

THE USE OF CURARE IN INFANTS AND CHILDREN *†

SCOTT M. SMITH, M.D.

Salt Lake City, Utah

CURARE was first used as an adjuvant during inhalation anesthesia in January, 1942 (1). Since then interest in the clinical use of this drug, as well as its pharmacologic properties, has grown rapidly.

An abundant literature is accumulating concerning the use of curare in combination with the anesthetic agents. Many technics of administration have been advocated by various investigators (1, 2, 3, 4, 5). It is generally agreed that curare is best given intravenously although satisfactory results have been reported from intramuscular administration.

The use of curare as an aid in providing muscular relaxation for surgical procedures in infants with pyloric stenosis was first mentioned by Cullen in 1943 (6).

The use of curare has not been restricted entirely to that of an adjuvant. Reports of its employment as the sole agent to provide satisfactory conditions for surgical procedures in adults and infants have appeared (5, 7).

TABLE 1
TYPES OF OPERATIVE PROCEDURES

No. of cases	Operation
12	Rammstedt
4	Appendectomy
1	Splenectomy
15	Other intra-abdominal procedures
1	Repair of diaphragmatic hernia into pericardial sac
1	Repair of tracheo-esophageal fistula
4	Herniorrhaphy
3	Miscellaneous

The purpose of this report is to record our experience with the use of curare ‡ (intocostrin and d-tubocurarine chloride) in infants and children. Curare was employed as the sole agent in 41 cases, and only a few patients received any premedication. Table 1 depicts the types of operative procedures for which curare was used and the number of cases in each category.

* From the Department of Anesthesiology, University of Utah School of Medicine and Affiliated Hospitals, Salt Lake City, Utah.

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‡ The two preparations of curare used, intocostrin and d-tubocurarine chloride, were supplied through the courtesy of Dr. H. Sidney Newcomer, E. R. Squibb & Sons.

The ages of the patients ranged from twenty hours to 2½ years. Eighteen were female and 23 were male. The weight varied from 4½ to 29 pounds. Intocostrin was used in 8 cases, and d-tubocurarine chloride in 33 cases. The curare preparations were given intravenously in 15 patients, intramuscularly in 21, and by other routes in 5. The initial dose varied from 4 to 44 units. The supplemental dose ranged from 2 to 20 units. The total dose varied from 0.6 to 3.6 units per pound. The duration of operation was from twenty minutes to three hours. Paralysis was present for from twenty-seven minutes to three hours and fifty minutes.

PREOPERATIVE MEDICATION

Atropine was given as the sole premedication in 9 cases. Two other patients had atropine and morphine, and 2 had atropine and phenobarbital sodium. Twenty-eight individuals received no premedication. No difficulty was encountered when atropine was not administered.

RESPIRATORY EFFECT

In order to provide the desired operative conditions, it was necessary in practically every case to administer a sufficient quantity of the curare preparation to produce complete respiratory arrest. Patients receiving less than this amount exhibited stimulation from the operative procedure. Various means of providing artificial respiration were used. Endotracheal insufflation and intubation frequently produced a marked increase in muscle tone throughout the tracheobronchial tree, making artificial respiration practically impossible. This phenomenon has been reported previously (5). Spasm was occasionally so marked that the endotracheal tube was removed and respirations carried on with a tight-fitting face mask and gentle compression of the rebreathing bag. A flow of from 5 to 15 liters of oxygen was maintained, allowing the excess to escape between the face and mask. This technic has proved the most satisfactory in our hands.

CIRCULATORY EFFECT

In patients receiving very large doses of curare, a definite slowing of the pulse occurred. Reliable blood pressure readings obtained in 5 cases showed no appreciable change attributable to curare. The quality of the heart sounds was found to be the most reliable index to the condition of the patient.

PROSTIGMINE

Prostigmine was administered to 32 of the 41 patients in doses ranging from 0.25 to 1.0 mg. It was effective in relieving respiratory depression, but did not completely abolish the skeletal muscular paralysis.

Prostigmine markedly increases secretions, and for this reason its use has more recently been restricted to cases having marked respiratory depression at the termination of the surgical procedure.

POSTOPERATIVE COMPLICATIONS

The only postoperative complication attributable to curare was moderate respiratory depression in 1 case, persisting for one hour. Cyanosis was not present and prostigmine was not given. Recovery was uneventful. No muscular twitchings or convulsions were observed in any patient in our series.

MORTALITY

There were 8 deaths in this series of 41 cases, giving a mortality rate of 19.5 per cent. Considering the preoperative conditions of these patients and the extensive operative procedures employed, it is thought that this mortality is not unduly high. There was no evidence that any of the deaths were attributable to curare.

PSYCHIC TRAUMA

Despite the fact that the operative conditions and the postoperative results in this series of patients were excellent, nevertheless the possibility of psychic trauma to the patient as a result of the lack of analgesia or anesthesia must be recognized. Knowledge regarding the physiology of the nervous system in infants and children is incomplete, and the age at which unpleasant or painful experiences may produce psychic trauma has not been determined.

CENTRAL EFFECTS OF CURARE

There have been reports of experimental work (8, 9) indicating that curare has a central depressant action. It has been stated from clinical observation that curare causes a loss of consciousness when administered in amounts sufficient to produce complete respiratory arrest (5). These reports have given rise to the belief that curare has an anesthetic action. Considerable research has been done regarding the effects of curare on the central nervous system, but definitive results have not been forthcoming to indicate whether curare is an analgesic or anesthetic in man.

In order to determine whether or not curare in large doses has any central depressant action, observations were made in a trained observer (the author of this report) under the influence of curare alone, and not undergoing operation. A dose of d-tubocurarine chloride two and one-half times that necessary for complete respiratory paralysis was given intravenously. At no time was there any lapse of consciousness or

clouding of the sensorium, and memory was unimpaired. Pain, touch and other modalities of cutaneous sensation remained normal. No changes occurred in the continuously recorded electroencephalogram. The details of this experiment have been reported elsewhere (10).

RECOMMENDED PROCEDURE FOR THE PROPER USE OF CURARE AS AN ADJUVANT IN ANESTHESIA IN INFANTS AND CHILDREN

I believe that curare should not be used as the sole agent in anesthesia because the drug is not a central depressant. It should be employed only as an adjuvant in combination with agents capable of producing analgesia or anesthesia. At the present time the following recommendations may be made. First plane anesthesia should be induced with cyclopropane, nitrous oxide, 1.0 per cent pentothal sodium or ether, and an initial dose of 0.5 unit of curare per pound of body weight should be administered, preferably intravenously. If ether is employed, the initial dose of curare should be reduced to 0.25 unit per pound. If muscular relaxation is inadequate, a supplemental dose of 0.25 unit per pound may be given. This amount can be repeated at three to five minute intervals as necessary to secure the desired relaxation. This method usually preserves spontaneous respiration and permits the anesthetist to judge more accurately the correct dose of the anesthetic agent. Because of its tendency to increase the production of secretions, prostigmine should not be used unless necessary. All methods of providing artificial respiration should be immediately available to the anesthetist.

SUMMARY AND CONCLUSIONS

Two preparations of curare (intocostrin and d-tubocurarine chloride) have been used as the sole agent to provide satisfactory conditions for various types of surgical procedures in a series of 41 infants and children. The operative conditions and postoperative results were excellent.

Despite these excellent results, in view of the conclusive demonstration that curare has no significant central depressant or analgesic action, I now believe that curare should always be employed in combination with agents capable of producing analgesia or anesthesia.

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One of the afternoon meetings of the Massachusetts Medical Society's postgraduate lecture course at Sanders Theater, Cambridge, Massachusetts, on March 19, 1947, 3:00 to 6:00 P.M., will be devoted to "Anesthesia and Its Complications." Drs. Henry K. Beecher and M. J. Nicholson will act as co-chairmen and the following program has been arranged:

1. "Current Trends in the Use of General Anesthesia," by Dr. M. Gene Black.
2. "Management of the Patient under Spinal Anesthesia," by Dr. Leo V. Hand.
3. "Post-anesthetic Complications," by Dr. M. J. Nicholson.
4. "Evaluation and Care of the Patient in Shock," by Dr. Henry K. Beecher.

Each of the speakers will be allowed thirty minutes to present their subjects and there will be a ten-minute discussion period immediately after the presentation. At the conclusion of the proposed four papers, there will be a twenty-minute discussion period of the subject "Anesthesia and Its Complications."

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