ANAESTHESIA FOR AN OBSTETRIC FLYING SQUAD

BY

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SUMMARY

A set of equipment for an obstetric flying squad is described. It is aimed at providing the sequence: pre-oxygenation, intravenous barbiturate, suxamethonium, endotracheal tube, nitrous oxide, oxygen, intermittent suxamethonium and intermittent positive pressure respiration. A certain amount of variation in technique is also allowed for. Details of thirty emergency cases anaesthetized with the equipment are given. The merits of the equipment are discussed.

Dallas (1967) described a method of domiciliary anaesthesia requiring a minimum of equipment and involving a technique using thiopentone, suxamethonium, endotracheal intubation and intermittent positive pressure respiration (IPPR) with air from an Ambu bag. Unconsciousness was maintained with supplementary doses of thiopentone. The present author has for three years been associated with a flying squad which has adopted a slightly different approach and has evolved a set of equipment which may be of interest to others.

GENERAL PRINCIPLES

The personnel of the squad comprises a resident obstetrician and a midwife from the adjacent Louise Margaret Military Maternity Hospital, and an anaesthetist, usually of registrar or senior registrar status, from the Cambridge Military Hospital. The party travels by ambulance which carries, apart from the driver, a male orderly to assist with stretcher carriage. It follows that there is no need for the equipment to be exceptionally light, nor for it to be designed for the occasional anaesthetist. On the other hand, it must be light enough to be carried up several flights of stairs, and compact enough to be used in an average bedroom.

The aim has been to provide for an anaesthetic technique basically similar to that used for obstetric patients in hospital. It has even been found possible to allow for some variations in technique, according to the preferences of individual anaesthetists.

Although the apparatus weighs 39 kg (88 lb.), it is compact enough to be carried by one person. Here the anaesthetist holds the Portanaest in his left hand, and the accessories case in his right, while the sucker is held under the right arm. This may look precarious, but even if the sucker falls to the ground it is so robust that it will be unharmed.
EQUIPMENT

There are three basic items of equipment: an anaesthetic machine, a sucker, and a case for drugs and accessories. The total weight is 88 lb. (39 kg), which can if necessary be carried by one person, as shown in figure 1. While these items are normally transported by ambulance, they could be fitted into even a small car.

The anaesthetic machine (fig. 2) is a modified Portanaest, which provides nitrous oxide, oxygen, a Boyle bottle and a Magill attachment. The carrying case can be used as a stand, or the machine can be placed on a bedside table. The modification, devised by Lieutenant-Colonel D. G. B. Riddick, comprises an additional oxygen inlet and tap (made from part of an old Heidbrink flowmeter) inserted between the oxygen regulator and the Rotameter. This modification was carried out because the machine has space for only one spare cylinder. Safety suggested that this space should be taken up by an oxygen cylinder, until it was realized that all ambulances carry oxygen cylinders. These are not pin-index cylinders, but they can be accommodated by an extra inlet on the low-pressure side of the oxygen regulator. Such a breach of the pin-index system would be unacceptable under normal conditions, but under the special circumstances of the Flying Squad it is inconceivable that a wrong cylinder could be attached. Figure 2 shows a rubber tube leading oxygen from the ambulance cylinder across the top of the machine to the additional oxygen inlet on the left of the Rotameters. The spare cylinder carried on the machine now contains nitrous oxide,

![Image of the Portanaest machine](https://academic.oup.com/bja/article-abstract/41/6/545/253112)

**Fig. 2**

The Portanaest machine, showing the additional oxygen inlet to the left of the Rotameters and immediately in front of the oxygen regulator. The rubber tubing seen connected to this inlet conveys oxygen from any available cylinder, such as the one partly shown on the extreme right of the picture. On the extreme left is part of the foot sucker.
and if the oxygen runs low the ambulance cylinder can be rapidly connected through the additional inlet.

The sucker, which is partly seen on the left of figure 2, is a standard Cape lightweight foot-operated suction pump (Sugden, 1963).

The case for drugs and accessories is shown in figure 3. A search of manufacturers’ catalogues having failed to find a suitable ready-made model, this case was designed by the author and specially made by Messrs. Allen & Hanbury. The method of design was to construct “mock-ups” of the drawers in cardboard, adjusting their sizes to accommodate the items to be carried, without overcrowding on the one hand or excessive movement during transport on the other. An important feature of the case is the drop-front, supported by a leather strap on each side to provide a working surface whether the case is on the floor or on some convenient piece of furniture. Previous experience had shown that space for laying out syringes, endotracheal tubes, and so on, was conspicuously absent in the average domestic bedroom in the throes of parturition.

Drawer by drawer, the case contains:

1. A range of adult and neonatal endotracheal tubes and suitable connectors, and a Mitchell “cuff-puff”.

2. Disposable syringes in 2, 5, 10 and 20 ml sizes, disposable needles, a Mitchell self-sealing needle, and a piece of rubber suitable for use as a venous tourniquet.

3. Thiopentone, methohexitone (already in 1 per cent solution), atropine, suxamethonium, alcuronium, neostigmine, water for injection, and ampoule files.

4. Adrenaline, methoxamine, mephenetermine, nalorephine in both adult and neonatal strengths, nikethamide, ergometrine, hydrocortisone, procaine amide, Vandid oral solution, calcium chloride, and more ampoule files.

5. Laryngoscope with adult Macintosh and infant Magill blades, spare batteries, scissors, mouth gag, stethoscope, Guedel airways, a stomach tube, zinc oxide plaster, water-soluble lubricating jelly, gauze swabs, a Pinkerton catheter, and a range of disposable suction catheters in sizes suitable for both adult and infant use.

6. A Cardiff infant inflating bag, various intravenous cannulae, a disposable recipient set, a bottle of dextran 70 (Macrodex) and a tin of trichloroethylene.

These three pieces of equipment are stored, together with a box containing the obstetric equipment, in a small room near the entrance of the Maternity Hospital. They are loaded by the ambulance driver and the orderly, while a supply of Group O Rhesus negative blood in Fenwal packs (plastic bags) and a bottle of fibrinogen are collected from a nearby refrigerator.

The obstetric element of the squad is contained in a separate box. Apart from purely obstetric equipment, this box contains some items of importance or interest to the anaesthetist, namely:

(a) Sphygmomanometer: apart from its obvious use, this can be employed to speed blood transfusion by wrapping the cuff round a Fenwal pack and inflating. Alternatively, the pack can be squeezed manually. Either method is preferable to the use of a Martin pump, which is liable to cause haemolysis of the transfused blood.

(b) Pethidine.

(c) Promazine.

(d) Sodium amylobarbitalone for injection.

(e) Aprotinin (Trasylol; FBA).

(f) Protoveratrine complex (Puroverine; Sandoz).
ANAESTHETIC TECHNIQUE
While there is obviously some variation of technique possible, most anaesthetists have adopted the following method.

After pre-oxygenation and intravenous injection of atropine, anaesthesia is induced with a sleep dose of thiopentone or methohexitone, commonly by way of a Mitchell needle in the dorsum of the hand. Suxamethonium is given and cricoid pressure applied by the midwife. (It is sometimes helpful to mark the position of the cricoid cartilage beforehand with a ballpoint pen.) Inflation of the lungs with oxygen is avoided at this stage. An endotracheal tube is passed, the cuff blown up and the anaesthetic machine attached. Anaesthesia is maintained with nitrous oxide, oxygen and IPPR, relaxation being obtained by intermittent suxamethonium or (recently) by alcuronium. Occasionally, nitrous oxide, oxygen, trichloroethylene and spontaneous respiration have been used.

MAINTENANCE OF EQUIPMENT
Each time the equipment is used, servicing is carried out on return to the hospital. All partly used cylinders are replaced by full ones, laryngoscopes, airways, endotracheal tubes and the like are cleaned or sterilized, and expendable items are replaced.

In addition, from time to time the equipment as a whole is reviewed by the Department of Anaesthetics and various changes are effected. For example, until recently the bottom drawer contained a Schimmelbusch mask, a Bellamy Gardner dropper, ethyl chloride and ether. These were included at the inception of the squad as an insurance against breakdown of the anaesthetic machine, but have now been removed to make room for the Cardiff inflating bag. (Figure 3 shows the case as it was some months ago, before these alterations.) A further addition, planned for the near future, is an East-Radcliffe Automatic-Vent.

PATIENTS ANAESTHETIZED
The flying squad has been in existence since 1960, but for the first two years the anaesthetic machine was an EMO vaporizer. At the beginning of 1962 this was replaced by the Portanaest apparatus, and the method of anaesthesia has remained basically the same ever since, though the modification of the Portanaest did not occur until 1966, the new accessories case being introduced about the same time.

Considering the period from 1962 up to the time of writing (October 1968), the squad has been called out 117 times, general anaesthesia being required on 47 occasions. However, some of the local general practitioner obstetric units have their own Boyle machines which were used for some cases, while the notes of some other cases do not make it clear which equipment was used; 17 cases have been excluded for these reasons, leaving 30 cases in which it is certain that squad equipment was used. Table I shows the distribution of these cases by location, and table II their clinical nature. In addition, neonatal resuscitation was carried out on 5 occasions, on 3 of which the need for such resuscitation was the reason for calling out the squad.

<table>
<thead>
<tr>
<th>Location of flying squad anaesthetics.</th>
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<tbody>
<tr>
<td>Domiciliary</td>
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<td>General practitioner unit</td>
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<td>Total</td>
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<table>
<thead>
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<th>Type of case</th>
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<tr>
<td>Retained placenta</td>
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<tr>
<td>PPH (other than above)</td>
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<tr>
<td>Complication in second stage</td>
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<td>Total</td>
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The general opinion of the anaesthetists involved has been that even in domiciliary cases, anaesthesia has been as smooth as if it had taken place in a fully equipped hospital. Only one serious complication occurred, when a patient appeared to have a cardiac arrest after the conclusion of an examination under anaesthesia for postpartum haemorrhage, while the squad was packing up to return to base. The heart was restarted within 20 seconds and complete recovery followed. The arrest was probably due to incomplete replacement of blood loss.
DISCUSSION

The problems of anaesthesia for domiciliary obstetrics are of two sorts: the general problems of all obstetric anaesthesia, and the special problems raised by the unusual location.

The general problems comprise the hazards of the full stomach and the effects of anaesthetic agents on the baby. In this unit we prefer to deal with these by pre-oxygenation, rapid intubation after administration of barbiturate and suxamethonium, and maintenance with nitrous oxide, oxygen, relaxant and IPPR. The special problems are that equipment must be carried to a distance and used in unaccustomed and sometimes difficult surroundings. A rapid return of reflexes is even more desirable than in hospital.

Stabler (1957) laid down two principles for obstetric flying squads: that the full facilities of the hospital should be brought to the patient's home, and that responsibility should not be delegated to junior staff. How each unit handles domiciliary midwifery should depend on to what extent it is able to satisfy these criteria.

Thus, Fraser and Tatford (1961) found that, in Balham an expert anaesthetist was rarely available, and that much apparatus had to be collected and transported. Quite rightly in the circumstances, they adopted the policy that an anaesthetic was never given, patients always being transferred to hospital.

Adamson and colleagues (1960) described the results obtained in 138 general anaesthetics given by the Edinburgh squad, open chloroform being used in 107 and intermittent thiopentone in 23 patients. The anaesthetist was usually a house surgeon or a general practitioner. While the results were extremely good, such methods would scarcely be acceptable today. Liang (1963) gave an account of experience in Glasgow. From 1951 to 1961, 305 anaesthetics were given, the agent being thiopentone with 98 per cent oxygen. An Ambu bag, endotracheal tubes and a laryngoscope were included in the equipment, but were apparently only intended for occasional use. On only four occasions was a specialist anaesthetist available. The method described by Argent and Evans (1961) has much more to recommend it. Thiopentone and suxamethonium were followed by intubation in the head-up position and anaesthesia was maintained with nitrous oxide, oxygen and ether, respiration being spontaneous. If any criticism is to be levelled, it is that having gone to the extent of intubating there seems little point in avoiding controlled ventilation. The head-up position has its disadvantages and is probably better abandoned now that cricoid pressure has been introduced. Dallas (1967) regarded the equipment required by Argent and Evans as too bulky and, while retaining endotracheal intubation as an essential part of his technique, preferred to maintain anaesthesia with thiopentone, suxamethonium and IPPR by an Ambu bag.

The principal advantage of the apparatus described in the present paper is that it permits a technique used in everyday hospital practice. Not only is this safe on pharmacological grounds, but it is also a method familiar to every anaesthetist and therefore likely to be administered with greater expertise, even in the middle of the night and in strange surroundings. Particular advantages are that pre-oxygenation before induction is facilitated, and that a very light level of anaesthesia is possible. The only major disadvantage which might be suggested is the weight of the equipment, admittedly ten times that of Dallas. This has been proved in practice to offer no problem. The two assistants referred to by Dallas would presumably be available to help carry the equipment if the anaesthetist could not manage the whole 88 lb. himself. A minor disadvantage is that the Magill attachment is theoretically inefficient at eliminating carbon dioxide during IPPR (Waters and Mapleson, 1961), but this is of little importance during short anaesthetics. A non-rebreathing valve could easily be introduced into the circuit.

This unit is fortunate in always having available a specialist anaesthetist to travel with the squad, and the method of anaesthesia described may be rejected by units which do not enjoy this privilege. However, the author has grave doubts about the theory that an occasional anaesthetist should fall back on methods such as open ether or chloroform which a specialist would hesitate to use. In any case, the occasional anaesthetist has no more place in a modern flying squad than an occasional obstetrician, and to include an anaesthetist who cannot pass an endotracheal tube should be as unthinkable as to include an obstetrician who cannot apply a pair of forceps.
ACKNOWLEDGEMENTS

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REFERENCES


BOOK REVIEW


This delightful book is what it says it is, and that, in itself, is quite remarkable! It is not a history of anaesthesia; it is a series of almost unrelated essays dealing with certain aspects of the history of anaesthesia in the United States of America, and it tells the story of many of the typical American developments in the subject. Some developments which took place outside the U.S.A. are hardly mentioned: in the chapter on Anaesthesia in the World Wars, there is no mention of Magill, although he receives considerable attention elsewhere in the book; H. R. Griffith is only mentioned twice, neither time in connection with curare; the history of endotracheal intubation begins with Meltzer and Auer (1909) and Elsberg (1909), not with Kite (1877) or even Macewen (1878). Nevertheless, within the view which the authors take, the history is not only accurate, but makes fascinating reading.

Those of our readers who can remember anaesthesia in Britain before the Second World War will be surprised to be reminded of the backwardness of American anaesthesia at that time; in spite of a few oases, the specialty seems to have been a vast desert, yet one can form a wry smile at the remark, concerning the period 1943–4 “There were no carbon dioxide absorbers [in Britain]." Ether vaporizers were, shall we say, primitive by American standards.” This implies, perhaps correctly, that the British did not hand over their best apparatus to their allies, although the authors are too polite to think this. Of course the British anaesthetic services had greatly expanded during the war (which began, for us, in 1939), and we were probably very short of ‘modern’ equipment at that date. It is odd, too, that in the chapter The Anaesthesia Library of Twenty-five Years Ago, the only English book mentioned is Noel Gillespie’s Endotracheal Anaesthesia. (No, he did not spell it the American way; even when he lived in the U.S.A., he refused to write other than ‘anaesthesia' and would, in no circumstances, use the ugly word, ‘anesthesiology.’) Opportunity should also be taken to state that the Charles King Collection of Apparatus was not destroyed during the war, and is now in the possession of the Association of Anaesthetists of Great Britain and Ireland; some of it is on permanent display at the Royal College of Surgeons of England.

But these criticisms are trivial. Dr. Davis, who edits the volume, has written nearly all of it, and has done a fine job; he is most excellently helped by Dr. J. S. Redding and Dr. J. C. Matthews, whose chapter on Anaesthesia during the American Civil War is one of the best in the book.

This collection of essays is very well produced and misprints are few. It is essential reading for all historians of anaesthesia, and, if one feels from time to time that its bias is too much towards the U.S.A., it may not do one any harm to remember that anaesthesia, the greatest boon which science has ever given to the world, is an American invention.

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