

CONTINUOUS SEGMENTAL PERIDURAL ANESTHESIA *

M. JACK FRUMIN, M.D., AND HERMAN SCHWARTZ, M.D.†

New York, New York

Received for publication January 17, 1952

IN an endeavor to assess the advantages in producing regional anesthesia limited to the operative field and to avoid puncturing the dura and injecting drugs into the subarachnoid space, a series of continuous segmental peridural blocks was performed. A catheter was passed to a desired level within the peridural space from a safe and easily accessible site—the caudal canal or a lumbar intervertebral space. The anesthetic agent was then introduced through the catheter.

METHODS

A 3½ French radiopaque, graduated, round nosed ureteral catheter ‡ with a stilet was used. The smooth closed tip maintained a fixed relationship between the catheter and the stilet and facilitated the passage of the catheter-stilet unit. The anesthetic agent was discharged from two foramina 1 cm. from the tip.

The patient was draped and prepared in the prone position. Dogliotti's technic (1) was used when the lumbar peridural space was entered with a 10 cm., 16 gauge Huber tip needle. The resistance encountered to the injection of fluid and to passage of the needle while the tip traversed the ligamentum flavum ceased suddenly when the peridural space was entered. The opening at the needle tip was then directed cephalad. The catheter with a stilet 0.011 inch (0.027 cm.) in diameter was inserted and emerged at a right angle from the needle tip without puncturing the dura. It was usually sufficiently rigid to pass to the desired vertebral level without curling. If resistance was encountered, excessive force was not applied. The needle was withdrawn over the stationary stiff catheter-stilet unit which then could be withdrawn and advanced alternately with safety in order to overcome tissue resistance.

When the caudal approach was used, an ordinary 15 gauge needle, modified by "campering" or grinding down the inner edge of the barrel at the tip (fig. 1), was inserted into the sacral canal using the conven-

* Supported in part by a grant from Eli Lilly and Company.

† From the Department of Anesthesiology, College of Physicians and Surgeons, Columbia University, and the Anesthesiology Service, Presbyterian Hospital, New York 32, New York.

‡ Bard Co., Summit, New Jersey.

tional technic. The catheter with a thicker stilet, 0.015 inch (0.037 cm.) in diameter, was then advanced cephalad and in some patients as much as 35 cm. to the mid-thoracic region. If the catheter encountered resistance when such a needle was used, the catheter could be withdrawn slightly since the sharp inner edge was absent and the long axes of the catheter and needle were parallel. Usually, however, the needle was withdrawn over the catheter and the unit manipulated as described previously.

When the catheter tip reached the desired level and the stilet was withdrawn, a catheter adapter ‡ was attached and aspiration attempted with a dry syringe to distinguish between a subarachnoid and a peridural location of the catheter tip. A syringe containing anesthetic

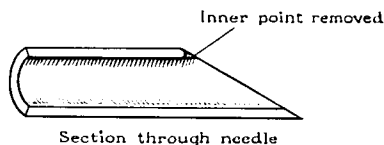


Fig. 1. The campered tip of the needle used in the caudal canal.

solution was then attached, establishing a closed system. The catheter was fixed securely to the patient with adhesive tape and the patient placed supine. Three milliliters of 1.5 per cent metycaine solution (45 mg.) was administered as a further test for an inadvertent subarachnoid insertion of the catheter. If an intrathecal block was not produced, then peridural anesthesia was instituted with approximately 300 mg. of drug. The initial doses were smaller than with the single dose technic since more drug could be given later if necessary. The upper and lower boundaries of cutaneous analgesia were determined frequently by pinprick. Hypesthesia usually extended beyond the anesthetized area for two or more dermatome segments. The anesthesia was characteristically slow in onset.

RESULTS

The analysis was limited to the 128 blocks in which the catheter was advanced more than 5 cm. in the peridural space. One-fourth of the subjects received no premedication and the others usually received morphine or meperidine and scopolamine subcutaneously two hours before operation. The depressant action had usually worn off when the operation had started. The median length of operation was 1.7 hours, ranging from thirty minutes to over five hours. The types of operation performed are listed in table 1.

Metycaine and xylocaine (ω -diethylamino-2,6 diethylacetanalide) were the agents usually employed (table 2). Anesthesia appeared ap-

TABLE 1
TYPE OF OPERATION

Upper Abdominal		
Cholecystectomy, common duct exploration, etc.	20	
Gastrectomy	4	
Pyloroplasty	2	
Other	2	28
Lower Abdominal		
Colectomy	6	
Colostomy, jejunostomy, ileostomy	5	
Appendectomy	3	
Abdominoperineal resection	3	
Cesarean section	8	
Other	3	28
Extraperitoneal		
Herniorrhaphy, inguinal	30	
Herniorrhaphy, ventral	6	
Cystostomy, prostatectomy, etc.	7	
Nephrectomy, nephrolithotomy	5	
Other	3	51
Miscellaneous		
Hip nailing	2	
Arthrotomy of knee	2	
Popliteal embolectomy	1	
Mammoplasty	1	
Vaginal deliveries	13	
Therapeutic blocks	2	21
Total		128

proximately twenty minutes after the initial dose. The addition of epinephrine to the anesthetic solution delayed the onset another twenty minutes and prolonged the duration of action of each dose of drug. Segmental blocks limited to the surgical field could be achieved.

The dura was inadvertently punctured by the catheter-stilet unit in 9 cases and successful segmental spinal blocks were carried out in all but one instance. The lumbar or lower thoracic interspinous approach was used in 85 patients while 34 cases were completed by way of the caudal canal (table 3). In 18 instances the caudal route was abandoned in favor of the interspinous approach because of obstruction to the passage of the catheter.

A case was considered clinically successful if (a) no supplemental

TABLE 2
ANESTHETIC SOLUTIONS

Anesthetic Agent, Per Cent	Without Epinephrine	With Epinephrine
Metycaine, 1.5	39	7
Metycaine, 2	48	0
Xylocaine, 1	10	3
Xylocaine, 2	7	10
Miscellaneous	4	0
	108	20

medication was needed or (b) the administration of other agents allayed fear or restlessness without producing surgical anesthesia. Exclusive of the inadvertent punctures of the dura, 94 cases or 79 per cent of all blocks attempted were successful clinically. Eighty-two per cent of the interspinous group and 71 per cent of the caudal group fell into this category (table 3).

Certain aspects of the technic were investigated radiologically in 52 cases. The interspinous level at which the space was entered was

TABLE 3
TYPE OF APPROACH

	Total Number	Successful	
		Number	Per Cent
Blocks attempted	128		
Peridural anesthesia	119	94	79
Interspinous approach	85	70	82
Caudal approach	34	24	71
Inadvertent spinal anesthesia	9		

estimated correctly to within one segment in 90 per cent of the patients. The vertebral level of the catheter tip could usually be predicted to within two segments, using measurements of the bony landmarks. The midpoint of the zone of cutaneous anesthesia corresponded to within two segments of the vertebral level of the catheter tip in 39 of 46 subjects. It appears from these findings that clinical measurements are an adequate guide for achieving the desired minimal segmental block.

COMPLICATIONS

Twice catheters were sheared off in the caudal canal and were removed by trephination of the dorsal table of the sacrum. No neurologic sequelae appeared in these patients during an eighteen month observation period.

Transient radiculitis with paresthesias occurred in 3 patients and was followed in one case by motor involvement, lasting a few months.

In three instances the catheter was occluded with clotted blood, presumably from small peridural hemorrhages.

One subject received a continuous lumbar block for the removal of a femoral embolus and for the treatment of postoperative arterial spasm. A hematoma formed in the peridural space during concurrent anticoagulant therapy and prolonged loss of function of the lower part of the body resulted from compression of the cord. This complication might be considered the result jointly of anticoagulation therapy and the anesthetic technic. The presence of a bleeding tendency makes this and similar anesthetic methods inadvisable.

The single death in the series occurred in a patient who was desperately ill with postoperative anuria, marked overhydration and acute congestive failure. Orthopnea, cyanosis and hypotension were present.

In order to relieve the anuria by altering the renal circulation (2), a lower thoracic peridural block with 20 milliliters of 1.5 per cent mety-caine was instituted. After the drug was administered, the arterial pressure fell rapidly and the patient died within twenty minutes. A dural puncture was not detected at necropsy. The sympathetic de-nervation, the systemic toxicity of the agent and the additional respira-

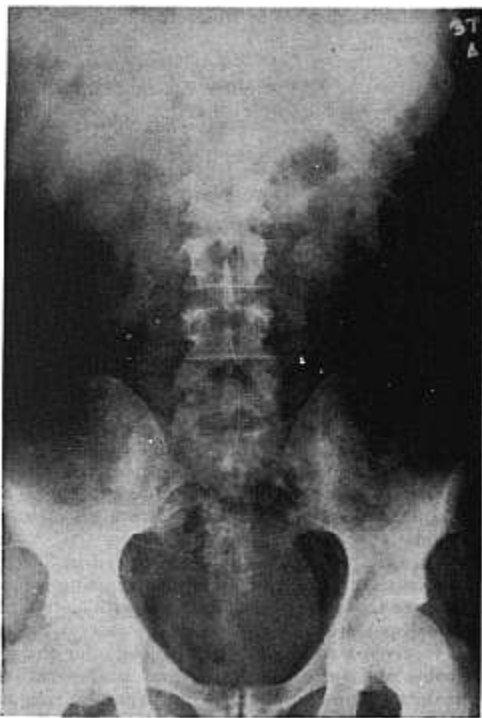


FIG. 2a.

tory difficulty from intercostal paralysis probably combined to cause the fatal outcome.

It was hoped that the hypotension would be less severe and less frequent if fewer sympathetic fibers were blocked than in the more conventional nonsegmental spinal block. However, this was not borne out when a comparison was made with the results in 500 cases of unselected

ordinary spinal anesthesia reported by Dripps and Deming (3). No vasopressor drugs were given prophylactically in either series. The hypotension was not treated in the spinal series regardless of its severity, although ephedrine was given to some subjects in this series. The incidence of hypotension greater than 25 per cent was 71 per cent in



FIG. 2b.

FIG. 2. (a) Anteroposterior projection. (b) Lateral projection. Roentgenograms of the vertebral column with a catheter inserted into the caudal canal and advanced to the level of the twelfth thoracic vertebra where spina bifida occulta is noted.

this series and 65 per cent in the group given spinal anesthesia. The difference is not statistically significant ($p > 5$ per cent).

The typical postspinal headache was noted only once and occurred when the dura was inadvertently punctured by the Huber tip needle.

An interesting complication of this technic was the aspiration of 3 milliliters of clear, watery fluid from a catheter which had been advanced from the caudal canal to the twelfth thoracic vertebral level. It was assumed that the dural sac had been entered, but 50 mg. of metylocaine did not produce anesthesia. A conventional segmental peridural block involving eight dermatome segments appeared after 375 mg. had been given. This apparent paradox was resolved when spina bifida occulta was diagnosed by roentgenologic examination (fig. 2). The fluid was probably aspirated from the meningocele which frequently accompanies this condition and not from the main body of spinal fluid.

DISCUSSION

The frequency of success suggests that this technic has practical clinical value when the rigid criteria employed and the variety of operations performed are considered. The incidence of failures could probably be reduced with the experience gained in this series. Insertion of the needle through which the catheter was advanced was safest when performed in the lumbar or caudal areas and was simpler technically in the former area because of the regularity of the bony landmarks.

The ability to advance the rigid catheter-stilet unit more than 5 cm. demonstrated the validity of considering the peridural space as a fascial plane and exploiting its longitudinal property with a catheter. Curbelo (4), Cleland (5) and others have advanced catheters in this space but the passage for distances exceeding 5 cm. without curling requires the stiff catheter-stilet unit described in the preliminary report (6) of this series. Obstruction to passage of the catheter became more frequent as attempts were made to pass it for distances greater than 20 cm. The lumbar approach was more convenient when intra-abdominal operations were contemplated since the catheter traversed a shorter path.

The chief advantages of this technic are the absence of troublesome neurologic sequelae such as headache, arachnoiditis, dysfunction of the urinary bladder and, with careful technic radiculitis. The extent of anesthesia was easily controlled. Levels higher than planned were rarely attained because gross mixing with spinal fluid did not occur. The catheter provided a reliable route for testing for subarachnoid location and for repeated small fractional maintenance doses which resulted in the use of smaller total amounts of anesthetic agent. The chief disadvantage is the technical facility which the use of the catheter-stilet unit demands. The procedure is time-consuming because the bony landmarks must be measured precisely and because of the slow onset of the block. The patient should be awake and cooperative since the upper and lower levels must be determined frequently to maintain minimal segmental denervation. The catheter can be sheared off but this danger is minimized by using the campered needle with the caudal approach and by the simple precaution of not withdrawing the catheter

through the Huber tip needle. The incidence of hypotension was comparable to that with the spinal technic.

SUMMARY

A series of 128 continuous segmental peridural blocks was performed by inserting a ureteral catheter with stilet into the peridural space and passing it to a desired level. The frequency of complications was low. Hypotension occurred as frequently as with spinal anesthesia but postanesthetic headache, arachnoiditis or serious neurologic sequelae were rarely encountered. Nine spinal anesthetics were produced inadvertently.

Roentgenograms of 52 subjects indicated that clinical measurements serve as an adequate guide for advancing the catheter tip to a desired level. The catheter tip was usually located near the midpoint of the zone of cutaneous anesthesia.

The frequency of clinically successful blocks was 79 per cent, which suggests that the technic has practical clinical value.

REFERENCES

1. Dogliotti, A. M.: *Anesthesia: Narcosis, Local, Regional, Spinal*, Chicago, S. B. Debour, 1939, p. 540.
2. Trueta, J.; Barclay, A. E.; Franklin, K. J.; Daniel, P. M., and Prichard, M. M. L.: *Studies of the Renal Circulation*, Oxford, Blackwell, 1947.
3. Dripps, R. D., and Deming, M. V.: Evaluation of Certain Drugs Used to Maintain Blood Pressure during Spinal Anesthesia, Comparison of Ephedrine, Paredrine Pitressin-ephedrine and Methedrine in 2500 Cases, *Surg., Gynec. & Obst.* **83**: 312-322 (Sept.) 1946.
4. Curbelo, M. M.: Continuous Peridural Segmental Anesthesia by Means of Ureteral Catheter, *Anesth. & Analg.* **28**: 13-22 (Jan.-Feb.) 1949.
5. Cleland, J. G. P.: Continuous Peridural and Caudal Analgesia in Surgery and Early Ambulation, *Northwest Med.* **48**: 26-30 (Jan.) 1949.
6. Frumin, M. J., and Appgar, V.: Continuous Segmental Epidural Anesthesia with Catheter via Caudal Canal; Preliminary Note, *Anesthesiology* **10**: 733-735 (Nov.) 1949.