ANAESTHESIA FOR POSTERIOR CERVICAL OSTEOTOMY

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INTRODUCTION

OPERATIVE CORRECTION of extreme flexion deformity of the spine in ankylosing spondylitis was pioneered by Smith-Petersen, Larson and Aufranc.¹ They operated on the lumbar spine. That a similar operation might be feasible on the ankylosed cervical spine was suggested when Bergmann² and later Rogers³ reported the rapid healing of fractures of the ankylosed cervical spine. Posterior cervical osteotomy has been reported by several authors,^{4-8,10,11} but very little has been written on the anaesthetic technique for this operation.

The operation is performed to correct severe flexion deformity of the neck, usually caused by ankylosing spondylitis and often aggravated by recent trauma to the cervical spine. The chin is usually fixed on the chest, and the patients cannot see ahead while walking. They request the operation for this and for cosmetic reasons, as well as for dysphagia, and are willing to take any risk for correction.

Ankylosing spondylitis is a chronic progressive disease of unknown cause, the onset most frequently occurring in young men in their late teens or early twenties. It usually begins in the sacroiliac joints and spreads upwards involving the synovial joints of the spine at higher levels. Often the costovertebral joints, hips and shoulders are involved. The pathological changes resemble those seen in rheumatoid arthritis and consist of chronic proliferative inflammation involving the joint capsules and intervertebral ligaments. There is calcification in the annulus fibrosus of the intervertebral discs and of the overlying intervertebral ligaments. Ankylosis of the entire spine may occur, preventing motion in any direction.

Other associated features include arthritis of the peripheral joints in 20 per cent of patients (where it is indistinguishable from rheumatoid arthritis), and uveitis or iritis which occurs in 10 per cent to 15 per cent (two to three times as commonly as in rheumatoid arthritis). There is less constitutional involvement than occurs in rheumatoid arthritis, with fatigue, anorexia and weight loss being less common. The erythrocyte sedimentation rate is normal in 20 per cent. Isolated aortic insufficiency involving the aortic valve and ascending aorta occurs in ankylosing spondylitis. The vital capacity is usually reduced to about two-thirds of normal.

The surgical principles and anatomical considerations in posterior cervical osteotomy were outlined by Urist⁴ and restated by Simmons.⁵ Both felt that the operation should be carried out with the patient in the sitting position, awake and co-operative.

Briefly, the operation consists of posterior cervical osteotomy at the C7-T1 level. The vertebral arteries are therefore not in danger but the C8 nerve roots and spinal cord are.

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Minor adjustments to the position of the head can be made over the first few days post-operatively. Fusion occurs in about eight weeks. The anaesthetist aims to maintain the patient as free of pain and anxiety as possible, to monitor the patient and to provide resuscitation if necessary.

Nineteen cases of posterior cervical osteotomy have been reported.^{4-8,10} Ten of these are included in our present report of 22 cases. The anaesthetic technique in the 19 reported cases is mentioned only briefly. Herbert⁶ states that "anaesthesia is established if possible with endotracheal intubation. When this is not feasible a local anaesthetic may be used." He reported the operation in three patients. Law⁷ and Bovill⁸ performed the operation on a total of three patients under general anaesthesia following awake naso-tracheal intubation, but none of these three authors offers any further details of the anaesthetic technique. In a case report of tracheal intubation in a patient with ankylosing spondylitis of the cervical spine, Munson and Cullen⁹ describe a technique for intubation of a patient for cervical osteotomy but give no other details of the anaesthetic. More recently Chang¹⁰ has reported successful anaesthesia for posterior cervical osteotomy in two patients using awake naso-tracheal intubation followed by general anaesthesia. Urist,⁵ and Mason, Cozen and Adelstein¹¹ reported one case each. Both these operations were performed using local anaesthetic infiltration at the operative site, supplemented by nitrous oxide administered by face mask. The remaining eleven reported operations were performed by Simmons⁵ using local anaesthetic infiltration of the operative site, supplemented by nitrous oxide administered by face mask and intravenous neurolept agents.

No complications related to the anaesthetic technique were recorded in any of the above 19 cases. However, there were many surgical problems. Mason¹¹ reported pneumothorax at operation in his patient while sectioning the body of D1 vertebra with a long thin osteotome. In the same patient two weeks post-operatively hoarseness developed. This was probably due to traction palsy of the recurrent laryngeal nerve, because it immediately disappeared when the traction was diminished slightly.

Urist's⁵ patient also had post-operative neurological problems due to traction. She developed C8 nerve root compression symptoms on the left side eight days post-operatively and these were relieved by lessening of the traction; dysaesthesia lasted six weeks post-operatively. Of three cases Herbert⁶ reported one death post-operatively due to loss of control of the extension apparatus in a patient being transported. Of Law's⁷ two cases, one was "a complete success" and the other who had a history of tachycardia and heart failure and was said pre-operatively to be a "poor surgical risk", "collapsed and died of heart failure" three weeks post-operatively. At autopsy there was no spinal cord or nerve root damage.

Bovill⁸ reported no morbidity in his patient. Simmons⁵ reported no major morbidity or mortality in 11 cases, although one patient sustained a fall prior to removal of his plaster halo unit and went on to established non-union. This was later successfully treated by cervical fusion under local anaesthesia.

ANAESTHETIC TECHNIQUE

All operations were done using the same technique, which involved pre-operative medical and psychological preparation, operation under local anaesthesia injected

by the surgeon with sedation using Innovar and a few seconds of nitrous oxide and oxygen analgesia by mask at the time when the neck was straightened.

Pre-operative preparation takes seven to fourteen days during which time the operation is explained to the patient and rapport with the anaesthetist and the rest of the surgical team is obtained. As will be seen many patients have other problems which require medical treatment.

A few days pre-operatively a plaster jacket is applied to support the halo struts. The jacket must allow access to the chest for monitoring of the heart and must permit closed chest cardiac massage.

The day before surgery a halo is applied under local anaesthesia. Doing this procedure as a separate operation minimizes the amount of local anaesthetic injected and the time needed for the posterior cervical osteotomy.

By this time the patient is familiar with the members of the surgical team and confidence has been developed. It is also emphasized that the operation is of such a nature that surgery can be stopped at any point and taken up again at a later date. This has not happened in our series.

On the day of operation the patient is often given mild sedation with pentobarbitone. He walks from his bed and takes his seat in the operating chair. This is an ear, nose and throat chair which can be flattened quickly. The patient is supported with a seat belt, his elbows are padded, the halo is supported on overhead pulleys, elastic stockings are placed on his legs and his radio is tuned to suitable music.

A safe intravenous infusion of balanced salt solution is started. Monitoring includes pulse, blood pressure and precordial or oesophageal stethoscope or precordial Doppler ultrasound. A tracheostomy set and fibre-optic bronchoscope are available in the operating room.

Small doses of Innovar® ($\frac{1}{4}$ to 1 cc) are given as required to provide mild sedation and the surgeon uses a measured quantity of 1 per cent lidocaine with epinephrine 1/100,000 to a maximum of 10 mg/kg over three hours.

The patient is asked to flex his calf muscles regularly.

When the surgeon is ready to straighten the neck the patient is asked to apply an anaesthetic face mask and 80 per cent nitrous oxide and 20 per cent oxygen is given until consciousness is lost. The neck is then straightened and the head is firmly supported by a surgical assistant. The incision is closed, the halo struts stabilized and the patient is able to walk to his bed looking forward.

The reaction of the patient during the neck manipulation varies from a mild moan to no response at all. He is awake in a few seconds.

REVIEW OF CASES

We have records of 22 consecutive cases operated on at the Toronto East General Hospital from October 1967 to November 1973. A twenty-third case (the first one done) was uneventful and the patient was discharged from hospital improved but part of the hospital record is missing.

The age distribution was 35 to 79 years. Seventeen patients were male and five female. The average time in hospital following operation was 52 days, while the expected stay was three weeks. Only six patients were in hospital less than 22 days.

In all patients except one the aetiology of the neck problem was ankylosing spondylitis of five to thirty-years' duration, with an average duration of 19 years. Six of these patients gave a history of recent trauma. Only one patient had a purely traumatic aetiology to his illness.

PRE-OPERATIVE COMPLICATIONS

Five patients had no significant pre-operative complications.

Respiratory Problems

There was a significant decrease in vital capacity (17 per cent to 50 per cent in 14 patients). The average decrease was 32 per cent below expected value.

One patient had smoker's bronchitis.

One patient developed spontaneous pneumothorax six weeks prior to admission.

Cardiovascular Problems

One patient had severe aortic insufficiency and stenosis with congestive heart failure on a rheumatic basis. He underwent successful operation on his neck but died unexpectedly a few hours prior to scheduled operation on his aortic valve.

One patient had non-specific E.K.G. changes.

Other Complications

Three patients had diabetes mellitus (one diagnosed on admission); one patient had chronic idiopathic anaemia; two patients had psoriasis and one patient had chronic duodenal ulcer.

One patient was 79 years old with severe post-traumatic neck deformities. She was rejected for operation at first, but returned 18 months later pleading for operation because of increasing neck pain and severe eczema of neck folds. She died 21 days post-operatively of pulmonary embolism – the only death in the series. Incidentally, despite negative preoperative medical examination including normal E.K.G., autopsy showed extensive generalized arteriosclerosis in this patient.

COMPLICATIONS DURING OPERATION

Twelve patients had no significant operative complications.

Hypotension was the most frequent complication during operation. Eight patients had a fall in blood pressure greater than 25 per cent of their normal resting systolic pressure at some stage of their operation.

Treatment consisted of administration of additional intravenous fluids. The incidence of hypotension was greatly decreased with more liberal use of neuroleptanalgesia. (Six of our eight cases occurred in the first 10 operations.)

Two patients required blood transfusion. These occurred early in the series. Our last 14 patients have not required transfusion. One patient exhibited toxicity to local anaesthetic, developing dizziness and twitching. Plain lidocaine was used in this patient because he had preoperative evidence of ventricular irritability and epinephrine was felt to be contra-indicated. He thus received an overdose of lido-

caine. We recommend that the amount of lidocaine infiltrated be closely monitored and that a vasoconstrictor be added in all cases.

One patient developed bradycardia which was felt to be vagal in origin, and it responded readily to atropine.

One patient collapsed on the operating table. This occurred in a 36-year-old lady who had ankylosing spondylitis for 14 years. She had the usual neuroleptanalgesia plus local anaesthesia. As the osteotomy was nearing completion she complained of mild shortness of breath and gave a slight cough. Her symptoms cleared in a few seconds and some venous ooze was noted and packed. About 30 minutes later when the packing was being re-checked she suddenly lost consciousness, became apnoeic and pulseless.

She responded to vigorous cardiopulmonary resuscitation and a tracheotomy was done. She required 30 days of intermittent positive pressure breathing and was discharged 60 days post-operation. The neurologist felt she had evidence of a mild organic mental syndrome. Our tentative diagnosis was air embolism.

POSTOPERATIVE COMPLICATIONS

Postoperative complications were all related to the operation performed. (See Table I).

TABLE I
POST-OPERATIVE COMPLICATIONS

Neurological	8
Cardiovascular	2
Respiratory Infection	2
Pulmonary Embolism	2 (1 died)
Non-union of Neck Fusion	2
Acute alcohol withdrawal Syndrome	1

The neurological problems were mostly C8 root problems which were corrected by halo adjustment. There were no spinal cord problems.

One patient was confused and delirious. This was thought to be due to meperidine.

One patient had syncope in the intensive care unit the day following surgery. The E.K.G. showed ischaemia. He had a total hip replacement with uneventful anaesthetic nine months later.

One patient developed congestive heart failure five weeks post-operatively. He was the patient who was to have his heart valve replaced.

PATIENTS REQUIRING ANAESTHESIA AFTER POSTERIOR CERVICAL OSTEOTOMY

Even though the patient can see ahead after the operation the anatomy of his neck is still grossly abnormal. It remains extremely difficult to intubate these patients because the neck cannot be extended and the larynx usually lies anterior to the line of vision on direct laryngoscopy. Tracheostomy could easily be performed if necessary. Table II summarizes the operations performed on patients who had a previous cervical osteotomy. A number of anaesthetic techniques have been used successfully.

TABLE II

1. Total hip replacement	General Anaesthetic Mask Halothane
2. Total hip replacement	General Anaesthetic Mask Narcotic
3. Anterior Cervical Fusion	Local anaesthesia + Innovar (awake intubation unsuccessful)
4. Hip Synovectomy	Epidural anaesthetic
5. Release of acromioclavicular ligaments	Local + Innovar
6. Anterior Cervical Fusion	General Anaesthesia Awake Intubation

DISCUSSION

There are many neurological complications of this operation and we feel these can be minimized by having the patient awake during the procedure so that any C8 nerve root or spinal cord compression can be immediately detected and corrected (Urist,⁴ Simmons⁵). While general anaesthesia is possible using tracheal intubation to safeguard the patient's airway, we feel that the operation is far better performed with the patient awake and co-operative.

The sitting position may cause serious problems with hypotension and air embolism. It would be technically possible to perform this operation with the patient lying on his side. We consider the difficulty in stabilizing the head with the patient in the lateral position at a time when the spinal cord is in jeopardy outweighs any advantage of the lateral position.

Air embolism is a possibility during this operation and its prophylaxis is well discussed by Michenfelder *et al.*¹² Treatment of air embolism by hyperbaric pressure has been outlined by Calverley *et al.*¹³ We feel that of the available measures for prophylaxis of air embolism, observation by the surgeon is the most important. We also keep the venous pressure and blood volume as high as possible. We do not feel that the insertion of a right atrial catheter is justified in our patients. Because tracheal intubation is not used the question of controlled as compared to spontaneous ventilation does not arise. We rely on observation by the surgeon and on our monitoring of the pulse, blood pressure, heart sounds (Doppler ultrasound) and pattern of spontaneous respiration for detection of air embolus. E.C.G. and/or end-expired CO₂ monitoring could be considered.

It must be re-emphasized that these patients may be difficult or impossible to intubate by conventional means after posterior cervical osteotomy. This could be extremely important in patients presenting for emergency surgery. Local analgesia should be used in all patients if possible. If a general anaesthetic is required patients have been successfully managed using an oropharyngeal airway. If intubation is required it is best performed with the patient awake. A fibre-optic bronchoscope might prove useful in intubating these difficult patients.

VI SUMMARY

We have studied 22 consecutive cases of posterior cervical osteotomy done at the Toronto East General Hospital between October 1967 and November 1973.

The anaesthetic management is discussed in some detail and consists of psy-

chological preparation of the patient, and neuroleptanalgesia with infiltration with local anaesthetic by the surgeon. The reasons for this choice of technique have been discussed in some detail.

There were no deaths during operation, but one patient suffered collapse on the table, which was thought to be due to air embolism. One patient died three weeks post-operatively of pulmonary embolism.

Experience in anaesthetizing patients who require operation after previous posterior cervical osteotomy is mentioned briefly and techniques are recommended for successful management of such cases.

RÉSUMÉ

Nous avons relevé vingt deux dossiers consécutifs de malades ayant subi une ostéotomie cervicale postérieure au Toronto East General Hospital, entre octobre 1967 et Novembre 1973.

Ce travail discute en détail de la conduite de l'anesthésie chez ces opérés. Ceci inclut la préparation psychologique du malade, l'usage de neuroleptanalgesie et d'infiltration d'anesthésique local par le chirurgien. Les avantages de cette technique sont décrits.

Nous n'avons eu aucun décès durant l'intervention, mais l'un des patients a présenté un état de choc interprété comme une embolia aérienne. L'un des opérés est décédé trois semaine après l'opération d'une embolie pulmonaire.

Notre expérience avec l'anesthésie de malades ayant subi antérieurement une ostéotomie cervicale postérieure est également rapportée, avec des recommandations utiles à la conduite de leur anesthésie.

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