METHOHEXITAL IN DENTAL ANAESTHESIA

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In the majority of anaesthetics given to patients in the dental surgery or clinic the agents used are nitrous oxide and oxygen with or without a supplement such as trichloroethylene. If nitrous oxide with oxygen or air is used alone then it is often difficult to obtain satisfactory conditions for the dentist without subjecting the patient to some degree of hypoxia. There is no doubt that hypoxia is harmful even if the effects are not always immediately apparent (Bedford, 1955). Tom (1956) and Mostert (1958) in this country have separately described a technique whereby nitrous oxide and oxygen can be administered without hypoxia but giving adequate analgesia and a quiescent patient, although they admit that induction may be rather prolonged. Mushin (1952) estimates that from 7 to 10 minutes is required to achieve saturation with nitrous oxide using 80 per cent nitrous oxide and 20 per cent oxygen. In addition in the so-called “resistant” patient satisfactory conditions sometimes cannot be achieved and even the addition of trichloroethylene does not always give good anaesthesia. Thiopentone is sometimes used for induction in these patients but the recovery period is often prolonged and, in the light of our present knowledge, the patient needs escorting home.

Bourne (1952) condemned the illogical use of weak anaesthetic agents in out-patient anaesthesia and stressed the need for a “powerful” anaesthetic which is rapidly excreted. He has described the use of cyclopropane and oxygen for dental anaesthesia and has devised a piece of apparatus which enables a rapid induction and eliminates the risk of explosion. However, there is a high incidence of nausea and vomiting afterwards; in one series Bourne states that 21 per cent of patients vomited and 12 per cent were nauseated. The risk of explosion, unless special apparatus is used, and the high nausea and vomiting rate rather invalidate this otherwise suitable agent.

Induction of anaesthesia by an intravenous injection is preferred by the majority of patients to induction by inhalation of gas or vapour and if this can be combined with tranquil maintenance and a rapid recovery free from nausea and vomiting, then an approach will have been made toward an ideal dental anaesthetic technique.

Preliminary use of methohexital suggested that it is an ultrashort-acting barbiturate from which recovery is more rapid than after thiopentone. Encouraged by this a clinical trial was carried out in the Dental Out-patient Department of the Royal Free Hospital. The structural formula is shown in figure 1. The molecule contains two asymmetric carbon atoms so that two d-1-pairs exist capable of resolution into optically active d and l forms. Methohexital is the racemic form.

PRELIMINARY INVESTIGATIONS

Before the drug was used in the Dental Department a preliminary investigation was carried out upon patients undergoing modified electroconvulsive therapy to determine the comparative strengths of methohexital and thiopentone. This anaesthetic lends itself to comparison since each patient can act as his own control and may receive six or more anaesthetics at intervals of a few days. Thiopentone and methohexital were injected slowly and as far as possible at a constant rate. The loss of the eyelash reflex was taken as an end point. The same anaesthetist administered all these anaesthetics. The results were not analyzed until the completion of the series to avoid subconscious variation on the part of the anaesthetist. Eighteen patients were given 75 anaesthetics. The average dose of thiopentone

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and the average dose of methohexital was calculated for each patient and expressed as a ratio. There was a fairly large variation in the highest and lowest of these ratios (from 4:0 to 2:1) but this was expected in such a method. The average ratio was 3:1 and this has been taken as a guide to the comparative strengths. Table I shows the result of this investigation.

<table>
<thead>
<tr>
<th>Average dose thiopentone in mg</th>
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<td>116</td>
<td>3.02:1</td>
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<td>120</td>
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<td>80</td>
<td>2.34:1</td>
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<td>Mean</td>
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Inevitably with any intravenous anaesthetic agent a comparison must be made with thiopentone as the standard, in view of the latter's widespread use and satisfactory service. With any new intravenous agent the danger is that low potency may be mistaken for short action. It is easy to be over enthusiastic about an agent when it is reduced quantity of active drug rather than short action which causes a rapid recovery. Butalbital sodium was reported as having a shorter action than thiopentone but O'Mullane (1957) using the electroencephalograph was not able to support this. In view of O'Mullane's work, electroencephalographic recordings were made using methohexital and thiopentone. A dose of methohexital was given to volunteers while an electroencephalograph was recorded. On another day a comparable dose of thiopentone was given again with a continuous electroencephalographic recording. The patterns characteristic of barbiturate anaesthesia as described by Kiersey, Bickford and Faulconer (1951) were seen, with a short period of fast rhythm followed by slow wave forms. No definite conclusion could be drawn from the electroencephalograph with regard to differences in recovery time, as the fast rhythm faded into a normal rhythm without any abrupt change. It was noticeable, however, that with methohexital sleep the slow rhythm persisted for a longer period of time than with thiopentone. This presumably indicated that the depth of anaesthesia, as shown by these slower wave forms, lasted longer with methohexital. Despite this the recovery from methohexital sleep in these volunteers was clinically quite different. Following methohexital all volunteers were standing with no dizziness and
Methohexital in Dental Anaesthesia

were ready to leave much sooner than following thiopentone (table II).

<table>
<thead>
<tr>
<th>Subject</th>
<th>Methohexital</th>
<th>Thiopentone</th>
<th>Methohexital</th>
<th>Thiopentone</th>
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<td>M.Y.</td>
<td>89</td>
<td>52</td>
<td>10</td>
<td>25</td>
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<tr>
<td>S.A.</td>
<td>92</td>
<td>47</td>
<td>15</td>
<td>50</td>
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In the Dental Out-patient Department are reported. These were 284 adult female, 155 adult males and 61 children under 14 years of age. The youngest child was 5½ years old. The object was to obtain quiet dental anaesthesia without hypoxia and at the same time to achieve a rapid recovery. The patients were asked not to eat or drink anything for 4 hours before operation and to empty their bladders just prior to their appointment. No other pre-operative preparations were made.

Induction.

After examination of the mouth, a prop was inserted and methohexital was given intravenously as rapidly as possible. The dose decided upon after preliminary investigations was 5 mg per stone body weight. In young children slightly more methohexital was required in proportion to their weight. In order to conform with the conditions in the average dental surgery the patients were not weighed but their weight was assessed on their size and on information given. As soon as the patient was asleep, the nasal mask was placed over the nose and a mixture containing 15 per cent oxygen and 85 per cent nitrous oxide was administered. The time taken for sleep to ensue was between 17 and 20 sec. The nitrous oxide and oxygen mixture was delivered from a Walton machine with full pressure and the reservoir bag was turned off so as to eliminate rebreathing. A period of 1½ to 3 minutes was required to establish satisfactory conditions for operation in the majority of patients. At this stage, the oxygen percentage was increased to 20. To establish good operative conditions in the shortest time it was essential to have unobstructed nasal breathing. It was found that induction with methohexital gave very satisfactory results in this respect. The impression was gained that it is the smooth induction obtained when using methohexital which encourages nasal breathing, rather than any inherent characteristic of the drug. Systolic blood pressures were taken in 50 patients just after the onset of unconsciousness and again 3 minutes later. A transient fall of 5 to 10 mm Hg occurred in 60 per cent of this group. No fall or rise in pressure was found in 30 per cent. The remaining 10 per cent of patients all had systolic pressures above 170 mm Hg, and showed a maximum fall of 50 mm Hg.

Maintenance.

In only 15 patients was it found necessary to supplement the nitrous oxide with any other inhalation agent. In 9 of these nasal breathing was not easy to establish and trichloroethylene was used. In one patient ethyl chloride applied on a mouth pack was the only way to maintain anaesthesia in a persistent mouth breather. A further 5 patients required the use of trichloroethylene to establish smooth anaesthesia in spite of satisfactory respiration. A restraining strap was not used on any of the patients, although many were tough labourers. In only 45 (9 per cent) of the patients was any kind of restraint required.

A chairside spitoon was not provided and the patients were taken to another room for rinsing and spitting.

Recovery time (figs. 2, 3).

Two periods during recovery were recorded. These were: (1) the time from receiving the injection until the patient was capable of leaving the chair for the recovery room with the assistance of one nurse (fig. 2); the time from receiving the injection until it was considered that recovery was complete and that the patient could safely go home unaccompanied (fig. 3). The assessment of complete recovery was based on three main factors. These were: a co-ordinated gait; clear normal speech; absence of hangover. Absence of hangover was the final criterion for full recovery and was based on the answers to a number of standard questions: (a) Do you feel dizzy? (b) Does your head feel quite clear? (c) Do you feel quite normal? In the majority of patients it was observed that there was a fairly clear end...
Patients

Time in Minutes

**FIG. 2**
The time from receiving the injection until the patient was capable of leaving the chair for the recovery room with the assistance of one nurse.

**FIG. 3**
The time from receiving the injection until it was considered that recovery was complete and that it was safe for the patient to go home unaccompanied.
point when they suddenly felt "clear" and "normal".

Ninety-four per cent of the patients were deemed fit to return home within half an hour and 77 per cent within 20 minutes. Only one patient caused any inconvenience. She refused to stand on her feet for an hour and had to be taken home in a car. She returned later for further extractions when nitrous oxide only was used. The same performance was repeated but it was slightly less prolonged.

Ninety-one per cent of the patients were able to leave the dental chair within 6 minutes of receiving the injection. In most of the other cases (9 per cent) the period of administration was longer than 6 minutes.

**Reaction to the injection.**

In order to obtain the patient's reactions to this type of dental anaesthesia, 100 consecutive patients were given a questionnaire (fig. 4) before leaving the clinic. They were asked to fill it in at home and post it back the next day. This enquiry was continued until 100 questionnaires had been returned. At this time 17 patients had failed to return their answers.

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**Fig. 4**

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<table>
<thead>
<tr>
<th>Date...</th>
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<tr>
<td>Name...</td>
<td>Age... Weight...</td>
</tr>
<tr>
<td>Dose of C25398...</td>
<td>Time A... B... C... D...</td>
</tr>
<tr>
<td>Remarks...</td>
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**QUESTIONNAIRE**

1. Have you had your teeth out under gas? 
   If yes, do you prefer gas or injection? 
   Yes No Gas Injection
2. Did you find the injection unpleasant? 
   Yes No
3. Did you find going to sleep unpleasant? 
   Yes No
4. Did you find waking up unpleasant? 
   Yes No
5. If answer to 2, 3, and 4 is yes, please state why
6. Did you feel sick during recovery? 
   Yes No
7. Were you actually sick? 
   Yes No
8. Did you have a headache? 
   Yes No
9. Did you feel your teeth being pulled? 
   Yes No
10. Did you feel quite normal when you left hospital? 
    If no, how did you feel? 
    Yes No
11. Did you have to lie down or rest when you got home? 
    Yes No
12. Please add any personal remarks:
The questions were designed to find out the patient's personal response to this method of anaesthesia and to record any complications of recovery which might have occurred after leaving the clinic. They were invited to add any personal remarks which might be helpful.

The results of this questionnaire were favourable. Seven patients who had previously had nitrous oxide inductions for dental anaesthesia preferred that method to the methohexital for one reason or another. The majority of the remainder expressed their preference for the injection in enthusiastic terms. Sixteen patients felt the need to lie down on returning home; 13 of these were females, 1 was male and 2 were children. All except one of these patients, however, expressed their preference for this method. The rest of the patients were able to go straight back to their usual occupation. Two patients complained of feeling the extractions, although they made no complaint at the time. Five patients vomited during recovery and 14 felt nauseated but did not vomit at any time. Ninety-four patients said they felt quite normal when they left the clinic. Of the 6 who did not feel quite normal on the way home, 3 complained of feeling nauseated, 1 felt tired, 1 was dizzy and 1 felt faint. None of these patients had complained when seen prior to being given permission to go home.

DISCUSSION

In this investigation our main objective was to assess whether or not methohexital is a satisfactory and safe drug to use for dental anaesthesia in the chair. No attempt has been made to make a direct clinical comparison with any other intravenous drug or anaesthetic technique. Before commencing these trials it was necessary to carry out preliminary investigations in order to discover the relative potency of this drug as compared with thiopentone. The idea of using anaesthesia preceding electroconvulsive therapy to compare different barbiturates was first described by Egbert, Sechzer and Eckenhoff (1958). Their end point was lack of response to a command. In this investigation loss of the eyelash reflex was used. A considerable variation was expected and found, but the average ratio of 3:1, methohexital:thiopentone has since been supported by further clinical experience. It will be noticed that this ratio was different from the one found by Wyant and Chang (1959) but these authors used the dose per minute of anaesthesia, when the drugs were used for both induction and maintenance, as a criterion, whereas in this trial the drugs were used solely for induction. This difference in ratio would seem to agree with the fact that methohexital is shorter-acting so that more has to be used to maintain anaesthesia, when the ratio becomes smaller. When used for induction alone the length of action of each barbiturate is not taken into account.

The attempt to compare methohexital with thiopentone by investigating the electroencephalographic changes is open to criticism on the ground that not enough comparison is made with clinical findings and that alone the difference in wave form means little. Kiersey, Bickford and Faulconer (1951) have nevertheless described definite patterns to the electroencephalographic wave forms varying with the depth of anaesthesia. In this investigation the changing wave patterns during recovery were diffuse and gave us no useful information. However, the longer period of the slow wave pattern (Kiersey pattern 2) seen with methohexital was of considerable interest, as it coincided with the already formed clinical impression that methohexital gave deeper anaesthesia than thiopentone. The shorter recovery time, despite deeper anaesthesia, was a striking feature of methohexital anaesthesia as compared with thiopentone.

Wyant and Chang (1959) reported a high incidence of apnoea following induction of anaesthesia with methohexital. This did not occur on any occasion in our series, probably owing to the small dose of the drug used. Because of the difficulty in dealing with apnoea in the dental chair it is felt that it is most important that the induction dose should remain small. An additional small dose can be given during maintenance anaesthesia, if required, without the risk of prolonging the recovery time unduly.

The incidence of vomiting was encouragingly low. It is felt that 5 per cent is probably the irreducible minimum that can be obtained in the unpremedicated out-patient by any method.

Although the time taken to prepare the patients for dental extraction was longer than with pure nitrous oxide, the smoothness of the procedure...
and the absence of hypoxia, more than compensated for this. Nine per cent of the patients needed some degree of restraint, but this was only to hold an arm or the knees together. None of the patients were reported as being violent and on no occasion was it necessary to alter the planned operation because of difficulty with the anaesthetic.

The patients seemed to welcome this type of anaesthesia. Ninety-three per cent preferred it to nitrous oxide and 47 per cent gave an enthusiastic voluntary appraisal.

Using the technique described, perfect conditions were obtained in over 90 per cent of the patients anaesthetized without subjecting them to any period of suboxygenation or having the inconvenience of a moving patient during the extractions. Yet the time required for complete recovery was conveniently short. Since a short recovery time is the main advantage hoped for in this drug and one of the most important features of any drug used for out-patient anaesthesia, a critical investigation on this point is being carried out. It must be remembered that until it can be established without reasonable doubt that the assessment of clinical recovery means a return to complete normality, all patients should be accompanied home and must not be allowed to drive cars or any other vehicle for several hours after anaesthesia.

**SUMMARY**

Some of the problems of dental anaesthesia are discussed.

An intravenous induction with 1 per cent methohexital, using a dosage of 5 mg/stone (6.3 kg), followed by nitrous oxide and oxygen, was given to 500 patients in the dental surgery. Particular attention was paid to the prevention of hypoxia. The technique is fully described.

Preliminary investigations were carried out on volunteers with e.c.g. recordings and also with e.c.t. anaesthesia when the ratio of strength of methohexital to thiopentone was 3.1 to 1.

In 15 cases nitrous oxide needed trichloroethylene as a supplement. In 45 cases some restraint was required. Ninety-four per cent of patients were able to return home within half an hour and 77 per cent within 20 minutes.

Apnoea was not found in this series, probably because of the low dose and the incidence of vomiting was only 5 per cent which was considered the irreducible minimum.

In 100 patients a 24-hour follow-up was carried out by means of a simple questionnaire which the patients were asked to fill in and return the following day. All but 7 per cent of the patients preferred this type of anaesthesia. The results are fully recorded.

Methohexital is considered to have great promise in dental anaesthesia, provided it is used solely as an induction agent and in the small dosage described. The anaesthesia is more smooth and satisfactory than with nitrous oxide-oxygen and the recovery is rapid, but the patients should be escorted home until further work has been carried out on the assessment of clinical recovery.

**ACKNOWLEDGMENTS**

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**REFERENCES**


