A CONTINUOUS DROP METHOD FOR SUBARACHNOID ANALGESIA: PRELIMINARY REPORT *

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SINCE March 1941, fractional spinal analgesia has been employed in the Massachusetts General Hospital, utilizing the equipment and technic described by Lemmon (1). It has been observed that, after the desired spinal level has been established by an initial dose of 2.5 per cent procaine in physiologic saline solution containing 3 per cent glucose, satisfactory analgesia can be maintained using a 1 per cent procaine solution; and that the patient's general condition continues to be better than with higher concentrations of the drug.

We became interested in working out a continuous drop method by which satisfactory spinal analgesia could be maintained using an even more dilute solution. Obviously, the more dilute the solution, the greater would be the volume necessary to maintain adequate analgesia, and it seemed possible that the consequent increase in spinal fluid pressure might be a limiting factor. With these considerations in mind, we assembled equipment for subarachnoid administration of solutions by the drop method, combined with manometric readings of the spinal fluid pressure.

APPARATUS

To the tubing of a continuous spinal set is attached a two-way stopcock. The spinal fluid manometer is connected to one arm of this stopcock (fig. 1). A 250 cc. pyrex leveling flask is used as a container for the solution to be administered. The flask is suspended at a suitable height and connected to the other arm of the stopcock by rubber tubing fitted with a Murphy dropper. The speed of dropping is controlled by a needle valve which can be regulated to deliver 2 to 80 drops per minute.

TECHNIC

Lumbar puncture in the selected interspace is accomplished in the usual manner with a malleable needle, which is then connected to the rubber tubing of the continuous spinal set. The air in this tube is expelled by permitting the spinal fluid to fill it, and the patient is placed in recumbent position. The spinal fluid manometer is attached and a reading taken. Then the initial dose of procaine, 2.5 per cent in physio-

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logic saline solution containing 3 per cent glucose, is administered, the level of analgesia established at the desired height, another manometer reading taken, and the operation started. The leveling flask is filled with the solution to be used, suspended at a height of 60 to 80 cm. above the spinal needle, and the air exhausted from the system. Ten minutes are allowed to elapse after the initial dose; then 2 cc. of fluid is withdrawn from the tubing connected to the spinal needle, previously measured to contain exactly that amount. This does not result in with-

FIGURE 1.

drawal of any significant amount of procaine from the subarachnoid space or in disturbance of the level of analgesia. Koster et al. (2) have shown that the amount of procaine thus removed is negligible.

The glass adapter from the tubing of the leveling flask is then connected to the two-way stopcock and 40 drops of solution run in to refill the continuous spinal tubing with dilute procaine solution (20 drops of this solution equals 1 cc. according to our calibration). On the basis of previous experience with fractional doses of 1 per cent procaine in

normal saline solution, we find that if 4 cc. of this solution, representing 40 mg. of procaine, is given thirty minutes after the initial injection and repeated every twenty minutes thereafter, analgesia is maintained at the level of the third to fifth thoracic segment. To approximate this dosage, 8 cc. of 0.5 per cent procaine solution must be given during each twenty-minute period. Since 8 cc. contains 160 drops, the rate is established to deliver 8 drops per minute. This rate of dropping is started twenty minutes after the original dose in order to be sure that the level does not recede before adequate dosage with the dilute solution is accomplished. Manometric readings are recorded and the level of analgesia tested every ten minutes, together with the usual readings of pulse, blood pressure and respirations.

One case in which 0.3 per cent procaine solution was used indicates that analgesia can be maintained with less concentrated solutions. Additional work is necessary to ascertain the minimum concentration which will efficiently control pain and maintain adequate height.

CASE REPORTS

The following are brief histories of cases in which the method was used. Figure 2 (Case 2) is a typical example of the operative course.

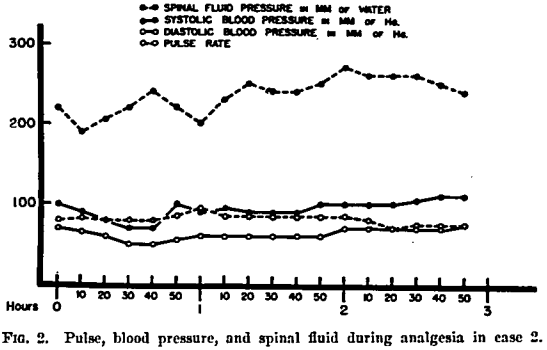

FIG. 2. Pulse, blood pressure, and spinal fluid during analgesia in case 2.

Case 1.—Mrs. R. C., 39 year old housewife, was admitted for the sixth time to the Massachusetts General Hospital with complaints of nausea, vomiting, intermittent abdominal pain and increased frequency of bowel movements, of three months' duration. She had had four previous laparotomies for intestinal polyposis and its complications.

After premedication with morphine sulfate 10 mg., atropine sulfate 0.6 mg. and ephedrine sulfate 50 mg., analgesia was established at the sixth thoracic segment with 5 cc. of 2.5 per cent procaine in normal saline solution containing 3 per cent glucose.

Before induction, the blood pressure was 115 mm. of mercury systolic and 75 mm. diastolic, pulse rate was 110, respiratory rate 18, and the spinal fluid pressure 235 mm. of water. Twenty minutes after the initial dose, continuous infusion of 0.5 per cent procaine in normal saline solution was started into the subarachnoid space at the rate of 6 drops per minute. There was a slight drop in blood pressure, which reached its lowest level (90 mm. systolic and 60 mm. diastolic) at the end of forty minutes, at which time the level of spinal analgesia had risen to the second thoracic segment, where it was maintained throughout the operation. The spinal fluid pressure reached a maximum of 350 mm. of water after fifty minutes. During the ninety minute operation for removal of two jejunal polyps, the patient was quite comfortable. The total amount of procaine used was 190 mg. The postoperative course was uneventful, except for slight nausea and moderate retention, for which the patient was catheterized eight hours after operation.

Case 2.—Mr. C. C., 50 year old watchman, entered the Hospital for radical groin dissection following combined abdominoperineal resection for carcinoma of the rectum.

After premedication with morphine sulfate 10 mg., pentobarbital sodium 100 mg., scopolamine hydrobromide 0.3 mg., and ephedrine sulfate 50 mg., spinal analgesia was established at the eighth dorsal segment with 4 cc. of 2.5 per cent solution of procaine in normal saline solution containing 3 per cent glucose. Before induction, the blood pressure was 100 mm. systolic and 70 mm. diastolic, pulse rate 82, respiratory rate 20, and spinal fluid pressure 220 mm. Twenty minutes after the initial dose, continuous infusion of 0.3 per cent procaine was started into the subarachnoid space at the rate of 8 drops per minute. There was a moderate drop in blood pressure, which reached its lowest level (80 mm. systolic and 50 mm. diastolic) after thirty minutes, at which time the spinal level rose to the sixth thoracic segment. At this point, 5 units of pitressin and 25 mg. of ephedrine sulfate were administered subcutaneously and the rate of the infusion was temporarily decreased to 6 drops per minute. Ten minutes later, the blood pressure attained its preoperative level and the rate of the subarachnoid infusion was again increased to 8 drops per minute. The spinal level was maintained at the sixth thoracic segment throughout the operation, which lasted two hours and fifty minutes. No significant change was observed in spinal fluid pressure during the analgesia. A total of 300 mg. of procaine was used. The patient, who had a colostomy opening, had moderate nausea and vomited once on the operating day. Otherwise, the postoperative period was uneventful.

Case 3.—Mr. A. P., 64 year old store-helper, entered the Hospital for bilateral inguinal herniorrraphy. After premedication with morphine sulfate 10 mg., scopolamine hydrobromide 0.3 mg., and ephedrine sulfate 50 mg., spinal analgesia was established at the sixth thoracic segment with 4 cc. of a 2.5 per cent procaine in normal saline solution containing 3 per cent glucose. Before induction, blood pressure was 110 mm. systolic and 70 mm. diastolic, pulse rate was 78, respiratory rate 20 and spinal fluid pressure 220 mm. of water. Twenty minutes after the initial dose, continuous infusion of 0.5 per cent procaine was started into the subarachnoid space at the rate of 5 drops per minute. There was no significant change in pulse rate or blood pressure. The spinal fluid pressure was gradually elevated from 220 mm. of water to 330 mm. of water during analgesia, without causing any symptoms. The patient was comfortable during the operation, which lasted two hours and forty minutes, and in the course of which 300 mg. of procaine was used. The postoperative course was uneventful.

COMMENT

A method for administering subarachnoid analgesia by the drop method has been described. We believe it offers the following advantages:

1. The concentration of the anesthetic drug in the subarachnoid space and the level of analgesia can be kept constant, avoiding those fluctuations which necessarily occur with any method involving fractional doses. Undesirable side effects are thus reduced to a minimum.
2. Complete asepsis can be maintained at all times, since the system can be kept closed.
3. There is reason to believe that the total dose of procaine is smaller for a given procedure than is the case with a fractional method.

REFERENCES

1. Lemmon, W. T.: A Method for Continuous Spinal Anesthesia, Preliminary Report, Ann. Surg. 3: 141–144 (Jan.) 1940.
2. Koster, H.; Shapiro, A., and Warshaw, R.: Concentration of Procaine in the Cerebrospinal Fluid of the Human Being after Subarachnoid Injection, Arch. Surg. 39: 97–103 (July) 1939.

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