# THE SPREAD OF LIDOCAINE AND I-131 SOLUTION IN THE EPIDURAL SPACE

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ONE of the difficulties associated with the management of epidural anesthesia is the unpredicted ability of the drug to spread in the epidural space. There are conflicting ideas regarding the factors which influence the spread of the solutions injected into this space. Our study attempts to determine the influence of several of these factors including speed of injection, position of patient and age of patient, using I-131 as a tracer.

## METHOD

A mixture of I-131 and 2 per cent lidocaine was injected into the epidural spaces of 84 patients before operation. Twenty milliliters of the solution was injected because we usually use 20 ml. of 2 per cent lidocaine for single injection epidural anesthesia. The thoracolumbar region, about second to third lumbar intervertebral space was chosen for insertion of the needle. The solution was injected within a period of 20 seconds to two minutes with the patient in the lateral position. The spread of the solution was determined by the use of the Geiger-Mueller counter along the course of the spinal column as shown in figures 1 and 2. The distribution of the solution could be accurately correlated with the level of sensory anesthesia as determined by pin prick.

FIG. 1. Position of the patient and the counter.

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## RESULTS

If the value of count per minute of $\gamma$-rays is plotted on the ordinate and the distance from the site of the injection on the abscissa, four major patterns of distribution of I-131 become apparent. They are symmetrical, with a tendency toward caudad, cephalad, and cephalad distribution (fig. 3A, B, C and D).

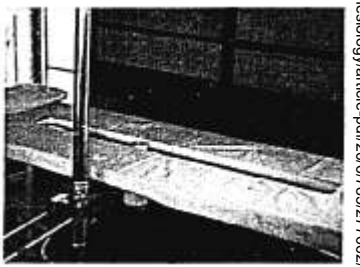

FIG. 2. Position of the counter and the table.

In most of the cases the distribution was cephalad or symmetrical (table 1). There was no remarkable difference between slow and rapid injection of the solution (table 2).

If the patient data were divided into two age groups, less than 49 years of age and more than 50 years of age, we noticed a greater tendency of the solution to spread cephalad in the older group (table 3). Typical cases are represented in figures 3A, B, C and D. In figure 3C the normal tendency of distribution is shown, that is cephalad tendency. As is shown in figures 3A, B, C and D the concentration of the solution in the epidural space diminished rapidly as the counter moved away from the site of injection. The correlation between analgesia and the concentration of the solution is apparent from figures 3A, B, C and D.

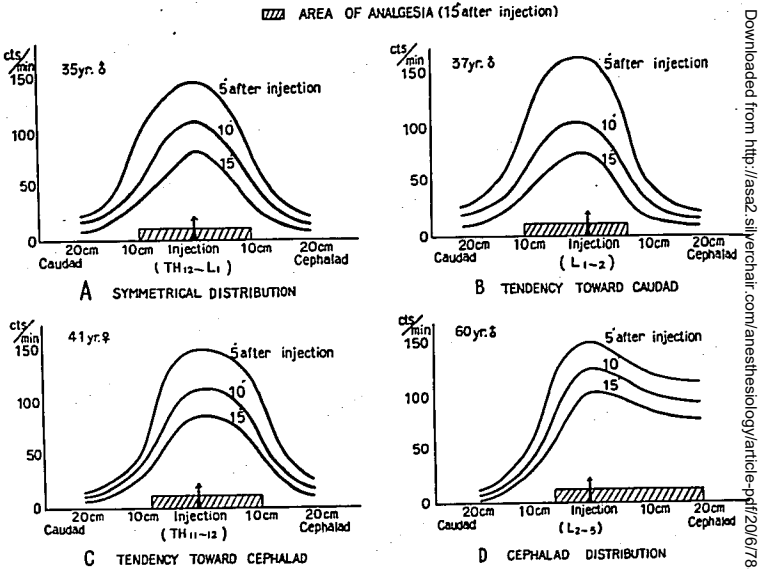


FIG. 3. Pattern of spread of lidocaine and I-131 solution in the epidural space.

*Effect of Position of the Patient.* In 40 cases the solution was injected with the patient in the lateral position, in 5 cases with the patient in the Trendelenburg position, in 17 cases with the patient in Fowler's position and in 5 cases with the patient sitting. The distribution of the patterns of spread of the solution is shown in table 1. In the Trendelenburg position the solution tended to spread symmetrically or cephalad but the tendency for it to move cephalad was not as remarkable as might have been expected. In Fowler's position the solution spread more symmetrically than in the lateral position, and there was a tendency to shift the distribution caudad. In the sitting position the solution spread rather cephalad and there was no tendency to caudad distribution as might have been expected. Upon change of position of the patient (sitting to lateral in 3 cases, Fowler's to Trendelenburg's in 3 cases, and lateral to Trendelenburg's in 1 case) there was no change of distribution of spread.

## DISCUSSION

We believe this to be a reliable method to determine the spread of solutions in the epidural space. The epidural space is closed and the spread of solutions must be limited by its confines. If a solution is injected into the lumbothoracic region the spread is limited caudad and has a tendency to spread rather easily cephalad. Usually the highest concentration of the solution is at the site of the injection and the concentration in the more remote areas is less. The area of analgesia of the skin follows the distribution of the solution. The cephalad distribution of the solution in the patient over 50 years of age is interesting. We believe this is due to the fact that in this age group the escape routes of the solution are limited and the solution spreads more easily cephalad. Solutions do not move readily in the epidural space because the epidural space contains much fatty tissue. This is also the reason that change of the position

after injection of the solution has so little effect on redistribution of the local anesthetic. The solution in the epidural space is absorbed rapidly and disappears rapidly from the epidural space.

The cephalad spread of the solution in the sitting position suggests the importance of the hydrostatic effect of the spinal fluid on the spread of the solution in the epidural space. In the sitting position the pressure of the spinal fluid occludes the epidural space in the lumbosacral area and the solution spreads cephalad.

TABLE 1

PATTERN OF SPREAD OF LIDOCAINE AND I-131 SOLUTION IN THE EPIDURAL SPACE IN RELATION TO POSITION OF PATIENTS

| Pattern of Spread (patients less than 49 y.) | Position of Patients | | | | |
|---|---|---|---|---|---|
| | Number of cases | | | | |
| | Lateral | Trendelenburg | Fowler | Sitting | Total |
| Symmetrical distribution (fig. 3A) | 6 | 3 | 9 | 0 | 18 |
| Tendency toward caudad (fig. 3B) | 9 | 0 | 2 | 0 | 11 |
| Tendency toward cephalad (fig. 3C) | 24 | 0 | 6 | 5 | 35 |
| Cephalad Distribution (fig. 3D) | 1 | 2 | 0 | 0 | 3 |
| Total | 40 | 5 | 17 | 5 | 67 |

## SUMMARY

The spread of 2 per cent lidocaine and I-131 in the epidural space has been investigated in 84 patients prior to operation. Spread of the solution has been determined by the use of the Geiger-Mueller counter. In the average patient 20 ml. of this solution resulted in a spread 10 cm. caudad and 15–20 cm. cephalad. The peak of concentration was always at the site of injection. Speed of injection did not affect the spread of solution. Four patterns were apparent and have been presented and discussed. Alteration of position of the patient during or following injection did not significantly affect the results. In patients of over 50 years of age the solution spread more cephalad than in young adults.

TABLE 2

PATTERN OF SPREAD OF LIDOCAINE AND I-131 SOLUTION IN RELATION TO SPEED OF INJECTION

| Pattern of Spread (patients less than 49 y. of age) | Speed of Injection | | | |
|---|---|---|---|---|
| | Number of Cases | | | |
| | 2 Minutes | One Minute | 20 to 30 Seconds | Total |
| Symmetrical distribution (fig. 3A) | 1 | 0 | 5 | 6 |
| Tendency toward caudad (fig. 3B) | 2 | 4 | 3 | 9 |
| Tendency toward cephalad (fig. 3C) | 2 | 10 | 12 | 24 |
| Cephalad Distribution (fig. 3D) | 0 | 1 | 0 | 1 |
| Total | 5 | 15 | 20 | 40 |

## REFERENCES

1. Adriani, J.: Techniques and Procedures of Anesthesia. Springfield, Illinois, Charles C Thomas, Publisher, 1956.
2. Frumin, M. J., Schwartz, H., Burns, J. J., Brodie, B. B., and Papper, E. M.: Appearance of procaine in spinal fluid during peridural block in man, J. Pharmacol. & Exper. Therap. 109: 102, 1953.

TABLE 3

PATTERN OF SPREAD IN RELATION TO AGE OF PATIENTS

| Pattern of Spread | Number of Cases | | |
|---|---|---|---|
| | Less Than 49 y. | More Than 50 y. | Total |
| Symmetrical distribution (fig. 3A) | 6 | 1 | 7 |
| Tendency toward caudad (fig. 3B) | 9 | 2 | 11 |
| Tendency toward cephalad (fig. 3C) | 24 | 0 | 24 |
| Cephalad Distribution (fig. 3D) | 1 | 7 | 8 |
| Total | 40 | 10 | 50 |

3. Frumin, M. J., Schwartz, H., Burns, J. J., Brodie, B. B., and Papper, E. M.: Sites of sensory blockade during segmental spinal and segmental peridural anesthesia in man, ANESTHESIOLOGY 14: 576, 1953.
4. Bonica, J. J., Backup, P. H., Anderson, C. E., Hadfield, D., Crepps, W. F., and Monk, B. F.: Peridural block: analysis of 3,637 cases and a review, ANESTHESIOLOGY 18: 723, 1957.
5. Moore, D. C., Brindenbaugh, L. D., Van Ackeren, E. D., Belde, F. B., and Cole, F. V.: Spread of radiopaque solutions in epidural space of the human adult corpse, ANESTHESIOLOGY 19: 377, 1958.
6. Crawford, O. B., Ottosen, P., Buckingham, W. W., and Brasher, C. A.: Peridural anesthesia in thoracic surgery: reviews of 67 cases, ANESTHESIOLOGY 12: 73, 1951.
7. Wagner, R. S.: Needle for single-dose peridural anesthesia, Anesth. & Analg. 36: 31, 1957.
8. Pitkin, G. P.: Conduction Anesthesia. Edited by Hingson, R. A., and Southworth, J. L. Philadelphia, J. B. Lippincott Company, 1954.
9. Bromage, R. R.: Spinal Epidural Analgesia. Edinburgh, E. & S. Livingstone, Ltd., 1954.
10. Kitahara, T., Kuri, S., and Yoshida, J.: Spread of drugs used for spinal anesthesia, ANESTHESIOLOGY 17: 205, 1956.
11. Evans, F. T.: Modern Practice in Anesthesia. London, Butterworth & Co. Ltd., 1949.

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**ANESTHESIA FOR PYLOROMYOTOMY** Although local anesthesia may be indicated in the rare case of pyloric stenosis occurring in a premature infant, general anesthesia is usually preferred. Prior to surgery, a naso-gastric tube is passed and left in place to aspirate stomach contents. For premedication, atropine in doses of 1/600 to 1/1,000 of a grain is preferred. Precautions must be taken to prevent lowering of the infant's body temperature, especially in air-conditioned operating rooms. During operation, the room should be warmed to at least 75 F., and the infant transported through corridors in a warm incubator. Anesthesia is induced with cyclopropane and oxygen, using an infant circle machine. Some assistance to respiration is given to overcome equipment resistance, but hyperventilation must be avoided since it would exaggerate any residual alkalosis and might lead to tetany. An endotracheal tube is used frequently to assure a clear airway and assist in the removal of secretions. (*Gordon, H., and others: Hypertrophic Pyloric Stenosis, West. J. Surg. 67: 139 (May–June) 1959.*)

**PSYCHIATRIC EVALUATION** Psychiatric evaluation can indicate not only those cases in which operation may be contraindicated from the psychiatric viewpoint, but also those cases in which operation will be beneficial. By and large, psychiatric patients will not have a difficult postoperative course because of emotional decompensation. Patients with diagnoses of schizophrenia and depression, for example, seem to meet the stress of surgical procedures with good ego strength and the general tendency to avoid operations when there has been a history of psychiatric decompensation is not warranted. (*Litin, E. M.: Preoperative Psychiatric Consultation, J. A. M. A. 170: 1369 (July 18) 1959.*)