ANÆSTHESIA

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THE art and practice of anæsthetics in the Army has made great strides during the period of existence of the Royal Army Medical Corps.

Most of the advances have been made during the two Great Wars, when the problems of anæsthesia for wounded men under active service conditions have produced new techniques and improvements in the established methods.

In the early days of the Corps existence, anæsthesia was not regarded as a subject of much importance; to quote Major-General J. W. West, then a junior surgeon, "Any Medical Officer was considered as suitably trained to give a general anæsthetic and, when the infrequent operation occurred in a Military Hospital, the surgeon had to search round for some officer otherwise disengaged, who would administer the anæsthetic." Although the surgery in military hospitals of those days was not very enterprising, it was not the operation but the anæsthetic which caused anxiety; chloroform was the only anæsthetic available, and deaths under anæsthesia did occur. The inexperienced anæsthetists were a sore trial to the surgeon; the wait during induction was often long, the struggling of the patient great, and complete relaxation of the abdomen rare. Salivation, in spite of atropine was troublesome, and post-operative vomiting almost universal. A few medical officers, mostly trained in Scotland, gave chloroform with a folded towel and a drop bottle most satisfactorily, but anxiety never ceased until the patient was safely back in bed.

During the South African War conditions such as those described above obtained; there were no specialist anæsthetists and little equipment. Chloroform was the agent used and it was often difficult to find a medical officer willing to act as an anæsthetist. It is interesting to note that in 1904 an investigation was carried out to ascertain whether deterioration occurred in chloroform exposed to hot climates on active service. Samples of chloroform from South Africa and from the China Field Force were, at the request of Army authorities, examined by Dr. F. W. Tunnicliffe, Professor of Pharmacology in King's College, London. After an exhaustive series of tests, it was found that these samples of chloroform showed no change in properties.

In the years between the South African War and the First World War, various new methods of anæsthesia were tried in the Army. Local anæsthesia using B-eucaine and adrenalin for minor operations was employed by Captain J. W. Houghton in 1905. Spinal analgesia was first used in military practice in 1907 by Major C. G. Spencer and Captain J. W. Houghton at the Q.A. Military Hospital, Millbank. Stovaine was the agent used, according to

Barker's original technique, and excellent operative conditions were obtained, though the incidence of post-operative headache appears to have been relatively high. Captain Houghton published a series of articles in the *Journal on spinal analgesia*; in 1909 he used tropocaine in Sierra Leone and published further series of cases using stovaine in 1911, 1912 and 1913.

The absence of trained anaesthetists and the difficulty of finding officers to administer general anaesthetics made the practice of the spinal method highly acceptable to Army surgeons, and made it possible for them to operate in out-of-the-way stations and on board ship without other trained assistants.

During this period up to 1914, ether came into use in military hospitals in the United Kingdom and the Clover's inhaler was the apparatus employed. Mixtures of chloroform and ether were used, and ethyl chloride was sometimes used for induction.

Though the Senior Course at the R.A.M. College produced medical officers specially qualified as surgeons, no attempt was made to have officers specially trained in anaesthetics and it was suggested in articles in the *Journal* in 1904 and 1905 that N.C.O.s of the corps should be trained in the administration of anaesthetics, though there is no indication that this suggestion was ever implemented.

In India, during the period up to the First World War, chloroform was given by the open method and was the general anaesthetic mainly used, the official view being that ether would not be effective in the hot weather, and the difficulties of transport and storage of ether was considered to make its use impracticable. An individual surgeon procured privately a Vernon Harcourt chloroform inhaler and used it with great improvement in the induction and maintenance of anaesthesia and in the post-operative condition of the patients. No trained anaesthetists were available in military hospitals, and anaesthetic duties had often to be delegated to members of the Indian Medical Department. Eventually, official objections to ether were overcome, and it was supplied to military hospitals, but as no special apparatus for its administration was available, the open method had to be employed. Individual surgeons also used spinal analgesia with stovaine and local anaesthesia with B-eucaine, providing their own apparatus as there was no official supply of such equipment.

During the 1914-18 War, much was learnt about anaesthesia for wounded men under active service conditions and notable advances were made.

In a short survey of this nature, it is not possible to deal with all the details of the techniques evolved; the subject has been very adequately dealt with by Captain H. P. Crampton in the "Medical History of the War." For the first two months of the 1914-18 War, chloroform was the only anaesthetic available for medical units in the field, but after this ether and other agents were procurable.

In the early part of this war, before the establishment of Casualty Clearing Stations, a certain amount of surgery had to be undertaken in Field Ambulances, and chloroform supplied in sealed glass tubes was useful on account of its portability.

To quote Dr. Ashley Daly: "It was soon learned (1) that prolonged deep ether or chloroform anæsthesia had a bad effect on a shocked or septic patient; (2) that spinal analgesia was dangerous and must be avoided in these cases; (3) the danger of operating on a shocked patient without resuscitation treatment; (4) the value of blood pressure readings in estimating the degree of shock present."

A notable advance was the introduction in 1916, of Dr. (later Sir Francis) Shipway's well-known warm ether apparatus, by means of which warmed ether and/or chloroform vapour could be delivered to the patient using oxygen or air to vaporize these agents. This compact and convenient apparatus was extensively used in Casualty Clearing Stations and hospitals throughout the war.

The patients, then, as now, were nearly all heavy cigarette smokers and ether by the open method tended to produce a high incidence of post-operative pulmonary complications, which was considerably reduced after the introduction of the "warmed ether vapour" method. Ether was also administered by means of the Clover's inhaler and to a limited extent by the rectal and intravenous routes.

In 1916, nitrous oxide and oxygen became available and were administered by the Boyle's apparatus. It was soon found that, in skilled hands, this was the method of choice for use on the severely wounded and shocked patients or toxic patients with gas gangrene: small quantities of ether could be added if required, especially during induction, and it was of great importance to ensure that there was no limitation of the oxygen supply. After adequate pre-operative resuscitation, transfusion, warmth, etc., these patients came through prolonged and serious operations and post-operative effects were markedly reduced. Owing to difficulties in the supply of gas and the scarcity of skilled administrators, this method had often to be reserved for selected cases.

Spinal analgesia with stovaine was found to be followed by a dangerous fall in blood pressure, and its use in forward medical units was soon abandoned entirely. Stovaine and novocain were used in Base hospitals for spinal analgesia for amputation through the lower extremity, though spinal methods were not on the whole favoured by surgeons.

Local anæsthesia by infiltration with novocain was used by some operators either alone, or combined with light general anæsthesia with nitrous oxide and oxygen. Successful use of local methods was made in a Special Head Unit at the Base under the direction of the late Colonel Sir Percy Sarjent. Towards the end of the war the endotracheal administration of anæsthetic vapours by the insufflation method was introduced and proved invaluable in dealing with facio-maxillary cases.

As regards personnel, up to 1916 there were no specially trained anæsthetists, anæsthetics were administered by any medical officer available in a medical unit. Then special anæsthetists were appointed on the staffs of Casualty Clearing Stations as members of surgical teams; none of these officers

so appointed were regular officers of the Corps. In 1918 some two hundred nursing sisters, having been specially trained as anaesthetists, became available for service in Casualty Clearing Stations and many of them became very skilful; they also freed a corresponding number of medical officers for duty at the front where there was a serious shortage of the latter. To quote from the "Medical History of the War," "The art of administering anaesthetics was greatly developed during the war with immense benefit to the patient and the surgeon. The increased supply of special apparatus contributed very greatly to this result and the administration of warm ether vapour and of gas and oxygen instead of chloroform saved many lives."

In the years between the World Wars, anaesthesia in the Army progressed more or less *pari passu* with anaesthesia in civil practice, though there was often a time lag between the introduction of new agents and their issue as an official supply and, in some cases, anaesthetists purchased their own drugs and equipment in order to keep up to date.

In India, however, things remained as they had been before the 1914-18 War: chloroform, ether by open method, and nitrous oxide and air were considered by the Government of India to be modern and adequate methods of anaesthesia. It was not till the 1930s that modern anaesthetic apparatus became an official supply, and even in 1934 a Vernon Harcourt chloroform inhaler was produced with great pride by an Indian store-keeper as "modern equipment."

Endotracheal anaesthesia by the insufflation method was in use in large military hospitals in the U.K. and an article on this method was published in the Corps Journal in 1929 by Major L. M. Routh. Later the methods of blind intubation and inhalation endotracheal anaesthesia came into general use by anaesthetic specialists.

Avertin is first recorded as having been used in the Army in 1934 by Major L. S. C. Roche, and in the same year intravenous barbiturates came into use in military anaesthetic practice, a series of fifty cases using evipan being published in the Corps Journal by Major K. P. McKenzie.

It was, however, in the training and status of anaesthetists that great strides were made in the years between the two world wars.

The Senior Courses for officers at the R.A.M. College, Millbank, were resumed after the war and anaesthetics was recognized as a special subject; in 1920, after special training in civil hospitals, Captain R. Martyn Davies became the first Regular specialist in anaesthetics in the Corps.

The speciality was not a popular one, as the number of hospitals requiring a full-time anaesthetist at the time were few, and anaesthetists were only entitled to specialist pay when employed as such, and if posted to one of the smaller military hospitals, they remained General Duty officers. Still, a number of specialist officers were trained and, after the inception of the Diploma in Anaesthetics in 1935, a few Army specialists were successful in obtaining this Diploma.

The outbreak of the second World War in 1939 saw an enormous expansion in the personnel of the Corps. Almost all the Regular anaesthetists were

soon employed on non-professional duties and a large number of skilled specialist anæsthetists came into the Army from civil life.

In 1941 Major Ashley Daly was appointed the first Adviser in Anæsthetics to the War Office with the rank of Lieutenant-Colonel, and in 1945 he was made Consultant Anæsthetist with the rank of Brigadier; the first anæsthetist ever to attain this rank in a purely professional capacity. Under his wise guidance the anæsthetic service of the Army grew "in wisdom and stature." Advisers in the rank of Lieutenant-Colonel were appointed to overseas theatres of war, M.E.F., C.M.F., B.L.A., etc., these officers being chosen from anæsthetists who were on the teaching staff of civil hospitals in peacetime.

In 1944 Brigadier H. K. Ashworth was appointed as Consultant Anæsthetist to G.H.Q., India, and Advisers were appointed in each of the four commands in India and one with H.Q., A.L.F.S.E.A.

The appointment of these Advisers in Anæsthetics was of great importance in raising and maintaining the standard of anæsthesia in the Army. The Adviser was usually in a position to tour forward medical units and Base hospitals in his area, when he could make personal contact with anæsthetists and help them with their professional, and sometimes personal problems, and stimulate their interest in new techniques. An important part of the Adviser's duties was the supervision of the teaching of trainees, which was carried out in all overseas theatres. The morale of anæsthetists was greatly assisted because they felt they had someone "higher-up" looking after their interests and ready to help them with their personal problems.

At the Headquarters of the formation the Adviser had a close liaison with the Consultant surgeon and was able to help with the posting and distribution of anæsthetists according to their ability.

As regards the supply of anæsthetics, agents and equipment, the specialized knowledge of the Adviser enabled him to be a great assistance to administrative medical authorities.

In the matter of the technical development of anæsthetics during the war, space does not allow of a detailed description of the intricacies of the various methods used. One cannot do better than quote from the memorandum on anæsthesia written by Brigadier Ashley Daly in the "Field Surgery Pocket Book" (1944): "Since the last war (i.e. 1914-18) the problem of anæsthesia in the Field has been simplified by the introduction of new drugs and improved methods of administration of the older agents. Chief among these innovations are the development of the intravenous route, consequent upon the discovery of the various barbiturates, the use of agents such as cyclopropane and trilene, and the invention of a most useful machine for giving definite percentages of ether and air known as the Oxford Vapouriser Number One. Considerable advances have also been made in the technique of local anæsthesia and though its use in war surgery is chiefly to reinforce general anæsthesia, local blocks, e.g. brachial block, are useful in severe injuries of the hand, and intercostal block combined with bilateral splanchnic block is occasionally used for an abdominal injury. Spinal analgesia has a very small place in the surgery of the wounded man."

The importance of adequate resuscitation before surgery was undertaken on the wounded man was fully realized; the magnificent work of the blood transfusion units, which worked in close touch with the surgical teams, lightened the anxieties of the Field anaesthetists to a considerable extent.

The adequate premedication of patients before anaesthesia was a matter of importance and was usually carried out by the transfusion officer in liaison with the anaesthetist, care being taken not to administer morphia to a patient who had already received a heavy dose of this drug as part of first aid. Omnopon and scopolamine were usually employed and when necessary were given intravenously.

Of all the anaesthetic techniques employed during the war, perhaps the most outstanding success was the use of pentothal sodium. It was used as the only anaesthetic for a large number of wounded men and almost as a routine induction before proceeding to an inhalation agent. Extreme caution was required in cases suffering from "shock," e.g. cases with abdominal wounds or extensive injuries of the limbs and only very small amounts of pentothal were required for induction in the former and for induction and maintenance in the latter type of case.

In patients with extensive burns, such as were seen in the Western Desert campaigns, great caution was required when administering pentothal, and where possible intravenous omnopon and morphia only was given in these cases.

Oxygen was often given during pentothal anaesthesia, and nitrous oxide and oxygen were used to supplement the pentothal anaesthesia in many cases.

The more severely wounded always came to the theatre with a blood, saline, or plasma transfusion set up and induction of anaesthesia was easily carried out by injecting a small amount of pentothal solution through the rubber tubing of the transfusion apparatus. On many occasions when a patient recovered consciousness after an extensive operation he would enquire when the operation was to take place; what a contrast to the South African War!

Endotracheal methods were used in appropriate cases by all anaesthetists and were especially valuable in facio-maxillary and in neurosurgical units.

Cyclopropane was available for most chest and neurosurgical units, and in the later stages of the war was supplied to other surgical units also.

The supply of gases used in anaesthesia, nitrous oxide and oxygen, presented considerable difficulties in overseas theatres of war, when shipping space was limited and cylinders had to be returned to the U.K. for refilling. This difficulty was overcome to a large extent in the Italian theatre by obtaining large cylinders of nitrous oxide containing 3,000 gallons from which the small cylinders used professionally could be refilled. Oxygen cylinders were refilled by the R.A.O.C. with gas manufactured in Italy, and a natural source of carbon dioxide was found at Pompeii, from which cylinders for medical purposes were refilled. This service was organized by Lieut.-Colonel B. R. M. Johnson, Adviser in Anaesthetics, C.M.F., with the help of the R.A.O.C. and the R.E.M.E.

As regards anaesthetic equipment, the field pattern Boyle's apparatus did

good service in all theatres of war and was even packed in special containers for mule transport in the Burma campaign, but it was not sufficiently accurate for modern methods of anæsthesia. The addition of a to-and-fro carbon dioxide absorber increased its sphere of usefulness.

In 1944, a portable military model of the American Heidbrinck apparatus was introduced, which was a great advance on the Boyle's apparatus.

Mention must be made of the great ingenuity and resource shown by anæsthetists in all theatres of war in modifying existing machines to modern techniques and even in constructing new apparatus. The container of the Service respirator was utilized as a carbon dioxide absorber and many other ingenious modifications were carried out with the willing help of the craftsmen of R.E.M.E. Also various types of apparatus for the continuous administration of pentothal sodium were devised by anæsthetists on active service.

So far post-war anæsthetic practice in the Army has maintained the high standard reached during the war and is equal to that reached in civil life. Military hospitals are equipped with modern apparatus, and up-to-date techniques, such as the use of curare, are employed by trained anæsthetists.

It has been said that the "corner stones of modern surgery are asepsis and anæsthesia." Many of the surgical procedures carried out during the war would have been impossible, had it not been for modern anæsthetic techniques, and the skill and devotion of the anæsthetists who, often in circumstances of considerable danger and discomfort, unobtrusively carried out their duties and worthily upheld the traditions of the Royal Army Medical Corps.

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