

Special Contribution

Electrical Anesthesia for Major Surgery

IV. Report of Two Cases

James D. Hardy, M.D., Leonard W. Fabian, M.D., and M. Don Turner, Ph.D., Jackson, Miss.

THE POSSIBLE USE of an electrical current to produce surgical anesthesia has interested physicians for many years. In 1956 we began experimenting with animals, and it was eventually found that a current of 700 cycles and 35 milliamperes, employing about 25 volts, would induce acceptable general anesthesia. Thereafter operations of various types were performed on more than 60 dogs, and changes in blood gas values, blood pH, plasma catechol amine and corticoid levels, blood glucose content, and blood pressure and pulse rate were followed.¹⁻³ The results were similar to those published by Knutson, Tichy, and Reitman,⁴ and in general the data appeared to establish the fact that no serious or permanent effects were produced by electrical anesthesia lasting up to 6 and even 8 hours. Induction and recovery were both extremely rapid. The principal precautionary measure required was that of preliminary intubation of the animal, with topical anesthesia in the oropharynx and a small amount of curare. If this were not done, to permit adequate mechanical ventilation of the lungs, there was a serious risk of hypoxia.

Thus, in January, 1961, it was considered reasonable to begin guarded clinical application of the method. Taking all possible precautions against serious mishaps, we induced electrical anesthesia or narcosis in a first patient on Jan. 14, 1961, and in a second patient on Jan. 17, 1961. The results were most gratifying and fully established the feasibility of further clinical trial.

Reports of Cases

CASE 1.—A 67-year-old woman was admitted to the University Hospital on Jan. 2, 1961, with the tentative diagnosis of carcinoma of the rectum with omental metastases. Because of what later proved to be neoplastic deformity of the rectum, it was not possible to perform either barium enema examination or proctoscopic biopsy successfully. Therefore, diagnostic laparotomy was decided upon.

Operation.—At 8:00 A.M. on Jan. 14, 1961, the patient was taken to the operating room and intubated under topical anesthesia with tetracaine (Pontocaine) and succinyl choline. Mild tranquility was achieved with thiamylal, and the two electrodes for the induction of electrical anesthesia were then applied to each temple. The current was switched on at 8:15 A.M. and increased over a period of 15 seconds to 50 milliamperes, at which level the patient had ceased straining on the endotracheal tube and was "asleep." Pulmonary ventilation was achieved by manual assistance, but late in the operation the patient was breathing spontaneously. The abdomen was prepared and draped, and an upper abdominal midline incision was performed to expose the peritoneal cavity. A mass was present in the lower sigmoid colon, and there was neoplastic seeding over most of the viscera. A biopsy specimen was taken and the abdomen closed. Small amounts of succinyl choline had been given intermittently to achieve adequate relaxation.

The current was switched off at approximately 8:45 A.M., the electronarcosis having lasted 30 minutes. Within less than 60 seconds the patient opened her eyes and shortly thereafter answered questions correctly with appropriate nods of the head—though the endotracheal tube was not removed until several minutes later. All of this was recorded by moving picture camera. As soon as the tube was removed the patient stated that she had felt no pain and in fact remembered nothing of the operation. She was singularly free of nausea or other symptoms except for excisional pain.

The blood pressure was 130/80 mm. Hg preoperatively, rose to 180/100 while she was being intubated, fell to 160/100 just prior to application of the current, rose again to 190/120 briefly, and then gradually declined under the electrical narcosis to a level of 140/90 mm. Hg just prior to cessation of the current. No cardiac arrhythmia developed at any time.

The postoperative course was uneventful and the patient was discharged from the hospital at the end of 5 days.

Comment.—This first case was instructive in a number of ways. Inasmuch as we had been unable to find that a planned operation under electrical narcosis had previously been performed, we were naturally apprehensive that unanticipated complications might occur. Among these might be mental changes, irritation of the scalp at the points of entrance or exit of the current, and cardiac arrhythmias—perhaps even ventricular fibrillation, with which we were fully prepared to cope. However,

From the departments of surgery and anesthesiology and the University Hospital, University of Mississippi Medical Center.

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none of these problems had developed in animals after the very earliest exploratory studies, and none developed in the patient. In fact, the entire procedure was unremarkable. The recovery of the patient following cessation of the current was extremely rapid, just as it had been in animals, and the after-effects were truly minimal. There was excessive salivation during electrical narcosis, but this did not appear to be associated with a similar increase in pulmonary secretions aspirated from the endotracheal tube.

Thus, the first case of electrical anesthesia had established a satisfactory basis for careful further exploration of the method.

CASE 2.—A 43-year-old woman was admitted to the University Hospital with a tumor of the left breast of at least 9 months' duration. The skin had ulcerated over the large neoplastic mass and a simple biopsy disclosed carcinoma. Since surgical cure was not believed possible, we elected to perform a simple mastectomy and then to continue treatment with radiation.

Operation.—On Jan. 17, 1961, a left simple mastectomy was performed. The endotracheal tube was inserted, with 120 mg. of thiamylal and succinyl choline given intravenously. Thereafter the patient strained on the endotracheal tube until the electrical current was turned on, when all movements ceased. Relaxation was maintained through minimal use of the succinyl choline drip, and the operation lasted a little less than 30 minutes. Blood pressure fluctuations were not remarkable; systolic pressure did not exceed 180 mm. Hg and diastolic pressure did not exceed 100 mm. Hg. Blood gas analyses revealed excellent ventilation throughout the procedure.

This patient too began to breathe spontaneously midway through the operation. Near the end of the procedure she began to move her legs slightly and the current was increased from 45 to 55 milliamperes, after which movements ceased. Excessive salivation was noted.

Recovery was very rapid after cessation of the current, and extubation was performed promptly. The patient was instructed to look upward and to the right (directly into the camera lens), which she did, and was photographed. Recovery from the "effects" of anesthesia was essentially immediate, and there was virtually none of the residual somnolence so conspicuous after other forms of general anesthesia. She had felt nothing after application of the current.

An electroencephalogram performed two days after operation revealed no focal changes. Minor changes compatible with a normal EEG will be investigated. All future patients will undergo extensive electroencephalographic evaluation before and after electrical anesthesia.

Comment

Variations in the use of electroshock therapy have been employed to prolong the state of un-

awareness. Knutson and others⁴ maintained unconsciousness for variable periods of time in a group of psychotic patients, but no surgery was attempted. Complications ensued.

Much has been learned from these two cases, but even more important is the demonstration that carefully controlled clinical study is reasonably safe. There would seem to be little doubt that practical clinical use of electrical narcosis will eventually prove feasible under appropriate circumstances. It should be especially adapted to brief procedures, and it should be useful under conditions of field warfare. Now that it has been found suitable for carefully controlled clinical evaluation and study, the energies and enthusiasm of workers in the field should be increased substantially.

Summary

Extensive studies in animals established the basic simplicity of application and safety of the equipment for carefully controlled clinical evaluation of electrical narcosis. Two patients were operated upon under electrical anesthesia. One underwent exploratory laparotomy and the other simple mastectomy. The series is being increased with extensive monitoring by means of electroencephalography, psychological testing, blood gas analyses, and long-term follow-up. To our knowledge, this constitutes the first planned and controlled use of electrical narcosis for successful major surgery.

2500 N. State St. (Dr. Hardy).

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VENOM NEUTRALIZED BY LIGHTNING.—When venomous serpents or other animals whose bite is fatal are struck with lightning, all the poison disappears. How, you say, can I tell that? In the dead bodies of poisonous animals worms are not produced. But when struck with lightning they breed worms within a few days.—J. Clarke, *Physical Science in the Time of Nero, Being a Translation of the Quaestiones Naturales of Seneca (B.C. 4-65 A.D.)*, Macmillan, London, 1910, p. 79.