

amines which have a direct cardiac action. In dogs ventricular arrhythmias can be instigated by the injection of ephedrine and norepinephrine, while the injection of a relatively large dose of epinephrine produces ventricular fibrillation.

Histological studies on seven dogs and two monkeys exposed to anesthetic concentrations of Fluothane for a total of 24 hours over a period of six days have revealed changes only in the liver. In hematoxylin-eosin stained slides, there was a pallor about the central vein of the liver lobules. No cellular destruction was apparent.

To date Fluothane has been employed as the principal anesthetic drug in 145 patients undergoing surgery. Four to six minutes after beginning anesthesia, sufficient relaxation was present to perform endotracheal intubation. A moderate fall in blood pressure (30 to 40 mm. Hg) was seen during induction in about 50 per cent of patients. This corrected itself within 10 to 20 minutes, and the blood pressure was maintained usually about 10 to 20 mm. Hg below the preoperative level. Respiratory depression occurred frequently. Almost all patients have been monitored with the electrocardiograph, and in ten (6.9 per cent), cardiac arrhythmias, readily reversible by lightening anesthesia, have been noted. The depth of anesthesia could be altered in three or four respirations. Recovery from anesthesia has been rapid and remarkably benign. Complete mental orientation has occurred in all patients within 30 minutes of termination of anesthesia. Nausea has occurred in 4 patients (2.7 per cent) and vomiting in 8 patients (5.5 per cent). Bromsulphalein dye tests done in 18 patients showed in 14 patients a retention of 8 to 39 per cent in 24 hours, but no retention in any patients five days postoperatively. Blood sugar estimations performed during operation in 17 patients showed no significant elevation.

Circulatory Arrest in Patients with Complete Heart Block During Anesthesia and Operation. LEROY D. VANDAM, M.D., AND GEORGE A. McLEMORE, M.D., Division of Anesthesia, Department of Surgery and the Medical Clinic of the Peter Bent Brigham Hospital, Harvard Medical School, Boston, Massachusetts.

CARDIAC arrest during anesthesia is usually unexpected except perhaps in patients undergoing operation on the heart. The cardiac patient operated on for other conditions usually fares well in this regard. Recently, however, we have witnessed several episodes of cardiac arrest in patients with heart block. This has led us to review the previous anesthetic experience with this type of heart disease. The discovery of an inordinate number of arrests indicates that circulatory arrest should be anticipated in this group of patients and that the means for prevention should be investigated further. Circulatory rather than cardiac arrest is the better term since it has been shown that asystole, ventricular tachycardia or fibrillation may be the primary event.

The records of twenty-two surgical patients with established complete heart block were studied. The group comprised patients in the older age groups with coronary sclerosis or hypertension the usual underlying heart disease. Twelve had Adams-Stokes attacks prior to operation. Fifteen of the operations were major with cholecystectomy accounting for seven. Diethyl-ether was the principle agent for most of the major operations while local anesthesia predominated in the minor procedures. It is a striking fact that six of the twenty-two patients had two or more episodes of circulatory arrest during anesthesia and operation. Fortunately there were no fatalities and emergency thoracotomy was performed in only one case. In retrospect the thoracotomy need not have been done. The circumstances surrounding the circulatory arrests are illuminating.

Five of the six patients with arrest had had Adams-Stokes attacks that had not responded to the usual measures. Adrenalin, sympathomimetic amines, atropine, thyroid, barium and ammonium chloride were ineffective in preventing attacks. Five of the patients underwent major operations and cholecystectomy was accomplished in four. Cholecystectomy has been suggested as a therapeutic measure for the relief of Adams-Stokes disease when a relation to gall bladder disease seems likely. Atropine in doses up to 0.6 mg. for preoperative medication failed to protect against arrest. There is reason to believe that larger doses would have been equally ineffective. The depressant

effect of ether on the myocardium may have led to arrest during induction in one case. Similarly rapid absorption of a local anesthetic from the injection site may have affected cardiac conduction in another case. In the remainder reflex stoppage of the heart was suggested by the precipitating events. Circulatory arrest followed endotracheal intubation in two and the others were associated repeatedly with intra-abdominal manipulation. Any one or a combination of the aforementioned mechanisms have led to arrest in the normal patient but the patient with heart block is particularly susceptible.

Patients with complete heart block should be prepared for operation with the drugs successful in preventing Adams-Stokes attacks before operation. Preparations should be made to monitor the electrocardiogram continuously. Adrenalin for injection and an external cardiac pacemaker of the Zoll type should be at hand. Care should be taken to avoid overdosage either with general or local anesthetics and to watch for arrest at the time of reflex stimulation. Thoracotomy need not be performed immediately if arrest occurs. Cardiac action was reinstated in the cases reported here mostly by mechanical means. Pounding the chest, needling the myocardium and stimulating the heart through the open abdomen proved effective. In one case an external cardiac pacemaker was helpful.

Anesthetic Management of Infants and Children with Double Aortic Arch

BERNARD V. WETCHLER, M.D., AND WILLIAM O. McQUISTON, M.D., The Children's Memorial Hospital, Chicago, Illinois.

DOUBLE aortic arch or constricting vascular ring was present in 2.2 per cent of the patients operated upon for congenital heart disease at The Children's Memorial Hospital in Chicago during the past ten years. Twenty-three of this group of twenty-eight patients were under one year of age. One infant died from hemorrhage, one from failure to locate and divide the anomalous constricting vessel, and four from anesthetic complications [Arch. Surg. 73: 508-516 (Sept.) 1956].

The diagnosis and surgical treatment of conditions arising from these vascular anomalies have been fully covered by Gross [Pediatrics 7: 69, 1951]. Operative and postoperative complications can be minimized only if the anesthesiologist is prepared to treat ventilatory problems arising from tracheal compression. A wide assortment of long, thin walled but firm endotracheal catheters and several sizes of polyethylene tubing must be available. The tip of the catheter or tubing must be advanced beyond the obstruction. Although we prefer a closed-to-and-fro absorption technique, and light cyclopropane anesthesia, there have been times when the lumen of the trachea was so small that intubation with the smallest endotracheal tube was impossible. In these instances, we resorted to insufflation of gases through a small (18 gauge) endobronchial polyethylene tube. Moderate hypothermia (86 to 96 degrees) proved to be a valuable adjunct and reduced metabolism to the point where an inadequate, obstructed airway became adequate.

The immediate postoperative period is critical. Chondromalacia may permit collapse of the trachea, and tracheal edema may produce an acute, fatal obstruction. An oxygen tent with high humidity and Alevaire® was employed routinely. This seemed to decrease the frequency and severity of tracheal edema, tracheitis and bronchitis or pneumonia, which are the principle causes of morbidity and mortality.

The following case report illustrates most of the more serious complications and the means used to combat them:

A six months old infant was admitted to the hospital with the symptoms and clinical findings of a vascular ring compressing the distal portion of the trachea and right main bronchus. Because of the respiratory difficulty, premedication consisting of morphine $\frac{1}{60}$ grain and scopolomine $\frac{1}{600}$ grain was administered intravenously in the operating room. An improvised endobronchial tube was fashioned from No. 330 polyethylene tubing. Multiple alternating holes were made along both sides of the distal two inches of this tube. Right endobronchial intubation provided an adequate airway to both lungs. Anesthesia was uneventful. Following extubation, breathing became labored with a pronounced but ineffectual expiratory effort. A progressive emphysema of the right

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