ANÆSTHESIA IN THE U.S.A.

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Since the inception of surgical anaesthesia, the English-speaking countries have been the pioneers of progress in this new field. Despite the constant exchange of ideas and the vast amount of literature on subjects related to anaesthesia, the specialty has developed along somewhat different lines in Britain and America. Each country has developed its own system of training, its own equipment, and has demonstrated certain preferences for agents and methods, not always shared by the other. This is not surprising if one considers that even within Britain there are marked regional variations; the pre-eminence of chloroform in Scotland is an example.

Papers have been published before in the English literature on Anæsthesia in the United States, but they have largely been from the pens of British visitors to the States after a comparatively short stay, during which they had visited some of the more prominent medical centres. The authors feel that they may have something more to contribute because of their more intimate acquaintance with both countries. One of them (G.M.W.) received his training in anaesthesia and did much of his post-graduate work in England, and has been teaching in the U.S.A. since 1950; while the other (M.S.S.) spent four years in the British Isles with the U.S. Forces during the late war; he then had occasion to visit many hospitals up and down the country.
This paper is presented in the hope that it may contribute something useful to anaesthesia in both countries by furthering the understanding of mutual problems. It must be emphasised at the outset that there is no such thing as "American Anaesthesia", and that this paper can only deal with general trends; there may be marked variations from these trends in the various centres.

ANAESTHETIC AND AUXILIARY AGENTS

Nitrous oxide, ether, cyclopropane, vinyl ether, ethyl chloride, thiopentone, bromethol and the muscle relaxants occupy a position in the United States similar to that which they hold in Britain.

Ethylene, however, which is almost never found in Britain, is a great favourite in the Middle-Western States of the Union and there is second only to nitrous oxide. Its properties and indications are roughly those of nitrous oxide, and its mode of administration is similar, but as it is slightly more potent, it may be used with a little higher concentration of oxygen, thus reducing the hypoxic hazard of nitrous oxide. Its high inflammability and explosiveness, however, limit its use as compared with nitrous oxide. A further disadvantage is that it is lighter than air, and explosive mixtures of the gas are therefore more widely distributed in the operating suite.

Trichlorethylene, on the other hand, so beloved in Britain, has never gained popularity in the United States and is used as rarely as is ethylene in England. The drug has never been able to recover from some early unfavourable reports of its pharmacological properties, despite the fact that clinical experience in Britain seems to invalidate these theoretical considerations.
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If chloroform is rarely used in hospital-practice in England, it is hard even to find a bottle of the drug in the average American hospital. As far as the use of chloroform in domiciliary midwifery is concerned, the situation appears to be similar in the two countries, except that deliveries in the home are practically non-existent in the larger towns and are on the decrease in rural areas.

Where cinchocaine is the long-acting spinal analgesic of choice in Britain, amethocaine (Decicaine, Pontocaine) is the favourite in the United States for reasons which it is beyond the scope of this paper to discuss. While light and heavy solutions of amethocaine are commercially available, many anaesthetists prefer the use of crystals which are being dissolved at the time of lumbar puncture; by dissolving these crystals in distilled water a hypobaric solution can be prepared, while the addition of dextrose will result in a hyperbaric solution.

Carbon dioxide administration is rarely resorted to during anaesthesia. Any increase in pulmonary ventilation that may be desired is achieved by manual assistance of respiration or by temporarily excluding the soda-lime absorber from the anaesthetic system. Indeed the Army and the Veteran's Administration even expressly forbid the attachment of carbon dioxide cylinders to anaesthetic machines in their hospitals.

Helium, which for a time enjoyed much popularity, is now being used much less frequently than before. However, one has the impression that it is still more common in the States than in Britain. Its chief use is for asthmatic patients and for laboured breathing from other causes. Its employment during the post-operative period and for the dilution of explosive mixtures is definitely on the decrease.
Intravenous procaine has in the last few years become established as a valuable aid in the prevention of cardiac arrhythmias during thoracic surgery, and is widely employed also for the suppression of harmful reflex-activity in a wide variety of surgical procedures. In some cases it almost has assumed the role of a basal narcotic, but the exact status of intravenous procaine in anaesthesia must still evolve with the passage of time.

TECHNIQUES

Inhalation anaesthesia is administered by the closed, semi-closed and open techniques very much in the way it is administered also in Britain.

Intravenous anaesthesia with the ultra-short-acting barbiturates is administered in many centres by the continuous drip method, a technique less frequently encountered in Britain. The advantages claimed for this method of administration are that it affords a more even level of anaesthesia throughout the operation and that less fall of blood-pressure and less respiratory depression are encountered; it also prevents the often troublesome occlusion of the needle seen with repeated-dose administration. However, one cannot fail to notice that with the lighter plane of anaesthesia thus obtained, many more instances of laryngospasm from trivial stimulation are encountered than are seen with the fractional-dose technique, and the inadvertent omission to discontinue or slow the drip when the desired level of anaesthesia has been reached after induction is a potential danger. Concentration of thiopentone for continuous drip varies between 0.1 and 0.5 per cent, and occasionally a 1 per cent solution is employed for induction. For single or fractional-dose injection the concentration of
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thiopentone practically never exceeds 2.5 per cent in the United States.

Continuous spinal analgesia is a very popular method in the U.S.A., presumably because operations tend to last so much longer than do the same procedures in Britain. Not at all infrequently analgesia is required for five, six, seven hours or even longer; and in these cases continuous spinal is one of the possible ways of providing analgesia over so protracted a period. Another important reason is that in continuous spinal, procaine, with its low toxicity, can be injected in small doses from time to time as required, thus avoiding the large single dose which is objectionable to many in the States. By correct positioning of the catheter-tip at the proper level of the spinal canal, analgesia can be obtained in just the segments only, where it is needed, thus further reducing the amount of drug required and minimizing the danger of serious hypotension (segmental spinal analgesia).

By and large the catheter-technique has replaced the malleable needle, and very excellent fine polyethylene and other plastic tubing is now available, which from many aspects is superior to the ureteric catheter previously employed.

Another technique for prolonging the action of spinal analgesia is the addition of small amounts of adrenaline 1:1,000, ephedrine, or of a similar vasopressor to the spinal solution. By this means it is possible to prolong analgesia with cinchocaine or amethocaine in the usual doses by an additional two or three hours.

In an attempt to decrease the incidence of spinal headache, the two-needle technique is gaining in popularity. In this, a 24- or a 25-gauge needle is employed for lumbar
puncture and is introduced through a larger needle which serves as a guide and has been advanced down to the ligamentum flavum.

Continuous caudal analgesia is quite popular for obstetrical analgesia in many places, although there appears to be at present a trend away from this method in favour of subarachnoid saddle-block. This is possibly due in no little measure to the fact that continuous caudal analgesia is a time-consuming procedure. That both caudal and spinal almost invariably necessitate the use of outlet-forceps is no factor, as this type of delivery is practised in the large majority of cases anyway.

Obstetrical analgesia with nitrous oxide and air, comparable with that obtained by the Minnitt apparatus, is not practised in the United States; and no machine is available for that purpose. Trichlorethylene, too, is rarely resorted to for the reasons already mentioned.

Indications for tracheal intubation are considered similar to those in Britain, with blind nasal intubation being much less popular in the United States. Where an air-tight fit is needed cuffed tubes are preferred rather than pharyngeal packs.

One of the striking features of anaesthesia in the United States is the tendency to use drugs in greater dilution than in Britain and to employ smaller doses initially, repeating the administration if and when required or resorting to the continuous-drip technique. Apart from thiopentone, this is particularly noticeable in the techniques worked out for muscle-relaxant drugs and in the administration of vaso-pressors and similar potent drugs. Premedication, too, with morphine or similar agents is somewhat lighter than one is used to after practising in Britain.
Record-taking during anaesthesia is a universal feature of American anaesthesia. Blood pressure, pulse and respiration are taken at intervals of 5–10 minutes and charted during all operations. Most charts available require the noting of additional data regarding the pre-operative medication and findings, observations and drugs given during operation, and post-operative status and complications. The chart used at our Institution is a punch record-card similar to the Nosworthy-chart, but somewhat larger and more comprehensive. The keeping of good records enables good statistical analysis, but unfortunately much of the clinical material is lost, as in the smaller institutions charts are filed with the patient’s record and are thus not available for analysis. The chart used by us consists of two copies, a thin original sheet for inclusion with the patient’s notes and a carbon-copy on stout card-board for punching and filing in the anaesthesia-department. Apart from providing adequate records, the mere fact that charts must be kept on all cases compels the anaesthetist to observe his patient closely, take regular readings, and re-assess his patient.

APPARATUS AND APPLIANCES

Machines. The principal brands of American machines, the Heidbrink, Foregger, and McKesson are well known in Britain. Of these, the Heidbrink is the most commonly used machine in the States. They are all excellent and are equipped with circle absorption units, but can be adapted to to-and-fro absorption. However, there is no carbon-dioxide two-phase circle absorber, similar to the Coxeter-Mushin unit, American circle-absorbers acting only on one phase of respiration. Machines in the States have no provision for non-interchangeable couplings, but plans have
now been elaborated for a system by which cylinders can no longer be attached to the wrong yoke.

*Gas-cylinders* come in several sizes, varying from size A (20 gals. oxygen or 50 gals. nitrous oxide) to size G (3,200 gals. nitrous oxide) and H (1,825 gals. oxygen). Cylinder-outlet valves are all of the "American" type, being connected to the machine by means of yokes. The outer appearance of these cylinders is very clean and the paint is always in excellent condition. The distinctive colours are quite different from those in Britain at present, but a system of international colours is being elaborated at the present time.

*Laryngoscopes* are of many types, the most popular ones probably being the Guedel, Flagg, and Wis-Foregger blades. The Mackintosh-laryngoscope is used by many, but is less commonly seen than in Britain.

As for intravenous therapy equipment, the striking feature in the States is the use of disposable administration-sets. They are made of plastic material and are discarded after use. Although wasteful, it is much superior to the rubber-tubing set used in Britain and has been universally adopted in the States. Pyrogen-reactions from unclean tubing therefore do not occur. The various solutions are commercially available and hardly ever are manufactured by hospital dispensaries. Blood is usually available in ample quantities. Syringes are of the all-glass type, and cold-sterilization is not favoured.

*Oxygen-therapy* is administered by tent, mask or catheter. Although preferences vary with the individual anaesthetist, one may say that by and large the naso-pharyngeal catheter occupies the place for the surgical patient which in Britain is taken by the B.L.B. mask and similar types.
TRAINING AND QUALIFICATIONS

Undergraduates. Problems of undergraduate-training in anaesthesia in the States are very similar to those in Britain. The time allotted for teaching is totally inadequate and the student leaves his Medical School with very little practical experience and with only a sketchy theoretical background. In our own Institution a course of twelve lectures is given to the "Junior-Class" (penultimate clinical year) after they had received very thorough instruction in the pharmacology of anesthetic drugs in the course of their previous studies. "Seniors" (final year students) then attend for one week, or sometimes two, in the Operating-Rooms where an attempt is made to teach them practical anaesthesia provided cases suitable for instruction are available. Emphasis is laid on teaching "open-drop ether" and, circumstances permitting, "nitrous oxide-ether sequence" and "spinals". They are warned from employing any other agent after qualification without further instruction. Although our scope for practical tuition of students is very small, yet our school is well above the average in the country as far as time allotted for instruction in anaesthesia is concerned.

Postgraduates. Postgraduate training and instruction, on the other hand, is excellent. A residency of at least two years in an approved institution is minimum requirement for Board-Certification. During this time much emphasis is laid on basic sciences, particularly physiology and pharmacology, and the student is impressed with the fact that technique occupies second place of importance. The postgraduate student receives a wide variety of cases which include thoracic surgery, neuro-surgery, eye, E.N.T.,
orthopaedic, pediatric and geriatric cases. He receives instruction, both practical and theoretical, in the management of shock and resuscitation, in blood-transfusion and in the maintenance and restoration of water- and electrolyte-balance, in the management of respiratory emergencies other than those occurring during anaesthesia, and in the indications and performance of diagnostic and therapeutic nerve-blocks. In our own institution residents also attend a one-week course in bronchoscopy in co-operation with the Department of Broncho-oesophagology.

There exists in the States a vast opportunity for postgraduate instruction in the frequent meetings of scientific societies. Local Anaesthesia Societies exist in the larger towns, and they usually meet once a month. There are also Regional and State Anaesthesia Societies who hold scientific meetings from time to time, and the national societies with a yearly Congress. Other medical societies frequently have one or two anesthetic topics on the agenda of their scientific meetings, and most teaching-institutions hold anaesthesia-seminars at least once a week and often more frequently. They also offer from time to time refresher-courses in anaesthesia or in special techniques, such as intubation, bronchoscopy, etc. Seminars apart, there hardly passes a month when some meeting of interest to the anaesthetist does not convene within reasonable reach of all except those who practise in the most remote parts of the country.

**Qualifications.** There are two main qualifications in Anaesthesia in the United States. The F.A.C.A. (Fellow of the American College of Anesthesiologists) is awarded upon examination to those who do not yet hold the licence of the American Board of Anesthesiology, but who have completed one year in an approved residency, or who have
practised anaesthesia for not less than five years. The examination consists of a written, an oral, and/or practical part, and the requirements are similar to the D.A.

The Diploma of the American Board of Anesthesiology is the ultimate goal of all anaesthetists. It requires graduation from an approved medical school and an approved internship. A candidate must have limited his practice to anaesthesia as a specialty for five years of which at least two years must have been spent in formal approved training, and he must be a member in good standing of an approved national, state, or local society. The diploma is awarded after very thorough examination in three parts, namely written, oral, and practical, and the standard is very high indeed. Holders of the diploma must limit their practice exclusively to anaesthesia.

Apart from these, special qualifications are obtainable from some Universities, such as Master of Science (Anesthesia) and similar higher degrees. The International College of Anesthetists also awards a Fellowship, the F.I.C.A.

PERSONNEL, STATUS, AND SCOPE OF ANAESTHESIA

Nurse-technicians. One of the most striking features of American anaesthesia, and also one of the most controversial ones, is the existence of nurse-technicians in many States of the Union. These nurses receive a course of training up to twelve months, but often this is much less or only amounts to a short term of apprenticeship with a more senior nurse. In many of the smaller hospitals (and in some of the larger ones too) no physician-anaesthetist is even on the hospital staff. These nurses work under the direct supervision of the surgeon who also bears the medico-legal responsibility
for their work. In some places these nurse-technicians even carry out intubations, and in rare instances administer spinals. This situation has arisen because of the reluctance in years gone by for physicians to enter the field of anaesthesia; even today the demand for medically qualified anaesthetists much outstrips the supply. However, there is a gradual trend away from nurse-technicians ("Anesthetists") in favour of medical "Anesthesiologists", and more and more surgeons have come to recognise the value of having a colleague at the head of the table and of thus being relieved of a heavy burden of responsibility; not to mention the better service obtained. But still there are many who will not part with nurse-technicians. This is a tricky problem, as yet only partially solved, and certainly the economic implications of medical anaesthesia play a very important role. However much one may deplore the intrusion of nurse-technicians into a field which should be the sole domain of medical practice, one cannot forget that the nurse with her empirical knowledge and with her practical experience in anaesthesia is probably the lesser of two evils when compared with the newly-qualified house-surgeon whose lowliest duty commonly in British hospitals is to administer anaesthetics.

It is probably the existence of nurse-anæsthesia in the States which has delayed for so much longer than in Britain the recognition of anaesthesia as a fully-fledged specialty. To-day anaesthesia has achieved recognition in the larger sense of the word, although individual surgeons and some hospital-administrators continue in their refusal to accept this as a fact.

Anæsthetic-orderlies. Except for some few places, the anæsthetic-orderly is non-existent in America. The anæs-
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The anesthetist services his own machines, changes cylinders, prepares his own trays, and "cleans up the mess" at the conclusion of his labours. Any help he may require, he must ask from the "circulating nurse" and gets "when she has time". Occasionally, he may get assistance from a nurse-anæsthetist. This certainly is somewhat hard on the newcomer from Britain who has come to expect his machine ready for use, his syringe laid out, spinal trays set, tubes lubricated, and adhesive tape cut.

The field of anaesthesia in the United States includes what is implied in the training of residents, namely fluid-therapy, transfusions, oxygen-therapy, diagnosis and relief of pain-problems of all sorts, and bronchoscopy when related to the anaesthetic procedure. The anæsthetist is frequently called in for consultation on cardio-respiratory problems and on problems of resuscitation, and he should be the expert consulted in the care of the patient unconscious from any cause. Most anaesthesia-departments control the oxygen-therapy equipment and its maintenance for the whole hospital.

RESEARCH AND RECENT DEVELOPMENTS

Research in anaesthesia and related fields is very active indeed in the States. Much work is being done in pharmacological investigations and in the physiology of respiration and circulation. Co-operation is very intimate in most centres between the departments of Anaesthesia, Physiology, and Pharmacology, and anaesthetists are often regarded as "Applied Physiologists and Pharmacologists". Indeed many an anaesthetist has joined the specialty from the ranks of one of the basic sciences.

There is a constant flow of new pharmaceutical prepara-
tions which require attention, and although many of them are ultimately discarded, some very useful drugs have emerged and are constantly emerging from these studies. As examples of those which have probably come to stay one may cite new vasopressors (Methoxamine, Cyclopentamine, and a number of arterenol-like drugs), muscle-relaxants (dimethyl d-tubocurarine) and anti-curare drugs (Tensilon), ultra-shortacting barbiturates (sodium thioseconal or Surital) procaine amide, various blood-substitutes, and a host of new local analgesic agents. Other drugs, imported from abroad, have to be re-investigated and re-evaluated for their place in anaesthesia in the States. Foremost of these are Syncurine, Myanesin, and Kemithal from Britain, Xylocaine and Dextran from Scandinavia, Flaxedil from France, and polyvinylpyrrolidone, a blood-substitute, from Germany. Furthermore research is continuing in new preparations of older drugs, such as injectable quinidine, rapidly-acting digitalis-fractions, and benzocaine in solution. A very thorough study of re-evaluation of chloroform has been carried out at the University of Wisconsin some time ago. Research also continues in an attempt to improve existing anaesthetic machines and appliances, and in the development of new scientific instruments, such as gas analyzers, various electrical and electronic recording devices, and others employing radioactive isotopes. The use of music in the sedation of patients undergoing operation under regional or spinal analgesia continues to be explored at some institutions.

Postoperative recovery rooms are becoming very popular, and many of the better hospitals now have added these highly specialized units to their services. These units must not be confused with mere "wake-up rooms" present in
most institutions. The recovery-rooms are usually under the combined jurisdiction of the surgical and anaesthetic staffs, and are supplied with wall-oxygen and wall-suction; they are equipped to deal with all emergencies likely to arise in the immediate post-operative period.

The prevention of explosions is a subject under constant investigation. American anaesthetists are much more explosion-conscious than their British colleagues, probably because of the apparent greater frequency of such mishaps in the States. Conductive floors and conductive rubber, spark-proofing of equipment, air-conditioning and humidity-control in the operating-room are among the measures adopted to prevent such calamitous accidents. A "Staticator" has been devised which indicates the presence of static electric charges in the vicinity of the antenna of the instrument.

**CONCLUSION**

This survey must of necessity be rather sketchy, but we believe that it presents a fair survey of the situation as a whole. We hope it may acquaint our colleagues in Britain with the problems of anaesthesia in the United States and with the viewpoints of anaesthetists there, so that we may learn from one another and may go forward together with greater understanding of each other to the ultimate benefit of our patients.