A CLINICAL TRIAL OF APPARATUS FOR ANAESTHESIA FOR DOMICILIARY MIDWIFERY

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SUMMARY

A clinical trial was conducted in hospital using apparatus designed for anaesthesia for domiciliary midwifery. Patients presenting for minor gynaecological surgery were anaesthetized and subsequently interviewed to ascertain their reaction. Anaesthesia was induced with methohexitone and muscle relaxation was obtained with suxamethonium. Maintenance of anaesthesia was achieved with a 50% mixture of nitrous oxide and oxygen supplemented with trichloroethylene 0.25%. The apparatus and anaesthetic technique proved satisfactory in clinical practice with some minor complications.

The use of techniques of anaesthesia in which the patient is kept lightly anaesthetized with nitrous oxide and muscle relaxation provided by neuromuscular blocking drugs has not been popular in domiciliary midwifery, despite the fact that it is probably the technique of choice in obstetric practice in hospital (Hodges and Tunstall, 1963). The pre-eminent reason for this is obviously the difficulty in transporting cylinders of nitrous oxide and oxygen to the patient at home together with the other apparatus required for this technique.

The development of premixed gas mixtures consisting of nitrous oxide 50% and oxygen 50% (Tunstall, 1961) and its widespread use in domiciliary obstetrics appeared to proffer a new possibility in this field. Nevertheless, nitrous oxide in a mixture of 50% in oxygen is not reliable in keeping all patients unconscious during surgical operations and some supplementation of its anaesthetic action is required.

Davidson and colleagues (1970) described an apparatus in which the premixed nitrous oxide and oxygen are supplemented by low concentrations of trichloroethylene. It was, however, realized that little had been done to study the complications of this form of anaesthesia despite the fact that the apparatus had been used apparently successfully on more than fifty occasions in domiciliary obstetric practice.

It was decided to conduct a trial on hospital patients presented for routine operations, as it was not thought to be practicable to study domiciliary patients because the number available is so small.

APPARATUS

The apparatus has previously been described in detail (Davidson et al., 1970). It consists of an Entonox cylinder and demand valve, an Oxford Miniature Vaporizer, a bellows unit and a non-return valve, assembled as shown in figure 1.

![Fig. 1. The apparatus assembled for use.](https://academic.oup.com/bja/article-abstract/45/11/1153/251179)

METHOD

Eighty-five unpremedicated fit female patients who were undergoing minor gynaecological surgery were included in the trial. The age range was between 14 and 50 years (mean 29.7 years) and their weights...
lay between 38 and 91 kg (mean 58 kg). When each arrived in the operating theatre the pulse rate was noted and the blood pressure was measured by palpation using an oscillotonometer. A needle (21 gauge Butterfly; Abbott) was inserted into a vein on the dorsum of the right hand. Atropine 0.6 mg was administered through the needle, followed by methohexitone 70–100 mg in a 1% solution which was freshly prepared. This was immediately followed by suxamethonium 50 mg and the patients' lungs were ventilated with the premixed nitrous oxide-oxygen mixture. Endotracheal intubation was performed using an 8.0 or 9.0 mm cuffed endotracheal tube, and pulmonary ventilation continued, the gas mixture now being supplemented with trichloroethylene 0.25%. Controlled ventilation was used throughout the anaesthetic and muscular relaxation was maintained with suxamethonium using incremental doses of 10 mg. Ergometrine 0.5 mg i.v. was given to 39 of the patients. The pulse rate and blood pressure were recorded during the procedure at intervals of about 3 minutes.

The administration of trichloroethylene 0.25% was discontinued 2—3 min before the end of the operation. Controlled ventilation was continued until vigorous spontaneous movement was present. At this stage the patient was turned into the lateral position, the oropharynx cleared of secretions and the endotracheal tube removed. Premixed gas was then administered by facepiece during any period of breath-holding or hypoventilation.

The time at which the patient became able to obey simple commands was noted; the total anaesthetic time was taken to be the interval between the administration of methohexitone and the recovery of the ability to obey simple commands. The waking time was taken as the interval between the removal of the endotracheal tube and the recovery of the ability to obey simple commands. Monitoring the pulse and blood pressure continued until the patient was taken back to the ward. The occurrence of any complication during anaesthesia and after removal of the endotracheal tube was noted.

In 16 of the 85 patients samples of arterialized venous blood (Brookes and Wynn, 1959; Harrison and Galloon, 1965) were taken from a vein on the dorsum of the left hand in the absence of venous occlusion. Arterialization of the venous blood was ensured by warming the hand with water at a temperature of approximately 45°C. The syringes were sealed, stored in ice and determination of pH and Pco₂ were made within 30 min of sampling. Radiometer equipment (Radiometer Corp., Copenhagen) was used for these determinations, Pco₂ being determined by interpolation after tonometry (Sigggaard-Andersen et al., 1960).

In 10 of the 85 patients a continuous e.c.g. tracing was obtained using a Cambridge Transrite L.V. e.c.g. machine with two plate electrodes on the patient's shoulders. The recordings were begun before the induction of anaesthesia and continued until after the recovery of consciousness. All the patients were interviewed the next day by one of the investigators who had not been present in theatre. The patients were asked several stereotyped questions:

1. Did you have any dream or other experience while you were asleep?
2. What is the worst thing you remember about your visit to theatre?
3. Did you have any nausea or vomiting after the anaesthetic?
4. Do you remember any discomfort associated with the injection which put you to sleep?
5. Have you had any muscular pain or discomfort after the anaesthetic?

RESULTS

Induction and maintenance of anaesthesia was achieved without untoward incident in any patient and the operating conditions were satisfactory to the surgeon. The mean duration of anaesthesia was 11.5 min (range 7–36 min) and the mean waking time was 1 min (range 0.5–5.5 min). The total dose of suxamethonium used varied from 70 to 150 mg, the mean value being approximately 75 mg.

A slight tachycardia was frequently observed after induction, though in 20 patients the pulse rate remained the same or decreased. Usually the tachycardia amounted to an increase of up to 20 beats per min, but in some cases the increase was greater and in 4 patients it was between 40 and 50 beats per min. The systolic blood pressure usually rose after induction by 10–50 mm Hg; in some patients, however, there was a slight fall in systolic blood pressure after induction.

The range of blood pH and Pco₂, obtained from the spot sample of arterialized venous blood was wide: the extreme values of blood pH found were 7.35–7.60 and of Pco₂ 23–38 mm Hg.

Unifocal ventricular extrasystoles occurred in 3
of 10 patients on whom continuous electrocardiographic tracings were made. In one patient 8 coupled ventricular extrasystoles were seen immediately after the first inflation of the lungs with premixed gas supplemented with trichloroethylene. In another 7 ventricular extrasystoles occurred during the period of trichloroethylene administration, whilst in the third patient 3 ventricular extrasystoles were seen immediately after intubation of the trachea and before commencement of inflation of the lungs with premixed gas and trichloroethylene. After removal of the endotracheal tube 2 patients developed slight cyanosis which was rapidly relieved by the administration of premixed gas by facepiece. One patient became apnoeic after removal of the endotracheal tube and remained so for 3½ min, but cyanosis was avoided by ventilation of the patient's lungs with premixed gas administered by facepiece. Minor respiratory problems of coughing and transient breath-holding occurred in 19 patients and slight laryngeal spasm in 3 patients. Vomiting after removal of the endotracheal tube occurred in 15 patients, 10 of whom had received ergometrine. Transient excitement or confusion for a minute or two occurred in 14 patients, but rapid recovery of normal behaviour occurred in all cases.

All the patients were alert and co-operative when seen in the ward next day. Thirty-eight patients (44%) remembered an unpleasant sensation associated with the injection of methohexitone. In 5 patients this was described as "coldness going up the arm", in 10 as "discomfort", whilst actual pain was experienced by 23.

There were no cases of awareness in this series. Dreaming, however, was reported by 31 patients (36.1%). This was described as pleasant in 11 cases (12% of the whole series), indifferent in 13 (15%) and definitely unpleasant in 7 cases (8%). Twenty-three patients complained of nausea and vomiting. This appeared to be commoner in those who had had ergometrine; 14 out of 39 (36%) who had received this drug complained of this and only 9 out of 46 (19.5%) who had not received the drug complained. Muscular discomfort, varying in nature from stiffness to severe pain, occurred in 42 patients (49%).

In response to the question "Would you have this anaesthetic again?" 63 patients gave an unqualified affirmative as their answer (74%) while only 8 patients gave a negative answer (9%). The reasons given by those patients for not wanting this type of anaesthetic again were muscular pain (3 patients), sore throat (1 patient), pain associated with the injection of methohexitone combined with an unpleasant dream (1 patient) and nervousness (1 patient). In 2 cases previous anaesthetics were preferred although no reason for this could be elicited.

DISCUSSION

Anaesthesia for domiciliary practice and for the treatment of patients following accidents may present some similar problems because the patients are not usually prepared for general anaesthesia. Thus, both types of patients may have residual gastric content (either solid or liquid), may be hypovolaemic as a result of blood loss, and may have been given injudiciously large doses of powerful analgesic drugs. In these circumstances it may be argued that the anaesthetic technique used should be similar to one with which the anaesthetist is familiar. For example, it is undesirable that an anaesthetist who has not used ether by an open technique should have to use it for the first time in adverse conditions. The apparatus used, however, must be portable, reliable, suitable for use in resuscitation of the patient, and, in the case of obstetric anaesthesia, preferably suitable for the resuscitation of the child as well (Davidson et al., 1970). In addition, the agents employed should carry no risk of fire or explosion.

The technique used in the clinical trial in hospital is similar to that previously advocated for domiciliary obstetric practice (Davidson et al., 1970) except that (1) preoxygenation with the premixed gas mixture was omitted; (2) cricoid pressure was not employed; (3) trichloroethylene was always administered in a concentration of 0.25%; (4) at no time was it necessary to substitute air for the premixed gas mixture.

The patients anaesthetized, however, are comparable only in their sex and age distribution to those encountered in domiciliary obstetric practice. Their general condition in this trial was always satisfactory, blood transfusion was never required and anaesthesia was not complicated by the prior administration of analgesic, anti-emetic or other drug.

The concentration of trichloroethylene to be used as a supplement to the 50% nitrous oxide-oxygen mixture was chosen in an arbitrary manner. Cases of awareness have been reported during maintenance of anaesthesia with a 50% nitrous oxide-oxygen mixture (Crawford, 1971). Muscular relaxation was with suxamethonium and controlled ventilation was used throughout. A trichloroethylene,
air, relaxant technique was reported (Holmes, Parkhouse and Tunstall, 1963); ventilation was controlled and the trichloroethylene was administered in a concentration of 0.5%. No cases of awareness were reported in this series of patients. It therefore seemed reasonable to us to administer trichloroethylene in a concentration of 0.25% as a supplement to Entonox.

The effects of the technique on the cardiovascular system would seem to be acceptable and, although some patients showed a degree of tachycardia and hypertension, this is not unusual during light anaesthesia with surgical stimulation especially when endotracheal intubation has been performed and atropine and ergometrine administered. The isolated unifocal ventricular extrasystoles were not considered to constitute a serious arrhythmia.

The patients woke up quickly from anaesthesia and the incidence of complications during the recovery phase was low. Administration of the pre-mixed gas mixture rapidly relieved cyanosis when it occurred after removal of the endotracheal tube. Nausea and vomiting, which were probably frequently due to the administration of intravenous ergometrine, were troublesome to some patients. It is unfortunate, perhaps, that the use of anti-emetic drugs is not generally practicable under emergency conditions.

The absence of awareness under anaesthesia in this series is particularly important. The technique used in this investigation involved trichloroethylene 0.25% as adjuvant to nitrous oxide and may well have a wider application. The use of halothane as an adjuvant for obstetric anaesthesia has been advocated (Johnstone and Breen, 1966; Moir, 1970) but fear of haemorrhage due to failure of uterine retraction has precluded its use in many centres. Methoxyflurane has also been used for this type of anaesthetic (Crawford, 1971a, b; Wilson, 1971) but reports of high output renal failure following its use (Panner et al., 1970; Richey and Smith, 1972; Burbridge, Farman and Hains, 1972) have to be borne in mind.

Although the incidence of dreaming reported was 36%, no patient in this series classified an unpleasant dream as the worst experience associated with the anaesthetic. One patient, however, complained of an unpleasant dream and stated that she would not wish to have this anaesthetic again if an alternative was available; nevertheless she was more disturbed by pain in her arm associated with the injection of methohexitone than by her dream. It would appear, therefore, that trichloroethylene is of value in both the elimination of awareness and in the suppression of unpleasant dreams. In certain circumstances it may provide a satisfactory alternative to halothane, which, when used in a concentration of 0.5% as an adjuvant to nitrous oxide, has been shown to diminish the incidence of dreaming dramatically in this sort of technique (Harris et al., 1971).

A disturbing number of patients complained of pain in the arm following the injection of methohexitone into the veins on the dorsum of the hand. It may be possible to eliminate this by further dilution of methohexitone solution or by the use of a large vein such as is found in the cubital fossa.

The anaesthetic technique proved acceptable to the majority of patients, and clinical use in hospital (and in domiciliary practice) over the past 4 years has shown the apparatus to be entirely reliable and to justify its use on the grounds of versatility and portability. Evidence obtained from this trial would appear to indicate that the anaesthetic technique advocated provides safe stable conditions with a rapid recovery.

Although there is probably a diminishing need for anaesthesia for domiciliary midwifery in the United Kingdom it is unlikely to disappear entirely, in the foreseeable future at least. It is also possible that the development of accident flying squads (Little, 1972; Snook, 1972) may increase the need for this type of apparatus.

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REFERENCES


BOOK REVIEWS


Another edition of this comprehensive American monograph on cardiac arrest and its related topics will be widely welcomed. It ranges broadly over the field and includes chapters on such topics as the medico-legal aspects of cardiac arrest and the problems of electrically induced fibrillation. Despite its considerable length it is very readable, though this is perhaps because the style is not generally as terse and economical as is usual in books of this sort; indeed, sometimes the text becomes almost anecdotal.

The anaesthetist perhaps will find that his own specialty is treated with less than justice. Thus B. G. B. Lucas from this country, who writes on the role of anoxia and hypoxia in the aetiology of cardiac arrest, is the sole anaesthetist among nearly a score of contributors. It is not entirely surprising that the section on anaesthesia and cardiac arrest has a slightly old-fashioned look; certainly this seems to be one of the less happy chapters. Students of the relationship between surgeon and anaesthetist and others to perform spinal anaesthesia safely and well will continue to serve newcomers to spinal anaesthesia well.

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