CONTINUOUS SPINAL ANESTHESIA: A MODIFICATION OF THE URETERAL CATHETER TECHNIC

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The technic of continuous spinal anesthesia in which a ureteral catheter is used has been presented by Tuohy (1). He used a number 4 ureteral catheter threaded through a special 15-gauge spinal needle. The needle was inserted in the second, third, or fourth lumbar interspace, and the catheter threaded up the spinal canal, 4 to 7 cm. The anesthetic solution was contained in a 10 cc. Luer-Lok syringe, and injected as in the malleable needle technic. The use of the catheter allows the patient to move, or be moved, freely, without danger of the catheter being dislodged. It also obviates the use of a special mattress.

A modification of the Tuohy technic was made by the addition of a mixing device with three Luer-Lok syringes (2) (fig. 1). This device makes it possible to obtain a high level of anesthesia with a small dose of anesthetic agent.

In this paper a further modification of the ureteral catheter technic of continuous spinal anesthesia is described. The catheter is threaded up the spinal canal so that the tip lies beside the spinal cord. This position makes it possible to produce a segmental anesthesia. Because of the greater dilution of the anesthetic solution, the individual dose is small, and the total dose, therefore, minimal. The smallest dose used was 80 mg. of Intracaine to produce five hours of anesthesia. One of these operations was an exploration of the sciatic nerve for removal of tantalum foil, in which there was continuous anesthesia with no supplemental agent, the average dose of Intracaine per hour being 16 mg. The use of very small doses permits a more rapid return of function.

Equipment and Technic

To understand the technic, the equipment needed should be listed and illustrated (fig. 1).
One medicine glass contains merthiolate for the skin. The other two are filled with physiologic saline solution. A reservoir 30 cc. syringe is filled and connected to the mixing device to prevent subsequent interchange of syringes. The 500 mg. of Intracaine is mixed with 50 cc. of physiologic saline solution, and 30 cc. of this solution is aspirated into the other large syringe. This syringe, containing the anesthetic mixture, is connected to the mixing device, and the air is expelled from the tubing. The 10 cc. syringe is connected to the middle arm of the mixing device. The ephedrine and 1 per cent Intracaine are mixed in the 2 cc. syringe for infiltration of skin and muscle.

Since it is necessary to have the cooperation of the patient during the onset of anesthesia to distinguish between sharp and dull skin
sensation, premedication should be sufficient to allay apprehension without producing excess depression.

When doing the lumbar puncture, the tip of the 15-gauge needle should be angled cephalad as far as possible to facilitate introduction of the ureteral catheter into the subarachnoid space. It should be pointed out that once the ureteral catheter has been introduced past the end of the needle, any withdrawal of the catheter may "shear off" a portion of it into the spinal canal. Occasionally some difficulty is experienced in inducing the catheter to advance up the spinal canal.

Fig. 2. Diagram illustrating that the needle should be at as great an angle as possible with the skin, and the catheter should not be pulled back after it has reached the end of the needle.

This may be overcome by more cephalad angling of the needle by means of slight pressure on the needle at the skin level. If increased angling is not sufficient, another technic may be employed. The needle is very slowly withdrawn with one hand and the catheter advanced with the other. If any sensation of resistance can be felt as the catheter is advanced up the spinal canal, further advancement of the catheter is not advisable, as it may curl on itself and start down the canal again (fig. 4). We have never had any indication of immediate or delayed cord trauma.

After the catheter is connected to the mixing device, an initial test dose of 2 cc. of anesthetic solution containing 10 mg. of Intracaine is injected. This first dose may produce only hypesthesia, but frequently complete anesthesia may result. If the level of anesthesia is not high enough, a greater dilution of anesthetic solution can be used until the anesthesia is at the desired level. When the catheter is correctly placed, 2 cc. of anesthetic solution is adequate to achieve a satisfactory level of anesthesia. Occasionally, owing to insertion of the catheter too far cephalad, resulting segmental anesthesia may be present above the operative site. The catheter can be pulled out slightly and a greater
Fig. 3. Catheter in L2–L3 interspace up the canal 14 cm. with the tip at the bottom of D11. 10 mg. Intraeaine in 2 cc. volume gave absolute anesthesia from D9–L5.

Fig. 4. Case where an old catheter was used and advance continued after resistance was met.
volume of anesthetic agent used to diffuse the mixture caudad, as well as cephalad.

**Positioning the Catheter.**—A series of roentgenograms was taken with the catheter in the canal, and a correlation was made between the area of skin anesthesia and position of the tip of the catheter in relation to the spinal column. It was hoped that a predetermined placement of the catheter would result in a uniform area of anesthesia, but this was not borne out in actual practice. Because of variations from patient to patient, we have developed the following routine in placing the catheter in the spinal canal. For patients in whom surgical procedures are to be done in the region of the rectum, as in abdominoperineal resection, the interspace between the fourth and fifth lumbar vertebrae is utilized for the spinal puncture, and the catheter is inserted 5 cm. cephalad in the spinal canal. When operative procedures are to be done on the lower extremities, the catheter is introduced in the interspace between the third and fourth lumbar vertebrae, and advanced cephalad 5 cm. Operative procedures in the upper part of the abdomen require a high level of anesthesia, so the interspace between the second and third lumbar vertebrae is used, and the catheter is inserted 10 cm. cephalad in the spinal canal. No interspace above that between the second and third lumbar vertebrae is used for insertion of the needle because of the danger of traumatizing the spinal cord.

Spinal anesthesia using the catheter technic was performed on one patient for diagnostic purposes. The interspace between the first and second lumbar vertebrae was used, and the catheter was inserted 20 cm. past the tip of the needle. Roentgenograms showed the tip of the catheter to be at the level of the inferior border of the eighth dorsal spine, and at the inferior border of the ninth dorsal vertebral body. Intracaine, 10 mg. in 2 cc. of physiological saline solution, was injected, and segmental anesthesia was produced from the first to the twelfth thoracic segment. The patient had, apparently, adequate motion of the intercostal muscles. We do not recommend the repetition of such a procedure either for diagnosis or for operation, but for those who use spinal anesthesia for operative procedures in the thorax, this technic may afford a better control of the patient.

**Types of Cases.**—We have used this form of anesthesia for most types of operative procedures below the diaphragm: cholecystectomy, gastric resection, bowel resection, abdominoperineal resection splenectomy, hysterectomy, cesarean section, nephrectomy, sciatic and tibial neurorrhaphy, bone graft, colporrhaphy, excision of ruptured intervertebral disk, and ligation of arteriovenous aneurysm.

It is interesting to note the operative course of a patient undergoing a splenectomy following traumatic rupture of that organ. When the patient was brought to the operating room, the ureteral catheter was inserted, and the patient prepared and draped. Administration of blood was started and anesthesia begun. The total dose of Intra-
caine for the establishment and maintenance of anesthesia was 50 mg. for an operating time of one hour and ten minutes. The patient's blood pressure was 80 mm. systolic and 60 mm. diastolic, and the pulse rate was 140 per minute at the beginning of the procedure. At the end of the operation, the blood pressure was 110 mm. systolic, and 60 mm. distolic and the pulse rate 100 per minute. The patient received 1,500 cc. of blood during the procedure.

**Dosage.**—As has been mentioned, a dose of 10 mg. of Intracaine per injection is routinely used. In the exceptional patient, it may be necessary to use 20 mg. per injection. The duration of anesthesia from a single dose varies between fifteen and forty-five minutes. Since the small dose and high catheter technic has been used, the average hourly dose of one of the authors (C. C. W.) is 30 mg.

**Discussion.**—The principal disadvantage to the ureteral catheter technic is the high incidence of spinal headache. We found, by careful checking, that 30 per cent of the patients had a typical spinal headache. The severity ranged from a few hours of slight distress to extreme cephalalgia lasting from one to two weeks. The number of patients who were bitter about their headaches was small. We used as criteria for spinal headache, the onset or exaggeration of headache on raising up, or sitting, and relief of the pain by lying down. One must choose between the disadvantage of spinal headaches and the advantages of maximum relaxation, low dosage of anesthetic, early return of function, low incidence of nausea and vomiting, and, in the case of cesarean section, the ability to afford anesthesia and relaxation with the least danger to the mother and baby. The routine we have established to care for the patients with headache is as follows: 100 mg. of nicotinic acid in 10 cc. solution is injected intravenously in less than a minute (3); 1,000 cc. of 5 per cent glucose in distilled water is connected to the same needle and given as rapidly as the patient's cardiac status will allow. The bed is put in shock position for twenty-four hours, and the patient is advised to lie flat for the full twenty-four hours. He is ordered to drink while awake one glass of water, or fluids, each hour. After the twenty-four hours, he is allowed to resume normal activity. Although a statistical analysis has not been made, it was our impression that this procedure was successful in most of the patients with spinal headaches.

Failure to achieve satisfactory anesthesia may be the result of several factors, although improper placing of the catheter seemed to be the most common. The catheter may advance caudad (fig. 5) rather than cephalad in the spinal canal, particularly if the spinal needle is not inserted at an acute angle with the back. There is also the possibility that the catheter may curl back on itself if an obstruction is met in the spinal canal. This is more likely to occur with a catheter that has become too pliable from repeated autoclaving. The area of anesthesia produced by Intracaine, 10 mg. in 2 cc. of solution, varies con-
siderably. In some patients four or five dermatomes are involved, whereas in one patient the anesthesia from such a dose extended from the perineal region to the nipple line. We have found that in the patient who has a small area of anesthesia after the initial injection the level of that anesthesia is raised with difficulty by the use of a greater volume of anesthetic solution. On some patients in whom the anesthesia was not high enough, it was necessary to use as much as 10 or 15 cc. of anesthetic solution to raise the level of anesthesia to the desired dermatome.

FIG. 5. Case where catheter went down the canal and anesthesia could not be established.

Frequently the patient experiences considerable discomfort during manipulation of abdominal viscera. This discomfort is obviated by almost routine administration of pentothal when the patient is undergoing a laparotomy. The amount of pentothal required during even the longest procedure is small. Only enough is used to produce a light sleep, and respiratory depression is usually not marked enough to require administration of oxygen.

We have used both procaine and Intracaine for continuous spinal anesthesia. In our hands, Intracaine has produced more uniformly satisfactory results. For this reason, as well as because of its low toxicity, we now prefer to use Intracaine for continuous spinal anesthesia.

The possibility is always present that a portion of the catheter may break off, or be cut off, in the tissues of the patient, although we have
not experienced such a misfortune. A radioopaque catheter is always used so that its position or parts of the catheter may be located by a roentgenogram if necessary. Catheters are discarded when they become soft and discolored, which occurs after they have been autoclaved five to ten times. The catheter is sterilized by autoclaving it at 15 pounds pressure for fifteen minutes.

SUMMARY

A technic of continuous spinal anesthesia using a ureteral catheter is presented.

A mixing device used with this method is mentioned.

A technic is described for placement of the ureteral catheter in the spinal canal to obtain various levels of anesthesia.

The technics described are discussed.

REFERENCES


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Members of the U. S. Naval Reserve must transfer to the Army Reserve before being called to active duty. Families of married applicants will be allowed to accompany them to the place of duty. Suitable quarters are available. Families of individuals who do not declare their desire to serve for periods to exceed one year cannot be transported at Government expense.

3. Eligible physicians are invited to communicate with The Surgeon General, U. S. Army, Washington 25, D. C., for further information. Inquiries should include the following information:

a. Name
b. Address
c. Age
d. Nationality
e. Marital status
f. Dependents with age of each
g. Medical school and graduation date
h. Internship and date
i. Details of graduate training
j. Specialty and geographic location desired
k. Contemplated length of service
l. Details of prior military service