ANAESTHESIA FOR PHARYNGOLARYNGECTOMY AND COLON REPLACEMENT

by

T. V. CAMPKIN

SUMMARY

Anaesthesia employing a hypotensive technique has been used in twenty-nine operations for total pharyngolaryngectomy and colon replacement of the pharynx. Arterial hypotension to levels of 40–65 mm Hg was maintained for the duration of the neck dissection. The average volume of blood replaced during the operation was 2 litres and this was considered to be considerably less than what would have been required without the use of a hypotensive technique. The blood pressure was restored to a normal level prior to transposition of the colon and continuous electrocardiographic and electroencephalographic monitoring were employed.

Total pharyngolaryngectomy and colon replacement of the pharynx and upper oesophagus has become an established method of treatment for neoplasms of the piriform fossa, laryngopharynx and upper oesophagus (Fairman and Hadley, 1964; Brain and Reading, 1966; Lees, 1967). These tumours of the hypopharynx hitherto carried a gloomy prognosis when treated by radiotherapy or multiple stage procedures. In this series laryngopharyngectomy has been performed and the colon mobilized and transposed to the neck via the anterior mediastinum (5 patients), posterior mediastinum (2 patients) or presternal subcutaneous route (22 patients).

Gorham, Baskett and Clement (1965) described the anaesthetic management in fifteen of these operations and in a discussion of their technique concluded that the use of controlled hypotension to reduce blood loss might prejudice the viability of the colon graft and should, therefore, be avoided. In the present series of twenty-nine cases a somewhat different anaesthetic technique incorporating hypotension has been routinely used. This has considerably reduced the blood loss in these very protracted operations and in no case has the colon graft been jeopardized by the low blood pressure employed during the procedure.

PRE-OPERATIVE MANAGEMENT

There were twenty-nine patients in the series (23 females and 6 males, the preponderance of females being related to the higher incidence of post-cricoid carcinoma in women). Their ages ranged from 34 to 65 years, thirteen of the patients being under 55 years old. The body weight and nutritional state varied considerably and, particularly in some of the earlier cases, marked weight loss, malnutrition and dehydration were common. In more recent cases, with few exceptions, radical surgery has been undertaken earlier and the nutritional status of the patients has been satisfactory. With only one exception the respiratory and cardiovascular systems of all patients were normal, again reflecting the higher incidence of the disease in women of early middle age. One patient suffered from hyperthyroidism (unconnected with her tumour) and was treated with iodine pre-operatively. In two cases extensive growth and respiratory distress necessitated pre-operative tracheostomy.

Pre-operative investigations included blood and electrolyte estimations, and anaemia, dehydration and nutritional deficiencies were corrected as far as possible. Chest radiographs, tomograms of the upper oesophagus and trachea, and an electrocardiogram were also taken. A pre-operative electroencephalogram was also obtained in some cases. The extent and consequences of the operation were fully explained to the patient who also understood that a period

T. V. CAMPKIN, M.B., F.F.A.R.C.S., D.A., Queen Elizabeth Hospital, Birmingham.
in the intensive therapy unit would probably be necessary postoperatively.

Premedication in earlier cases was with atropine 0.6 mg and pethidine 50 mg, but more recently the atropine has been omitted since it sometimes causes tachycardia, thus necessitating higher halothane concentrations to induce the required level of hypotension during the operation.

**ANAESTHETIC TECHNIQUE**

Anaesthesia was induced with a sleep dose of 2.5 per cent thiopentone and with the aid of suxamethonium 50 mg the trachea was intubated with the largest cuffed endotracheal tube which would pass with ease. A selection of tubes was available, since in some cases the introduction of an endotracheal tube no larger than 6.5 mm was possible and it was considered that there might be a danger of detaching pieces of friable growth. A right-angled James tube was used in the two patients with a pre-operative tracheostomy.

On the resumption of spontaneous respiration, anaesthesia was continued with nitrous oxide, oxygen and halothane, until the patient was positioned on the operating table. An intravenous infusion of dextrose-saline was set up in a saphenous vein at the ankle and electrocardiogram and electroencephalogram leads connected. The blood pressure was measured with a Recklinghausen oscillotonometer and rectal temperature recorded with a thermocouple (Light Laboratories).

After positioning on the operating table with a 10-degree head-up tilt, tubocurarine (20-30 mg) was injected and ventilation controlled using a Manley or Blease ventilator, with negative phase. Gas flows ranging from 6 to 8 l./min oxygen (Blease) to 10-12 l./min (Manley) were used. Positive-negative ventilation was routinely employed, the inflation pressures varying between +25 and -5 cm. Anaesthesia was maintained with halothane and 100 per cent oxygen, and the halothane concentration increased to stabilize the systolic blood pressure at a level of 40-65 mm Hg, depending on the degree of haemorrhage during the neck dissection and on the maintenance of acceptable electrocardiographic and electroencephalographic appearances. Halothane was vaporized by the fresh gas flow from an M.J. Fluotec vaporizer (delivering up to 10 per cent).

In the first five operations in the series, laryngopharyngectomy and block dissection of glands preceded the abdominal part of the procedure, but in subsequent operations both surgeons have started simultaneously. The completion of the neck dissection usually coincided with the mobilization of the colon and the duration of this part of the operation varied from 1 to 3 hours, the average time being just over 2 hours. Hypotension was maintained throughout this period provided there were no untoward e.g. or e.e.g. disturbances. At the end of this stage of the operation the blood pressure was allowed to rise by reducing or discontinuing halothane administration and provided that blood loss had been adequately replaced, the systolic pressure returned to 100-120 mm Hg within 10-15 minutes.

Anaesthesia was thereafter maintained with nitrous oxide and oxygen, and incremental doses of tubocurarine (10 mg) and phenoperidine (0.5 mg). When the laryngopharynx was excised a sterile James tube and catheter mount were placed in the trachea, the corrugated tubing from the ventilator connected and the area covered with new, sterile drapes. At the end of the operation atropine and neostigmine were given while ventilation was still controlled, in order to avoid cardiac disturbances which may be caused when these drugs are injected intravenously in the presence of inadequate spontaneous respiration and a raised Pco₂.

Patients were then transferred to the intensive therapy unit, which is routine practice in this hospital after cardiothoracic and other major surgery. The facilities of an ITU are highly desirable for these cases in the immediate postoperative phase as the alternative would have been to return them to a busy ENT ward, and making heavy demands on nursing staff. In the ITU further transfusion of blood was given to replace any blood loss from the suction drainage and careful attention paid to postoperative analgesia. The tracheostomy was humidified using a Bird atomizer or by the hourly instillation of 10 ml normal saline.

**HYPOTENSION**

In the patient anaesthetized with halothane an immediate fall in systolic blood pressure usually
followed the injection of tubocurarine. This is primarily due to the ganglionic blocking action of the relaxant potentiating the hypotensive effect of halothane. A second factor may be the institution of controlled ventilation and the associated impedance of venous return, but this should not be a major factor when a negative phase is included in the pattern of ventilation.

The level of hypotension could usually be readily controlled with a vapour concentration of halothane not exceeding 2–3 per cent provided that the pre-operative administration of atropine was avoided. Higher concentrations of halothane were sometimes necessary when atropine had been given, and for this reason it is no longer used routinely. In a few cases it proved difficult to reduce the blood pressure with halothane because of persistent sinus tachycardia. Propranolol 1–2 mg given intravenously slowed the heart rate, and a satisfactory level of hypotension was then attained.

Hypotension was maintained for the duration of the neck dissection by which time the colon had been mobilized. The blood pressure was always elevated at this stage to allow an accurate assessment of the blood supply and viability of the graft, but occasionally it was reduced again if the neck dissection had not been completed.

Blood loss was estimated visually and the volume of blood transfused during the procedure varied between 1500 and 3000 ml, the average amount being approximately 2 litres.

**MONITORING**

The systolic blood pressure was measured with a Recklinghausen oscillotonometer. In two cases intra-arterial readings were also obtained and these correlated well with the oscillotonometer, particularly at low systolic pressures. This correlation has also been confirmed during neurosurgical operations where both methods are available. Figure 1 is a blood pressure record from an early case in which the neck dissection preceded the abdominal part of the operation.

The electrocardiogram was monitored continuously using a display oscilloscope ( Videograph) which enabled the classical and augmented limb leads to be obtained. Changes suggestive of myocardial ischaemia were seen in only two cases despite the level of hypotension employed. These consisted of ST segment depression and in both patients electroencephalographic changes indicative of cerebral ischaemia simultaneously appeared. The appearances of the electrocardiogram and electroencephalogram promptly returned to normal when the systolic pressure was elevated to 80 mm Hg.

Cardiac arrhythmias almost invariably occurred during the surgical manipulations involved in bringing the colon up into the neck via the anterior or posterior mediastinal route. These usually took the form of multiple ventricular extrasystoles but in two cases in which the graft was transposed via the posterior mediastinum, bradycardia, transient heart block and hypotension occurred, and were related to the gross interference with venous return by the surgical manipulations.

The presternal, subcutaneous route for transposition of the colon is now used routinely and is not usually associated with cardiovascular disturbance. Although most patients were not atropinized pre-operatively cardiac arrhythmias or bradycardia were not a feature of surgical interference in the carotid sinus region.

In twelve patients the electroencephalogram was also monitored continuously, using six scalp electrodes, and displayed on a two-channel oscilloscope. At a systolic blood pressure of 80–100 mm Hg an e.g. of alpha frequency was in-
Electroencephalograms during hypotensive anaesthesia. The upper traces show alpha frequency at a normal systolic blood pressure. The lower traces show the development of delta waves and loss of rhythmicity, suggestive of cerebral ischaemia at systolic pressures of 65 and 40 mm Hg respectively.

variably obtained, but with an increasing level of hypotension the amplitude and rate steadily decreased. The level of hypotension was considered acceptable provided that continuous rhythmic activity of theta type (4–7 c.p.s.) was present. In four cases, however, loss of rhythmicity associated with low-voltage delta waves occurred between levels of 40 and 65 mm Hg systolic, and was assumed to be evidence of impending cerebral ischaemia (figs. 2 and 3). ST segment depression appeared simultaneously in the electrocardiogram of two of these patients.

The rectal temperature was measured throughout the operation and despite the extent and duration of the procedure the lowest rectal temperature recorded was 34.5°C.

**POSTOPERATIVE COURSE**

No patients died in the immediate postoperative period (48 hours).
The following brief case reports are of particular interest.

A 60-year-old male patient who suffered from chronic bronchitis and emphysema failed to breathe adequately postoperatively and required artificial ventilation for several days. He then developed ileus, a burst abdomen and pneumonia and died 4 weeks later.

In one female, aged 50 years, the upper end of the colon graft partially broke down. Parenteral nutrition was required for several weeks, after which the graft was mobilized and its continuity restored. Her recovery thereafter was uneventful and it was not felt that the level of hypotension was implicated.

In a second female, aged 54 years, haemorrhage occurred from the left gastric artery, 36 hours postoperatively. Emergency laparotomy was performed and the bleeding controlled. Her convalescence was further complicated by the development of a subphrenic abscess.

In one female, aged 47, operation and anaesthesia were uneventful, but her postoperative course was complicated by transient attacks of syncope. Tetany was excluded since the serum calcium was normal but an electroencephalogram was suggestive of cerebral ischaemia and it was considered that hypotension during the operation might have been a contributory factor. However, it soon became apparent that she had developed cerebral secondary deposits and she died some weeks later.

Two other patients developed purely surgical complications not attributable to the anaesthetic technique, and in the remaining patients recovery was uneventful. Patients remained in the ITU for 48-72 hours with the exception of those who developed immediate postoperative complications; thereafter they were returned to the ENT ward. The first patient in the series is still alive and well five years later.

**DISCUSSION**

In this series of operations controlled hypotension was an integral part of the anaesthetic technique and was considered justifiable, because of the extensive and protracted nature of the surgery and the excessive blood loss anticipated. The rapid infusion of large volumes of cold stored blood may have serious deleterious effects since stored blood has a pH as low as 6.8 after 14 and 6.5 after 21 days. The viscosity of stored blood is also increased and this may further impair the microcirculation in shocked vasoconstricted patients (Albert et al., 1965; Litwin, 1965). During storage, coagulation factors rapidly decrease and when large volumes of banked blood are transfused the recipient's clotting mechanism is diluted and uncontrollable oozing may occur from cut surfaces (Feldman and Marks, 1961). The potassium content of stored blood is high, levels of 25–30 m.equiv/l. being present after 14–21 days. Conversely, the calcium concentration falls and this potassium/calcium imbalance depresses the myocardium and may provoke the electrocardiographic changes seen in hyperkalaemia. Finally, a rapid fall in body temperature may occur.

It was anticipated that blood loss of the order of 3-4 litres was likely to occur if the operations in this series were performed at normotensive levels. Unilateral block dissection of the neck involves blood loss of approximately 2 litres and laryngectomy a further 500 ml if haemorrhage is estimated postoperatively using a colorimetric technique after haemoglobin extraction (Conference on ENT Anaesthesia, 1965).

Haemorrhage in these cases was estimated visually, swab-weighing being the only alternative method readily available and from past experience underestimates of blood loss are possible with the latter method. Central venous pressure measurements were attempted in three cases but the size of the surgical team and their manipulations in the neck and chest made it impossible to obtain reliable readings. More sophisticated methods of estimating haemorrhage include blood volume measurements and haemoglobin extraction-dilution techniques. These were not available and are usually only possible at the end of the operation, reliance on cruder methods of assessing blood loss being necessary during the procedure. The case with which the systolic pressure could be restored to prehypotensive levels when the halothane concentration was reduced suggested that these patients were not seriously hypovolaemic and that visual estimation of haemorrhage was not unduly inaccurate.

Care was always taken to restore the systolic blood pressure to a normal level by the time the colon had been fully mobilized and prior to its transposition to the neck. If this precaution is not observed, it may be impossible to assess accurately the viability of the graft, and mediastinal manipulation may provoke a further fall in blood pressure in the already hypotensive patient. The use of hypotension did not appear to be unduly hazardous in this comparatively small series of operations. A similar hypotensive
technique has also been used (with appropriate monitoring) in over sixty transthoroidal hypophysectomies without any serious complications. In only two patients in this series was evidence of myocardial ischaemia seen during the period of hypotension and these changes promptly disappeared on restoration of the systolic pressure to 80–100 mm Hg. It is unlikely that the intra-abdominal haemorrhage which occurred post-operatively in one female was related to hypotension during the procedure, since the blood pressure had been elevated to its normal level well before abdominal closure.

No neurological complications attributable to hypotension occurred postoperatively. Despite an early report to the contrary, recent studies have consistently shown that halothane causes an increase in cerebral blood flow and an associated decrease in cerebrovascular resistance (McDowall, 1965; Wollman et al., 1964). Although the patients in this series received 100 per cent oxygen, an increase in PaO₂ produces only a slight rise in cerebrovascular resistance (Kety and Schmidt, 1948). All these quoted studies, however, were carried out at normotensive levels, and with a reduction in blood pressure the main factor ensuring adequate oxygenation of the brain is the autoregulation of cerebral blood flow over a wide range of perfusion pressure (Harper, 1965). It is obviously desirable, however, to use anaesthetic agents which ensure cerebral vasodilatation and a high inspired oxygen concentration when a hypotensive technique is employed. Halothane ensures cerebral vasodilatation and in one patient in this series in whom arterial blood oxygen tensions were measured the PaO₂ was 300 mm Hg at a systolic pressure of 45 mm Hg.

In general, a reduction of perfusion pressure does not significantly reduce cerebral blood flow until a mean pressure of 60 mm Hg is reached (Finnerty, Witkin and Fazekas, 1954). However, a critical level of perfusion pressure has not been established and this was apparent in this series where ischaemic electroencephalogram patterns appeared at systolic pressure levels between 40 and 65 mm Hg in four cases, while in the remaining patients an acceptable appearance was maintained. It is considered, therefore, that the use of the electroencephalograph is a valuable aid to the early detection of cerebral ischaemia.

It is not known how long the e.e.g. changes depicted in figures 2 and 3 may be allowed to persist before permanent neuronal damage occurs. With still lower blood pressures there is a tendency for iso-electric periods to appear which are punctuated by irregular bursts of activity of very low voltage (Honigsberger, L., 1969, personal communication).

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REFERENCES


ANAESTHESIA FOR PHARYNGOLARYNGECTOMY

SOMMAIRE
Une anesthésie avec technique hypotensive a été utilisée lors de 29 opérations de pharyngolaryngectomie totale et substitution du pharynx par cölon. Une hypotension artérielle de 40-65 mm Hg a été maintenue pour la durée entière de la dissection du cou. On a remplacé au cours de l'opération un volume de sang d'en moyenne deux litres et on croit que cette quantité est beaucoup inférieure à celle qui aurait été nécessaire sans l'emploi d'une technique hypotensive. La pression sanguine a été normalisée avant la transplantation du cölon et on a enregistré de manière continue l'électrocardiogramme et l'électroenzéphalogramme.

BOOK REVIEWS


This is the second edition of a book which originally appeared in 1958. Its title raises an interesting semantic point. Spinal anaesthesia is essentially something which is produced by drugs, and drug-induced disturbances of the function of the human body are usually known as pharmacology rather than physiology. There are, however, ample precedents for the use of a title such as this. Indeed the first work on the action of anaesthetic drugs orientated toward the basic sciences was Beecher's well-known volume entitled The Physiology of Anaesthesia.

In the last eleven years much new material has accumulated to help the clinician better to understand the physiological changes produced by spinal anaesthesia. The present volume, however, in addition to considering the new work which is available, contains a re-evaluation of older information and older concepts. A chapter has been added too, on the disturbances produced by epidural anaesthesia, drawing attention especially to differences from the changes produced by spinal anaesthesia. In this particular chapter, as would be expected, there are references to papers which appeared after the preparation of the first edition. In the remaining chapters, however, the author has chiefly considered again the data presented in the previous volume. The result is that only somewhere between one and two references in every twenty are to recent work. This, however, is in no sense an indictment of the author, for work on spinal anaesthesia has been very limited for the last ten years, and there is very little to add on the subject except that which relates to respiratory physiology and the newer knowledge of pulmonary blood flow. Even in this field, however, the number of references to work dating after 1958 is relatively small, again an indication of how little real interest anyone has taken in spinal anaesthesia of late years.

It is the reviewer's opinion that a recrudescence of interest in this field of anaesthesia is very likely in the not-too-distant future, especially in developing countries where cost is an important factor in methods of anaesthesia. For those who wish to be able to derive an interest in this type of pain relief, Dr. Greene has done a great service in presenting in the pages of his book so much useful information. The reviewer would certainly commend it to all who want an authoritative source of information on spinal anaesthesia. It is also a most valuable work of reference for anyone contemplating research work in this field, and a short time studying it will save many people hours of tedious work hunting through literature indexes and the like.

A. R. Hunter


The author reaches his objective which is to present to clinicians a brief review of up-to-date clinical physiology, so that they can, with little effort, bring their second M.B. knowledge into line with current developments. No one section is very profound, but the standard is just right for the general reader. For example, at first sight anaesthetists might be a little disappointed at the sections on respiration and cardiovascular system, but they should remember that there are bigger books for their purpose. On the other hand, they will gain much from the sections on the liver, the kidney and the nervous system. This little paperback can be enthusiastically recommended both to examination candidates and also to more senior men, so long as they bear in mind that this is not intended as an exhaustive treatise on clinical physiology, but only as a broad but stimulating refresher.

W. W. Mushin