic respiration.

The problem of the child who is distressed and unco-operative before induction remains the same whatever technique of anaesthesia is used. When anaesthesia was induced with the method described above the children did not show any evidence of an excitement stage of anaesthesia except in seven cases mentioned below, even though a few of them actively objected to the approach of the mask.

When induction of anaesthesia was completed the dentist inserted a dental prop and placed a gauze pack between the fauces. During each anaesthetic the child's superficial temporal or carotid pulse was palpated by the anaesthetist.
Duration of induction.
This was measured by the nurse with a stopwatch recording the interval between the first presentation of the mask to the child and the insertion of the mouth pack.

Maintenance of anaesthesia.
In cases of multiple extractions, the vaporizer control could usually be returned to position 2 after the extraction of the first tooth. The time required to complete the extractions varied between 10 seconds and 12 minutes, the average duration being about 4 minutes. The anaesthetist attempted to anticipate the probable duration of the dentist's work and to turn off the vaporizer some time before the end of the extractions. No fixed policy could be laid down on this point; as a rule the longer the anaesthesia had been maintained the earlier could the halothane be withdrawn.

After completing his work the dentist cleaned the mouth by swabbing, and suction if necessary, and then removed the dental prop and pack. As this was done the anaesthetist removed the mask and leant the child forwards in the chair so as to encourage drainage of the mouth, whilst still retaining control of the jaw.

Difficulties.
In seven cases (3.5 per cent) an adequate depth of anaesthesia was not obtained and the surgical stimulus produced reflex movements of the patient. In all these cases the extractions were completed without anoxia or surgical trauma to the children, who had no recollection of the proceedings as far as could be determined by questioning later. Five of these seven cases were in the 1-5 year age group. The causes of the difficulty were a poor nasal airway, misjudgement by the anaesthetist, or both. No cases of fainting, severe bradycardia, laryngeal spasm, cyanosis or vomiting under anaesthesia occurred.

Recovery period.
The experience of the anaesthetist determined the rapidity of recovery of consciousness after anaesthesia. It was found possible to have the children in full possession of their pharyngeal and laryngeal reflexes and able to obey simple commands, such as "Spit out the blood", within 2 minutes of the completion of extractions. They were then carried to the recovery room where they were able to lie down and be cared for by their parents and a nurse. No cases of delayed recovery occurred. Six children (3 per cent) vomited in the recovery room 5 to 15 minutes after the end of the anaesthetic. In each case the child vomited once only, producing blood swallowed during the recovery period. With the exception of these six cases, and a few with prolonged bleeding, all the children walked out of hospital after spending about 20 minutes in the recovery room.

Cost of anaesthetics.
For the average case 2.54 ml of halothane and about 50 l. of pre-mixed gas were used. The prices of these volumes in Brisbane are 23 cents and 27 cents respectively, so that the average cost of the drugs used for each anaesthetic was 50 cents Australian (or 4 shillings sterling). The apparatus used consisted of standard items with low depreciation and maintenance costs.

DISCUSSION
It seems probable that pre-mixed nitrous oxide and oxygen with halothane are worthy of further trial as agents for dental anaesthesia in children. The prolonged induction time has not been found to be a disadvantage of the technique since this period is singularly peaceful. The number of dental anaesthetics given to children appears to be increasing, at least in Britain (BDA Committee, 1966).

The concentration of oxygen delivered to the patients can only fall below 50 per cent if the cylinder has been exposed to temperatures below —7°C. The lowest temperature ever recorded in Brisbane is 2.6°C. In other parts of the world, the risks of separation of the gas phases following low temperatures can be overcome by precautions outlined by Tunstall (1963).

The apparatus described in this article is cheaper to buy than any form of anaesthetic machine, and mechanical failure or deterioration of its parts cannot influence the concentration of oxygen delivered to the patients.

ADDENDUM
The same technique has since been used for anaesthesia in a further 400 children. No complications of the method were encountered. One hundred adult
females were also anaesthetized. In some cases induction was prolonged and the depth of anaesthesia inadequate. In about thirty women a small dose of thiopentone preceded the use of the gas mixture supplemented by halothane. Adequate depth and easy maintenance were obtained in this way.

ACKNOWLEDGEMENTS
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REFERENCES

BOOK REVIEW


Although anaesthetists have so far found little use for the classical methods of hypnosis in solving the formidable clinical problems now presented to them, they have never ceased to be interested if not fascinated by what can be done by hypnotic methods. Perhaps because a good deal of the confidence or rapport between patient and anaesthetist is just another way of saying that the patient is partly hypnotized by the anaesthetist. This book is absorbing armchair reading. A considerable part of it is devoted to a delightful account of the history of both animal and human hypnosis, and this is followed by equally fascinating descriptions and illustrations of the hypnosis of animals. The photographs are intriguing and more than one anaesthetist will probably be tempted to reproduce what is displayed in them on his household pet.

The second half of the book attempts to relate hypnotic phenomena with neurophysiology and the book ends with illustrated accounts of hypnotic techniques. The discursive manner of writing makes easy reading and it is a tribute to the translator that the reader is unaware of his work. Many interesting hours are guaranteed by this book, and most anaesthetists will pick up more than a few tips to help them in their daily work.

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