

A DISCUSSION OF ANAESTHETIC PROCEDURES FOR THE FENESTRATION OPERATION *

(2,375 CASES)

L. A. STUBENSEY, M.D.†

Toronto, Canada

Received for publication October 23, 1952

INTRODUCTION

ANAESTHESIA for the fenestration operation has been administered at St. Michael's Hospital in Toronto since October 26, 1938, when the first operation of this type was performed in Canada. It was soon found that the anaesthetic requisites were as highly specialized as the operation itself. This paper deals with a general review of our cases. We endeavour to show the technics employed and point out the difficulties which may be encountered and the means we have used to overcome them.

Anaesthesia for the fenestration operation must provide several essentials for good operating conditions. An absolutely quiet patient and a bloodless field are the prime requisites of the surgeon. In addition the use of electrocoagulation necessitates precautionary measures with regard to the hazards of fire and explosion. The anaesthetic technic employed must, therefore, be organized to provide these in a way that is comfortable and safe for the patient.

The anaesthetic technics employed in 2,375 cases of fenestration were grouped into two main categories: (1) those patients receiving full general anaesthesia and (2) those in whom local anaesthesia was used with a varying type of supplemental analgesia. A third group which is not included in the two main groups is made up of the uncoöperative patients.

The first of the two main groups, general anaesthesia, can be subdivided into the following: (a) nitrous oxide, oxygen and ether, 1,422 cases or 59.8 per cent; (b) pentothal and ether, 258 cases or 10.8 per cent, and (c) pentothal, nitrous oxide and curare, 6 cases or 0.3 per cent.

The second main group, local infiltration with supplemental analgesia, can be subdivided as follows: (a) local anaesthesia with morphine sulfate, nembutal and neonal, 415 cases or 17.5 per cent; (b) local anaes-

* Read before the meeting of the Ontario Medical Association, Hamilton, Canada, May 24, 1952.

† St. Michael's Hospital, Toronto, Canada.

thetia with morphine sulfate, nembutal and $\frac{1}{250}$ sodium pentothal drip, 40 cases or 1.7 per cent; (c) local anaesthesia and morphine sulfate intravenously, 35 cases or 1.5 per cent; (d) local anaesthesia and demerol, 161 cases or 6.8 per cent, and (e) local anaesthesia with demerol and surital® sodium, 20 cases or 0.9 per cent. In the third group, the uncoöperative patient, there were 18 cases or 0.7 per cent.

Before proceeding to a discussion of the individual groups, it should be mentioned that there are three chief annoyances to the surgeon which occur at the time of making the fistula. These complications are vertigo, nausea and vomiting. Increased bleeding may also occur which may or may not be influenced by the anaesthetic agents. Therefore the patient under local anaesthesia may require supplemental analgesia by sedation before the fistula is made in order to control any movement on the part of the patient. Surgical control of bleeding may be achieved by proper injection with 2 per cent procaine hydrochloride and electrocoagulation. The common region in which bleeding may occur is in the floor of the external canal, or in the anterior wall of the aural canal where the flap has been cut. This can be controlled by proper injection with procaine and by cutting the flap before the fistula is made. This injection may be repeated immediately before the flap is cut. A temporary gelfoam pack used at this time may also aid in controlling the bleeding.

GENERAL ANAESTHESIA

In our series the largest group of cases, 1,685 in number, some type of general anaesthesia, as outlined above, was employed. In the first group, (a) 1,422 cases were included in which ether and oxygen were the principal anaesthetic agents, following nitrous oxide induction. All these patients were premedicated with morphine and atropine in suitable dosages. The induction was followed by nasotracheal intubation. The pharynx was then tightly packed with 2 inch gauze, folded so as to leave no fringed edges.

The next group, (b) included 258 cases in which sodium pentothal and curare were used for induction and after orotracheal intubation anaesthesia was carried on in a similar manner with ether and oxygen, and the pharynx was packed in the same manner.

In the last group of 6 cases (c) sodium pentothal curare nitrous oxide and oxygen were employed; intubation was performed orotracheally in all of these cases. The average dose of curare was 8 cc. of *d*-tubocurarine, and with 1.5 to 3 Gm. of pentothal for each case, depending on the type of patient and the length of operating time.

To the uninitiated anaesthetist, general anaesthesia may appear to be the ideal technic to use for this operation in view of the length of the operating time. Three important factors, however, must be considered: (1) the use of electrocoagulation; (2) carbon dioxide accumula-

tion during a long operation due to the deficiencies in the absorbing mechanism which cause an increase in blood pressure and therefore increased bleeding, and (3) movement of the patient's head caused by vomiting owing to over-ventilation or partial obstruction in the airway, caused by kinking of the tube, and so forth.

The use of electrocoagulation is an essential aid to the surgeon in the fenestration operation. The explosion or fire hazard with ether is reduced to a minimum by using a tightly fitting pharyngeal gauze pack, by screening of the operative area with adequate draping, and by control of the coagulation device by the surgeon's assistant.

The accumulation of a high concentration of carbon dioxide is eliminated by changing the soda lime in the rebreathing chamber at proper intervals, and by half-hourly emptying of the rebreathing bag and refilling with fresh oxygen.

Any movement of the patient's head, should it be troublesome to the surgeon, can be stopped by the use of small doses of 2.5 per cent sodium pentothal administered intravenously. The use of curare was attempted, but was not found to be successful; movement of the head became accentuated because of the type of diaphragmatic breathing which occurred.

It should be noted that the surgeon uses a binocular microscope while making the fenestrum. This operating microscope has a magnification of ten to twelve times. Therefore any movement of the head will be correspondingly magnified.

COMBINED LOCAL TECHNICS

In the early cases of this series local anaesthesia combined with sedation was the technic of choice. The chief reason for this was that the surgeon wished to have the coöperation of his patient at the time the fistula was being made. It should be mentioned here that the increased hearing which occurs when the fenestration is completed causes increased irritability of the patient because of the added noise in his ear. It is for this reason that the surgeon has insisted on an anaesthetist being in attendance in all cases. In this regard, close coöperation and teamwork between the surgeon and anaesthetist is of the utmost importance to the ultimate success of this operation.

The only time pain may be encountered is at the stage when the cells are being exenterated around the mastoid antrum and the labyrinthine capsule. This may be controlled by using a few drops of cocaine hydrochloride, 10 per cent. This is placed in the cavity and in sixty seconds is washed out with an irrigation of normal saline.

Under the general group of these technics there are five different combinations of local infiltration with sedative agents.

(a) In 415 cases all patients were premedicated with nembutal, 3 grains three hours preoperatively; neonal 3 grains one hour preopera-

tively, and morphine sulfate and atropine sulfate in adequate dosage as the patient is sent to the operating room. Then, depending on the patient's reactions, additional morphine was administered throughout the operation. In all these cases the local infiltration was done with 2 per cent procaine hydrochloride.

(b) In 40 cases local infiltration was supplemented with $\frac{1}{250}$ sodium pentothal used in continuous intravenous drip. The minimal and maximal total amounts of pentothal employed were 1.0 and 1.75 Gm., respectively. These patients were also premedicated with morphine and atropine in suitable dosage.

(c) In 35 cases local infiltration was supplemented with the use of intravenous morphine sulfate. This was used as in the Water's technic for intravenous administration of morphine. These patients were again premedicated with morphine and atropine in suitable dosages. A continuous intravenous drip of normal saline solution was started at the beginning of the operation and morphine was given at intervals in dosages which varied from $\frac{1}{24}$ grain to $\frac{1}{8}$ grain at a time. The smallest total dosage in a single case was $\frac{7}{8}$ grain, and the highest was $1\frac{1}{4}$ grains. The dosage varied with the length of time of the operation, and the size and general condition of the patient. These cases really belong in the group in which an attempt was made to find the proper combination of anaesthetic agents which would give the maximal comfort to the patient, the greatest ease and help to the surgeon and the greatest relief to the anesthetist. Unfortunately, it is to this group that we must ascribe our most severe misadventure. This will be discussed more fully later.

(d) In 161 cases local infiltration was supplemented with demerol given intravenously throughout the operation. These patients were sedated with nembutal, 3 grains three hours before operation, and nembutal, 3 grains one hour preoperatively; then 100 mg. of demerol was administered intravenously, the dosage depending on the size or condition of the patient. One case in this group is of interest.

A woman, 63 years of age, weighing 88 pounds was given nembutal, 3 grains two hours before operation, and 100 mg. of demerol on leaving her room. Local infiltration with 2 per cent procaine hydrochloride was carried out and an additional dose of 100 mg. of demerol was given intravenously during the operation which lasted three and a half hours. This patient was conscious and rational at the end of the operation. She recovered uneventfully and left the hospital in seven days.

This group also represents our most recent anaesthetic technics, and in properly selected cases appears to be the most promising method to date.

(e) From the above group (d) in which local anaesthesia and demerol were used, we have withdrawn 20 cases. The above technic was used up to the time of fenestration, but all patients were given

surital sodium, 2.5 per cent, intravenously, because we were unable to prevent their moving about owing to restlessness and some nausea. The dose of surital varied from 0.5 to 2.0 gm., given slowly. It was remarkable that in these cases there was very little if any respiratory depression during or following operation, and all these patients were conscious and rational on the table. It was for this reason that the use of surital was continued instead of employing another barbiturate such as nembutal or pentothal.

THE UNCOÖPERATIVE PATIENT

For the lack of a better term and because these patients do not belong to either of the two main groups, we have called 18 of them uncoöperative. This represents the type of patient who is restless and thrashing about upon arrival in the operating room either caused by emotional factors which had not been recognized earlier or stimulated by the preoperative sedation. In a few of these cases further sedation was attempted but, with experience, it was found that full ether-oxygen anaesthesia, following nasotracheal intubation was required. In spite of the heavy preoperative sedation and the ether anaesthesia, there were no complications or sequelae. The amount of ether required in these cases was very small.

AGE AND SEX

In our series, no attempt was made to correlate either age or sex with the anaesthetic technic or agent used. In the very young patients it was realized the general anaesthesia was required. In the older patients, even those well past middle life, it was found that they tolerated all anaesthetic procedures equally well. Our age distributions for all groups is shown in table 1.

TABLE 1
AGE DISTRIBUTION

Age, years	Number Cases	Per Cent
Under 15	1	
15-19	117	4.9
20-29	620	26.2
30-39	905	38.2
40-49	520	21.9
50-59	198	8.4
60-65	14	0.5

Of these cases 915 or 38.6 per cent were males, and 1,460 or 61.4 per cent were females. It is readily seen that the most frequently encountered patient was between the ages of 30 to 40 years and female. The youngest case was a boy of 9 years of age who was operated on in 1939. The oldest patient was a man of 65 years.

OPERATING TIME

The length of operating time depends on several factors, such as the differences in the anatomical structure of the temporal bone, the amount of bleeding encountered, and the coöperation of the patient. Most of these factors have been discussed previously. The fenestration procedure is necessarily a lengthy one. In our series the longest operation took five hours and fifteen minutes and the shortest one hour and forty minutes. The average length of time was two hours and forty minutes.

THE POSTOPERATIVE PERIOD

The average length of stay in hospital was 8.8 days for all cases, regardless of the anaesthetic technic employed. The shortest period of hospitalization was six days and the longest twenty-four days.

In spite of the length of this operative procedure there were relatively few anaesthetic complications. The most common complication postoperatively was dizziness accompanied by nausea and vomiting. Although nausea and vomiting did occur in over 60 per cent of cases, it is difficult to assess the actual role of the anaesthetic agent in its incidence. Whether the nausea and vomiting encountered was due to vestibular stimulation or to some other factor including the anaesthetic agent, it was impossible to determine. The usual duration of this complication was from twenty-four to thirty-six hours.

Postoperative respiratory depression occurred in about 2 per cent venously morphine. In all the early cases coramine was used intravenously with 5 cc. in 1,000 cc. of normal saline solution by continuous drip.

In the usual case postoperative fever is absent. In 2,375 cases there was only one instance of bronchopneumonia after operation. This occurred on the second day and was treated in the usual manner. The patient was able to leave the hospital on the fifteenth day. The anaesthetic agent employed was nasotracheal ether and oxygen. There was no evidence of pulmonary collapse.

One case of surgical emphysema was encountered. This occurred in a 42 year old patient who was given 0.5 Gm. of sodium pentothal and 4 cc. of *d*-tubocurarine prior to orotracheal intubation. Anaesthesia was maintained with ether and oxygen. A portex tube was used and no difficulty was encountered during intubation. The operating time was three and a quarter hours. The next day surgical emphysema was noticed bilaterally in the neck and the upper chest wall. There was no cyanosis or respiratory embarrassment, and recovery was uneventful.

An instance of prolonged recovery from anaesthesia occurred. The patient was a man, 35 years of age who weighed 120 pounds, with a severe thoracic kyphosis. He was given 15 cc. of 2.5 per cent sodium pentothal and 3 cc. of *d*-tubocurarine for orotracheal intubation. An-

esthesia was maintained for three hours with ether and oxygen; $\frac{3}{4}$ ounce ether was used in a closed system. Immediately after operation the patient's condition did not seem unusual. Although he was not conscious, the usual pharyngeal and other reflexes were present before he was returned to his bed. On return to his room his pulse and respirations were normal, and colour was good. However, he remained unconscious for twenty-three hours. During this time his colour was good, respirations and pulse normal, and there was no fall in blood pressure. As a precautionary measure intravenous administration of 5 per cent glucose in distilled water was started, and oxygen was administered by nasal catheters at the rate of 6 liters per minute. The patient was closely watched. On stimulation he would make apparently purposeful protective movements, but would not rouse to full consciousness. After twenty-three hours he became conscious and was lucid and rational. This brings to mind the observation that this type of deformity appears to predispose to a prolongation of recovery, because of lowered vital capacity and the probability of a degree of undetected anoxia. These patients are notorious for their reaction to opiates and barbiturates, probably for the same reason.

In our series there was one death and that occurred during the post-operative period. This patient was a 42 year old man of 155 pounds. His preoperative physical examination showed no abnormality other than clinical otosclerosis. He was sedated with neonal, 3 grains three hours before operation and nembutal, 3 grains one hour before operation. Morphine, $\frac{1}{4}$ grain, and atropine, $\frac{1}{120}$ grain, were administered when he was sent to the operating room. The operation lasted four and a half hours; during this time he received morphine sulfate intravenously in doses of $\frac{1}{24}$ and $\frac{1}{8}$ grain. During operation his respirations dropped to 6 to 8 per minute on three occasions. With the judicious use of coramine® and oxygen this decrease was rapidly corrected.

At the end of the operation the patient was conscious on the operating table. When he was returned to his room he talked to his relatives and was lucid and rational. His respiratory rate was normal. Two hours later he suddenly became cyanosed and his pulse became very difficult to obtain. He was given 5 cc. of coramine intravenously, but did not respond. At postmortem examination petechial haemorrhages were found scattered throughout the brain, and some oedema also was present. The pathologic report indicated that a sudden cerebral oedema had caused coning of the brain stem, with pressure on the vital centres.

SUMMARY AND CONCLUSIONS

A review of 2,375 cases of anaesthesia for the fenestration operation has been presented with particular attention to the technics employed.

These cases were shown in groups and the method in each was described.

Some aspects of the operative technic were discussed so as to demonstrate the need of close relationship between the patient, surgeon and anaesthetist.

The relative values of the various anaesthetic procedures, their indications and contraindications may be summarized as follows:

The general inhalation technic of ether and oxygen with induction by nitrous oxide and oxygen, administered by the nasotracheal route, with a tight intrapharyngeal packing, and the discreet use of electro-coagulation was employed in 1,422 cases without serious complications. The hazard of explosion or fire was never encountered. This method was the easiest to control and provided good operating conditions.

The use of pentothal sodium followed by ether and oxygen made it possible to intubate earlier but it did not otherwise improve the anaesthesia.

The addition of curare to the pentothal may have made the intubation somewhat easier, but it made control of the patient's movement more difficult during the maintenance of the anaesthesia.

Of the combined local technics, we believe that the intravenous use of morphine is too dangerous and too difficult to control.

Of the remaining groups of combined local technics, the use of local and supplementary demerol was found the most satisfactory.

In the so-called uncoöperative patient, complete general inhalation anaesthesia is advised when trouble is encountered early in the operation.

In closing I would like to thank Dr. J. A. Sullivan and his associates for their close coöperation and advice in preparing this paper. Thanks are also due to the other members of the anaesthetic staff, in particular Dr. J. A. Vining, and Dr. A. J. Dunn, and to our residents Dr. Paul Bailey and Dr. Gertrude Freund for their assistance in compiling our statistical material from the numerous charts examined.