ANESTHETIC PROBLEMS IN THORACIC SURGERY *

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IT can be safely stated, I believe, that the anesthesiologist receives his greatest challenge when he begins the administration of an anesthetic agent to a patient for a thoracic surgical procedure. This is readily apparent when one recalls the complications created by thoracic operations which make anesthesia for these cases difficult. Thoracic procedures are usually performed upon anemic patients with altered vital capacities and upon those who are suffering from pulmonary neoplasms, debilitating chronic diseases such as tuberculosis, or chronic suppurative diseases of the lung such as bronchiectasis and abscess. In such patients, even before the anesthesia is begun, the stage is already set for a complicating anoxic, anemic anoxemia and postoperative shock.

In excisional surgery of the lung as well as operations upon the esophagus and heart, the patient is subjected to the hazards of an open pneumothorax, stimulation of the mediastinum, arrhythmias of the heart, and the dangers of suffocation resulting from accumulated bronchial secretions, blood, pus or detritus expressed from the lung during operation.

The satisfactory maintenance of a closed anesthetic system is often disrupted by sectioning of the open bronchus as is necessary during the amputation of a lobe or lung. In addition, during this procedure blood may sometimes find its way through the open bronchus and require immediate aspiration through the endotracheal tube. The anesthetist is confronted with the same problem during muscle implant operations for the closure of "lattice" lung abscesses or emypema cavities with fistulae. The bronchial communication should be plugged with packing by the surgeon to prevent loss of the anesthetic gases and aspiration of blood resulting from the operation. In these situations, the anesthetist can do much to help prevent such complications by maintaining the patient on positive pressure and so prevent blood from entering the respiratory passages via the fistulous opening.

POSITIVE PRESSURE

The use of differential positive pressure is usually required in the delineation of lobe boundaries during segmental resections and is man-

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datory when both pleural cavities are simultaneously opened as not uncommonly occurs during resections of the esophagus.

During decortication operations it is often difficult to obtain a good cleavage plane between the visceral pleura and the scar plaque. In such instances the anesthetist, by maintaining positive pressure, can splint the lung so that a careful, sharp dissection is more easily accomplished. After a good portion of the lung has been uncovered, it is a good idea to inflate the lung with a few centimeters of water positive pressure (1). This procedure usually helps in opening up new planes for dissection and aids in gently freeing or releasing the remaining portions of attached lung. As not infrequently occurs, small incisions or openings are inadvertently made into the lung during the dissection, and the lung tissue so exposed soon commences to "bubble air" and may bleed profusely. Hemorrhage is promptly arrested by pressure with hot wet packs. The leakage of air stops as soon as positive pressure is discontinued.

If it becomes necessary to maintain positive pressure for protracted periods either continuously or intermittently, the added dangers of sudden fatal apnea, cardiac tamponade, and acute mediastinal, parenchymal and subpleural emphysema must be remembered (2).

ANOXIA

When acute respiratory failure occurs in the patient subjected to operation, rhythmic intermittent insufflation of oxygen through the endotracheal tube is often a life saving procedure. If adequate pulmonary ventilation with oxygen is maintained in a patient who has suddenly become cyanotic and pulseless, there will usually be prompt restoration of a good circulation, clearing of cyanosis and spontaneous breathing. Even in cases of cardiac standstill requiring manual cardiac massage, with intracardiac medication and electrical shocking, attempts to revive the heart will be futile unless high concentrations of oxygen can be maintained in the coronary arteries supplying the myocardium. This is best accomplished by adequate artificial pulmonary ventilation with pure oxygen.

It has been pointed out by Chase (3) that the most serious effects of anoxia are usually upon the brain and myocardium. Reflexes are abolished if anoxia exists for a few seconds and coma ensues if the cerebral circulation is interrupted from six to eight seconds. Irreparable brain damage occurs if anoxia continues from eight to ten minutes.

The myocardial coordinating mechanism is extremely sensitive to lack of oxygen. It has been estimated that even under normal conditions this organ requires five times the amount of oxygen needed by ordinary skeletal muscle, and that during periods of great activity the myocardium requires as much oxygen as the entire remainder of the

body. It is apparent from these observations that if cardiac and pulmonary operations are to be undertaken with the possible addition of shock owing to blood loss, the demand for oxygen will be great, and that in these instances early oxygen therapy through an adequately maintained airway is a primary consideration.

LOBECTOMY AND PNEUMONECTOMY

Postural drainage and preoperative bronchoscopic aspiration of the respiratory passages should be carried out before beginning any excisional surgical procedure in the treatment of pulmonary suppuration such as chronic lung abscess and bronchiectasis. As suggested by Blades and Mousel (4), it is good policy not to perform the bronchoscopic aspiration immediately before intrathoracic procedures, as instrumentation of the tracheobronchial tree preceding induction causes considerable coughing. Also bleeding and bronchorrhea may be provoked, increasing difficulties during the operation. Better results are usually obtained if bronchoscopy is performed two or three days before the operation. Postural drainage is employed immediately before the anesthetic is administered.

Following induction, few changes in the adjustments of the anesthetic machine are necessary until the pleura is opened, at which time gentle positive pressure, about 4 to 6 cm. of water, will help to forestall any pleural reflex and will prevent sudden lung collapse and mediastinal shift. Deeper anesthesia is usually required during the pull or operative tugging on the hilum.

Owing to the expression of secretions, pus or blood from the lung during manipulation, it is a good policy to ligate the bronchus as early as possible. Any spill-over that does occur can be aspirated by catheter through the endotracheal tube with the patient in a Trendelenburg position.

Just before completing the closure of the chest wall following lobectomy, the remaining lung is slowly re-expanded with 8 to 10 cm. of water pressure. It is important that positive pressure be applied slowly and maintained until the dressing is applied. Re-expansion of persistent atelectatic patches can usually be accelerated by gentle massage of the lung.

Bronchoscopic aspiration of the tracheobronchial tree is routinely performed at the end of most major thoracic procedures, and is particularly indicated following partial or complete resections of the lung. Oxygen lavage of the respiratory passages can be performed during bronchoscopy by connecting a tube delivering pure oxygen under moderate pressure to the sidearm of the bronchoscope. A roentgenogram of the chest made while the patient is still on the operating table, a routine suggested by Mousel (4), affords valuable information about residual atelectasis, tension pneumothorax and incomplete expansion

of the lung, all of which conditions can easily be corrected while the patient is still in the operating room where bronchoscopic instruments are conveniently available.

In instances in which lung tissue has been cut across and intercostal tube drainage has been necessary, it is important to have the intercostal tubes connected to water seal bottles before bronchoscopy is begun, as this permits expulsion of any residual intrapelural fluid, blood, pus or air during the coughing which results from the procedure.

Despite the use of an intratracheal tube with facilities for frequent aspiration, situations will occasionally arise during major chest operations in which this set-up will be inaedquate. For example, when sudden flooding of the entire trachebronchial tree with blood, pus or lung detritus occurs, immediate bronchoscopic aspiration should be performed. For this reason, sterile bronchoscopic set-ups should always be available in the operating room for emergency use whenever any operation is performed in the course of which sudden flooding of the respiratory passages might occur without warning.

Churchill and Belsey (5) have pointed out the frequent occurrence of atelectasis in the remaining portion of a lung lobe following segmental resection. Atelectasis of the left upper lobe, for example, is quite common following lingulectomy, and is thought to be caused by occlusion of the upper lobe bronchus by edema resulting from operative trauma at the time of amputation of the lingular bronchus at its point of origin. Immediate re-expansion follows bronchoscopic aspiration.

Following pneumonectomies performed in the lateral prone position, completion of the closure of the chest wall should be carried out with the remaining good lung on moderate positive pressure. This will neutralize shift of the mediastinum to the unoperated side owing to the dependent weight of the heart and other mediastinal viscera while the patient is in this position. Positive pressure administered during this phase of the operation will help to maintain the mediastinum near the normal midline position and so obviate the urgent necessity of rapidly removing air from the pneumonectomized side as soon as the patient is turned into a supine position.

Respiratory Stimulants

I mention respiratory stimulants or so-called analeptics only to condemn them. As has been pointed out by Mousel, Stubbs and Kreiselman (6), such drugs as coramine, metrazol, picrotoxin and alphalobeline are not only of no value in resuscitation, but may actually do a great deal of harm. Schmidt (7) has shown that analeptics actually increase the oxygen demand of the higher centers, and that if during a state of acute depression the patient is given one of the above mentioned analeptics, anoxia is greatly increased. If careful attention is paid to patency of the airway, adequate oxygenation during anesthesia and

replacement of blood loss as it occurs during the operation, much has already been done to prevent anoxia, which in the final analysis is the most important complication in anesthesia for thoracic surgery.

CHOICE OF THE ANESTHETIC AGENT

In the experience of Eversole and Overholt (8), cyclopropane is the choice for an ideal anesthetic agent in thoracic surgery. Beecher (9), on the other hand, prefers ether with nitrous oxide for the induction. In my opinion, nitrous oxide, oxygen, and ether, administered endotracheally through a closed apparatus, is the preferred anesthetic. This method of administering the anesthetic gas facilitates frequent aspiration by catheter of bronchial secretions, blood or pus as these materials accumulate during the course of the operation; it makes easier the maintenance of an even plane of anesthesia while at the same time using less of the anesthetic drug; it affords a simple method of controlling the desired degree of lung expansion during the operation, and insures an adequate airway for oxygen lavage at the completion of the operation.

SUMMARY

Anesthetic problems created by thoracic surgical procedures have been considered. During anesthesia for thoracic operations, the maintenance of an adequate airway, prevention of anxoia and the replacement of blood as it is lost during the operation should receive first consideration.

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Junior Ballroom. Hotel President. Charles H. White, M.D., Presiding.

1. The Pharmacological Effects of Procaine. Robert M. Isenberger, M.D., Prof. of Pharmacology, University of Kansas Medical School, Kansas City, Kansas.

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