THE USE OF CURARE* FOR ABDOMINAL SURGERY IN SERIOUSLY INJURED PATIENTS

Ernest A. Doud, M.D.†

New York, N. Y.

AND

Gerald Shortz, M.D.‡

Boston, Mass.

Recent reports on the use of curare (1) for obtaining relaxation of abdominal muscles in patients undergoing elective surgery in light planes of anesthesia prompted us to give this drug a clinical trial in seriously injured patients.

Curare, by direct action on the cells, blocks the response of skeletal muscles (and to a minor degree of autonomic ganglia) to nerve impulses and to the "nicotinic" action of acetylcholine (2). The effects of curare after intravenous injection are of short duration. It is partly destroyed in the liver and partly eliminated unchanged by the kidney. Prostigmine is its pharmacologic antagonist.

If small doses are administered, it is possible to demonstrate the serial progression of paralysis of first the muscles having cranial nerve innervation, then the muscles of the extremities, of the trunk, and lastly of the diaphragm (3). No harmful results ensue at the final stage of paralysis provided artificial respiration is performed and a single large dose of curare has not been given. Cullen advises against the use of a single large dose because hypotension is produced either "by loss of vasomotor tone caused by interference with the transmission between preganglionic and postganglionic fibers in sympathetic ganglia, or merely as the result of widespread and complete peripheral muscle relaxation with resulting lack of tonal aid to venous return" (4).

This study was begun with timidity because we did not know what the response to curare would be in patients who had just been brought out of shock and in whom shock might be expected to recur during operation. Furthermore, laboratory facilities were not available to determine the amount of functional damage to the liver and kidneys caused by the various degrees of shock that our patients had suffered. Nevertheless, the reports of favorable results warranted this clinical trial.

* Curare in the form of intocostrin was supplied by E. R. Squibb & Sons.
† Presently located with the Department of Anesthesiology, The Doctors Hospital, New York, N. Y.
‡ Presently located with the Department of Anesthesiology, The Massachusetts General Hospital, Boston, Mass.

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Curare extract was administered intravenously (by injecting into the infusion tubing) to 26 patients. Sixteen of these patients had abdominal wounds and 10 had thoraco-abdominal wounds, 5 of which were left and 5 right sided. Fourteen of these patients also had associated wounds. Thirteen were in shock when admitted. Nitrous oxide-oxygen and ether anesthesia, using the absorption, oro-endotracheal technic, was begun when restorative therapy was considered to have brought about the return of an adequate circulating blood volume. All patients were premedicated intravenously with 0.0006 Gm. of atropine sulfate, and, in addition, 10 received 0.008 or 0.01 Gm. of morphine sulfate. The atropine served to block the "muscarinic" action of acetylcholine. Curare was not given routinely in all abdominal cases, but it was used to obviate the attendant hazards of deep plane ether anesthesia during prolonged operations, or in relatively short operations on patients who had recently recovered from shock. The anesthesia time for the abdominal cases averaged two hours and thirty-six minutes and for the thoraco-abdominal cases it averaged three hours and fifty-four minutes.

Curare (30-40 mg. total dose) was administered to 3 patients only when closing the peritoneum, and to 11 others only when opening the peritoneum (25-40 mg.). The dosage was divided in some of the latter group of patients when more of the drug had to be added to an initial small dose to obtain adequate relaxation. Twelve patients received curare (20-40 mg.) at the time the peritoneum was opened and later smaller doses (5-15 mg.) of the drug were added to facilitate closing the peritoneum. The maximum amount of curare given to any one patient was 50 mg. This was given in divided doses over a period of ninety minutes. The average case required 40 mg.

In every instance, the abdominal relaxation was considered excellent by the surgeons, who also believed that the operating time was decreased as a result of the ease of intraperitoneal procedures and of peritoneal closure.

It must be remembered that the muscles of the abdominal wall have the same group innervation as the intercostal muscles. When they are completely paralyzed by means of general anesthetic or curare, the intercostal muscles also are paralyzed. Respirations ceased or the volume exchange was so diminished in 8 cases that controlled respiration or supplementary positive pressure on the breathing bag was required for six to thirty minutes. The jerky, diaphragmatic type of respirations in the remaining patients was of short duration and did not interfere with the surgeons' work.

There were no appreciable changes in the pulse rate, but the systolic blood pressure was raised 10 to 20 mm. of mercury in half of the subjects. This rise in pressure was sustained in some of the cases even when the respirations returned to normal. We believed that the in-
crease in tension might have been owing to the combined effects of retained carbon dioxide and transitory hypoxia resulting from an improper respiratory exchange. Because we were aware of these possibilities, we made every effort to provide adequate ventilation by artificial means. We believe that it is advisable to supplement the tidal volume for fifteen to thirty minutes after each injection of curare to guarantee adequate respiratory exchange.

Anesthesia was maintained in the lower part of the first plane to avoid reactions to the endotracheal tube. The amount of ether used in each case was markedly reduced as compared to that usually used in this type of case, and the postanesthesia reaction time was therefore decreased. The duration of relaxation with the larger doses of curare was forty-five to sixty minutes. When curare was added for closure of the peritoneum, we were able to observe the patient for at least an hour postoperatively.

One of us (E. A. D.) used 40 mg. of curare to relax the jaws of a patient with a thoraco-abdominal injury after a prolonged anesthesia induction. The intubation was facilitated, the induction was prolonged no further, and additional curare was not needed for the laparotomy. It was noted that the vocal cords were abducted immediately after the intravenous administration of curare.

No consistent changes in the tone of the intestines were observed. There were no postoperative complications that could be attributed to the use of curare. Four patients died postoperatively. This mortality of 15 per cent is in keeping with the 24 per cent mortality in the series of 3,154 abdominal and thoraco-abdominal injuries treated by surgical teams of an auxiliary surgical group in a period of sixteen months (5).

With proper precautions for adequate control of respiration, curare is a valuable addition to the armamentarium of the anesthesiologist. To avoid dilating the stomach while applying positive pressure to re-expand the lung, we recommend the use of an endotracheal tube with an inflatable cuff or a pharyngeal pack when curare is employed.

Summary

Intravenous curare [intocostrin, Squibb] has been employed as an anesthesia adjunct in 26 cases of severe abdominal and thoraco-abdominal injuries. Ether, using the oro-endotracheal absorption technic, and nitrous oxide-oxygen were the agents in all cases. No untoward effects have been observed. Doses of curare sufficiently large to produce respiratory depression or paralysis of short duration did not cause hypotension. No deaths occurring in the series could be attributed to curare. The surgeons enthusiastically declared that the relaxation was excellent and that the operating time was decreased because manipulation of intraperitoneal contents was easier, exposure was readily obtained and closure greatly facilitated.
Conclusions

1. Dogmatic conclusions cannot be drawn from the small number of cases presented.
2. The element of shock present in association with severe abdominal wounds does not appear to contraindicate the use of curare as an anesthesia adjunct.
3. This drug permitted extensive intraperitoneal surgical interference to be carried out with ease in light planes of anesthesia and decreased the amount of manipulation and walloping off of viscera.

References

5. Wolff, Luther H.: Personal communication.

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