Case 2. An 18 year old Puerto Rican primigravida was admitted to Wesley Memorial Hospital in spontaneous labor. Continuous caudal anesthesia was started five hours afterward in the same manner as described above. The dose of mepivacaine hydrochloride was 30 ml. of 1 per cent solution. The catheter was easily inserted and taped in place. After ninety minutes the patient delivered a viable female infant without complication. Following the episiotomy repair she was turned on her side for removal of the plastic tubing. When the catheter was withdrawn approximately four inches, it stuck and could not be further withdrawn. The catheter was then grasped with a forceps at the skin edge but the tension employed caused the catheter to break. About six inches of polyethylene tubing remained in the patient.

Neurosurgical consultation was obtained and sacral exploration was performed that afternoon. The free end of the catheter was located in the subcutaneous tissue and was followed down to the sacral hiatus. When the sacro-coccygeal ligament was removed, the segment of catheter was removed intact (fig. 1). The catheter had looped itself into a complete double knot and attempts to extract the catheter had only tightened the knot and wedged the tubing against the hialtal wall.

COMMENT

The experience of these two incidents suggests the following precautions: Using a needle of sufficiently large bore to insure an adequate lumen for the polyethylene catheter even if the sharp tip of the needle should impinge on the lumen to some extent. Insertion of the catheter no more than 2 inches beyond the tip of the needle. The clear plastic catheter should be appropriately marked before its use to insure the above precaution.

Cardiac Resuscitation Following Two Hours of Cardiac Massage and 42 Countershocks

WILLIAM J. STEPT, M.D., AND PETER SAFAR, M.D.*

The following case report may be of interest because of the unusual duration of cardiac massage, the effects of hypothermia, and the great number of high energy countershocks used.

A 59 year old white man was admitted to a community hospital after he collapsed while walking to work. Upon admission, he was confused, lethargic and complained of severe occipital pain. A lumbar puncture demonstrated bloody spinal fluid. His condition improved slightly, and after seven days he was transferred to the Presbyterian-University Hospital for further evaluation. On admission, he was mildly confused and lethargic without focal neurologic signs. His past history revealed untreated hypertension of several years' duration. The electrocardiogram showed a questionable old myocardial infarction. Carotid angiography revealed a right middle cerebral artery aneurysm.

Five days after admission, the patient was taken to the operating room for clipping of the cerebral aneurysm. At 7:45 a.m. anesthesia was induced with 300 mg. thiamylal, relaxation was achieved with succinylcholine, and an atraumatic tracheal intubation was performed. A thermometer probe and stethoscope were inserted into the esophagus. Anesthesia was maintained with nitrous oxide/oxygen, 3/2 liters per minute, and halothane 0.75 per cent in a semiclosed circle system. Mechanical hyperventilation with positive-negative pressure was employed, using tidal volumes of 800 ml. at a rate of 20 per minute. Surface cooling was started immediately after induction of anesthesia with a water mattress and ice bags. Shivering was prevented with a continuous intravenous infusion of succinylcholine. At 9:45 a.m., with his temperature...
at 33° C., the operation was started. The aneurysm was clipped successfully when the temperature was 31° C. One thousand ml. of blood, more than the estimated loss, was given. At 11:20 a.m. rewarming was started, coinciding with the closure of the dura. The operation lasted 2 hours and 25 minutes. At the conclusion of the operation, although 1,200 mg. succinylcholine had been given, spontaneous tidal volumes were 500 ml. and "vital capacity" over 1,000 ml. Since the patient was restless and moving all extremities on command, the tracheal tube was removed prior to transfer to the recovery room. At this time the esophageal temperature was 33° C. His airway appeared adequate, he seemed reasonably alert, and he was not shivering.

In the recovery room, oxygen was administered by face mask. His condition remained unchanged for 10 minutes; then he suddenly became apneic and the lips became dusky. Positive pressure ventilation with a Ruben bag immediately restored a pink color and spontaneous breathing. A second apneic episode followed within one minute, but his color remained pink and breathing began unabated. A few seconds later (12:25 p.m.) the pulse, which was being felt continuously, suddenly disappeared. External cardiac compressions and ventilation were started immediately and a tracheal tube was inserted. An electrocardioscope was connected showing the heart to be in standstill. Epinephrine 1 mg. was injected intravenously with immediate conversion of the asystole to ventricular fibrillation. This was treated with an external d.c. countershock of 100 watt seconds, which was repeated several times at two to three minute intervals. Throughout two hours of external cardiac compression, while ECG patterns alternated between standstill, ventricular fibrillation and very brief periods of weak spontaneous cardiac contractions, intravenous injections of epinephrine and sodium bicarbonate were used. A norepinephrine infusion was used to support the arterial pressure. Pupils remained small and reactive to light throughout.

As the first few d.c. external countershocks with 100 and 200 watt seconds were unsuccessful, the energy was increased to 400 watt seconds during the subsequent 35 external countershocks. Some stopped fibrillation, but only temporarily. Hypothermia was suspected as the cause of failure to permanently defibrillate. External application of a warm water mattress failed to raise the esophageal temperature. Therefore, after 1 hour and 30 minutes of external resuscitation attempts, during which a good artificial femoral pulse could be felt, the chest was opened and warm isotonic saline solution poured into the pericardial cavity. Direct cardiac compressions were carried out immediately. Following rewarming of the heart, three attempts at internal defibrillation were made with 120 watt seconds energy, applying the electrodes directly on the heart. The third shock converted the patient into asystole which was followed by effective spontaneous contractions. The blood pressure was supported by a slow norepinephrine infusion. A total of two hours of manual systole had elapsed.

Several minutes later the patient began thrashing about and made purposeful movements. A tracheotomy was performed and intermittent positive pressure ventilation continued, because of multiple rib fractures. Within two hours the patient maintained adequate spontaneous blood pressure and the norepinephrine infusion was discontinued. His mental state was comparable to his pre-operative condition and there was no focal neurologic deficit. He excreted 3,400 ml. of urine in the first eighteen hours following resuscitation, but became oliguric during the next 48 hours and subsequently started an output of increasing amounts of dilute urine. The blood urea nitrogen increased steadily.

On the seventh postoperative day a hemothorax developed, necessitating an emergency thoracotomy. A large intercostal bleeder was found at a rib fracture site and ligated. Five hundred milliliters of blood were evacuated. Following this, the patient's general condition deteriorated, the BUN rose to 207 and the potassium to 7.1 mEq., but decreased immediately before death. He became deeply comatose, hypotensive and expired at 6:40 p.m. the eighth day following cardiac arrest.

Pertinent autopsy findings showed general arteriosclerosis, an old and recent healing myocardial infarction, acute tracheobronchitis, and later stages of lower nephron nephrosis.
Discussion

The cause of the two episodes of apnea and cardiac arrest was not clear. Although cyanosis and gross shivering did not precede the event, there could have been hypoventilation and occult shivering during transportation of the patient from the operating suite to the recovery room. Hypoxia could thus have added insult to an already ischemic myocardium. Coronary disease must be suspected as a primary cause of the arrest, since (1) the preoperative ECG suggested old questionable infarction; (2) the ECG following resuscitation showed acute ischemic changes; and (3) the autopsy showed diffuse arteriosclerotic changes with an old healed and a recent infarct. We suspect, therefore, that a combination of factors led to the arrest, namely hypoxemia of a cold, ischemic heart and hypothermia.

The duration of cardiac compression is one of the longest reported. Artificial blood flow during external or internal cardiac compressions was found to be borderline both in dogs and in man. Nevertheless, this case illustrates that prolonged external cardiac compressions, when performed correctly, can keep the brain adequately perfused for prolonged periods. Although hypothermia may have had a protective influence on the brain, it failed to prevent renal damage, which proved to be the final cause of death.

The resistance to defibrillation probably is attributable to the increased irritability of the myocardium during hypothermia and ischemia. The ease with which defibrillation was accomplished following rewarming of the heart supports this view. Direct rewarming via thoracotomy should have been done earlier, since rewarming by external means is impossible in the presence of the borderline systemic circulation produced by massage.

The great number of countershocks (39 external and 3 internal) is also unusual. Kong and Proudfoot reported a patient who had 140 external d.c. countershocks with no evidence of burns either on the chest wall or myocardium at autopsy. Our patient had no burns of the heart at autopsy. There were second degree burns of the skin where the electrodes were applied. Several countershocks had produced sparks which could have been avoided by proper usage of electrode jelly. There is no evidence at present to indicate that external high energy countershocks produce myocardial damage.

Since the recommended energy of 150-watt seconds d.c., or 400 volts a.c., in our experience often failed to defibrillate successfully at the first attempt, particularly in patients with diseased hearts, it seems justified to start with higher energy shocks. Shortening the period of massage seems more important than the possibility of chest wall burns. However, with direct application of electrodes to the heart, myocardial burns have been seen, and therefore, lower energy shocks should be tried first. Retrospectively speaking, we should have warmed earlier via thoracotomy and applied high energy countershocks externally, which—even when the chest is open—seems preferable to direct application of electrodes, to avoid cardiac burns.

The ultimate demise of this patient was due to uremia and the additional insult of a hemotherax and re-exploration. Extracorporeal hemodialysis was not performed because potassium plasma values, although high, began to fall before the terminal events. In cases of cardiac and cerebral pathology, where acidemia is particularly harmful, dialysis should probably not wait for a significant rise in plasma potassium.

Summary

Cardiac arrest occurred following craniotomy in a patient at 32°C. with coronary artery disease. During 1½ hours of external cardiac compressions and 39 external d.c. high energy countershocks, defibrillation proved impossible. Subsequent thoracotomy and direct rewarming of the heart allowed effective internal defibrillation (3 shocks) and return of spontaneous circulation. In spite of the return of apparently normal cerebral function, the patient died on the eighth postoperative day from lower nephron syndrome.

References


Caustic Skin Burns Following Contact with Solution from Exhausted Carbon Dioxide Absorption Canister

WARREN H. ROSSWAY, M.D.*

This communication illustrates the need for care in preventing highly alkaline carbon dioxide absorbing materials from coming in contact with skin surfaces of patients.

During the emptying of an exhausted carbon dioxide circle filter, several moisture-laden granules of barium hydroxide lime (Baralyme) accidentally fell upon the sheet covering the operating table cushion. These granules were brushed from the sheet and the adjacent drawer.

*Department of Anesthesiology, Huntington Hospital, Huntington, New York.

Fig. 1. Caustic skin burns following contact with solution from exhausted carbon dioxide absorption canister, 14 weeks after anesthesia.