

SOME CLINICAL OBSERVATIONS ON LUCAINE *

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In November 1940 Hunt and Fosbinder (1) reported on the anesthetic potency of some new piperidine derivatives. The most promising one of the group was B-(2-piperidyl)-ethyl ortho-aminobenzoate hydrochloride, labeled PT 19. The manufacturers, The Maltbie Chemical Company, have adopted the name lucaine for this drug.

This is a report on some clinical observations with the use of this drug in spinal anesthesia.

The first clinical report by Finner and Rovenstine (2) indicated that the drug produced efficient analgesia when administered by the spinal route, and that the duration of effect was about twice that of procaine in doses approximately one-fifth as great. They made the interesting observation that while muscular relaxation was good, there was incomplete paralysis of the muscles innervated by the segments blocked, and that patients were able to move their lower extremities although the level of analgesia might be as high as the third thoracic segment. Further, muscular relaxation remained adequate in the abdominal wall so long as painful traction reflexes set up by manipulations within the peritoneal cavity were blocked by light general narcosis.

It was decided to investigate the drug for spinal anesthesia in procedures outside the peritoneal cavity in which efficient analgesia and relaxation would be needed, and in certain superficial procedures wherein spinal anesthesia without paresis of the extremities might offer an advantage. For that reason its use was confined in a great measure to genito-urinary procedures and in certain superficial operations such as vein ligations, pilonidal cystectomy and skin grafting operations upon the lower extremities. It was thought that if the results were favorable in genito-urinary operations, the drug might have real merit inasmuch as such patients often are considered unfavorable surgical risks. The figures to be presented below appear to bear this out.

This series includes 85 cases studied. A few more cases were omitted from the report because all data relative to evaluating the drug were not present. Fifty-two of the 85 patients were in the ad-

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vanced age group with varying degrees of arteriosclerotic cardiovascular disease with or without hypertension, patients in whom spinal anesthesia is ordinarily avoided.

TECHNIC AND DOSAGE

All spinal taps were done with the patient in the lateral recumbent position between the third and fourth lumbar vertebrae. The skin and subcutaneous tissues over the point of tap were infiltrated with from 1 to 2 cc. of 1 per cent procaine. When a block of the lower abdomen or higher was anticipated, 50 mg. of ephedrine was injected with the preliminary skin wheal. When a block of the perineum or lower extremities was desired, from 0 to 25 mg. of ephedrine was used. The dose of drug chosen was dissolved in enough spinal fluid to make a 1 per cent solution and injected at the rate of 1 cc. per four seconds. It was soon found that 30 mg. proved to be adequate for anesthesia to the ninth thoracic level, although in the early cases 40 mg. had been used; 30 mg. was needed for complete analgesia of the lower extremities. When the site of operation was about the perineum, the dose of lucaine could be decreased to 20 mg. In one instance in which a hypobaric technic was attempted by dissolving 10 mg. of the drug in 5 cc. of distilled water, injected at the fourth lumbar interspace, with the patient immediately placed in the prone position and the table jack-knifed, the analgesia proved to be incomplete, although the sphincter appeared well relaxed. In all other instances the mixture of lucaine in spinal fluid appeared to act like a hyperbaric mixture and the height of analgesia could be controlled during the period immediately after injection by either raising or lowering the head of the table. The standard technic was to put the table into 5 degrees Trendelenburg until the zone of hypalgesia reached the upper limit of the skin incision, and the table was then leveled.

Analgesia was rather slow in reaching a peak effect. Although the surgical procedure could be commenced within ten minutes after the injection of the drug, the height of analgesia determined at the end of twenty-five minutes proved to be from 2 to 3 dermatomes higher.

As previously noted, the length of analgesia was approximately twice that of procaine for comparable levels of analgesia (1).

RELAXATION

Relaxation was excellent in all cases with one exception. In this case both analgesia and relaxation were inadequate for a suprapubic prostatectomy in which 30 mg. of lucaine had been given. In all other cases the relaxation as judged by the surgeon was said to be the same as when other more commonly used drugs were injected. In several instances the surgeon could not distinguish which drug had been given.

All patients were able to move their lower extremities regardless of the height of analgesia. One particular patient undergoing cystoscopy and retrograde pyelography under 30 mg. of lucaine was able to support himself, unassisted, while the table was shifted to an upright position to permit roentgen examination of the kidneys in the standing position. It is of interest to note that in this case, while the patient had a hypertension, with the level of anesthesia at the eleventh or twelfth thoracic segment, there was only a mild fall in blood pressure level during assumption of the upright position and it immediately returned to the previous level when he was placed in the recumbent position. It is common knowledge that after the administration of a spinal anesthetic the relaxation of the abdominal musculature can be determined by watching the upper abdomen. As the anesthetic spreads upward to involve the nerve supply to the abdominal musculature, the epigastrium becomes flattened out or scaphoid. It was decided to determine whether this could be detected when lucaine was employed inasmuch as it appeared to have minimal effects upon motor nerves. Accordingly, one patient was given sodium pentothal until rendered unconscious, turned on the side, and then given 40 mg. of lucaine at the third lumbar interspace. Within five minutes of administration of lucaine the same changes in the upper abdomen were noted as when any other drug for spinal anesthesia was used. Supravaginal hysterectomy and bilateral salpingo-oophorectomy were done with the patient lightly narcotized with pentothal. The abdomen was well relaxed, and at the end of the procedure, one hour after the start, the patient moved from the operating table to the litter herself.

TABLE I
CHANGES AND LEVELS OF ANESTHESIA

Level of Anesthesia	40 Mg.	35 Mg.	30 Mg.	25 Mg.	20 Mg.	10 Mg.
T3	1	1	0	0	0	0
T4	0	0	0	0	0	0
T5	0	0	3	0	0	0
T6	5	0	3	0	0	0
T7	4	0	9	0	1	0
T8	2	1	9	0	1	0
T9	3	0	8	0	0	0
T10	0	0	11	0	1	0
T11	0	0	3	1	3	0
T12	0	0	7	0	5	0
L1	0	0	0	0	0	0
L2	0	0	0	0	0	0
L3	0	0	0	0	0	0
L4	0	0	2	0	0	0
S1	0	0	0	0	0	1
No recorded level	1	0	1	0	0	0
Total	16	2	56	1	11	1

The dosages of the drug used in this series are listed in table 1 with the level of anesthesia attained for the dosages. It is noted that of the 15 recorded cases in which 40 mg. of lucaïne was given, a level of anesthesia to the sixth or seventh thoracic segment was obtained in 9 (56 per cent, the over-all variation being from the third to the ninth thoracic segment. Of the 55 recorded patients receiving 30 mg. of the drug, a level from the seventh to the twelfth thoracic segment was obtained in 47 (85 per cent), the over-all variation being from the fifth thoracic to the fourth lumbar segment. Of the 12 patients receiving 20 to 25 mg. the level was the eleventh or twelfth thoracic segment in 9 (75 per cent), the over-all variation being from the seventh to the twelfth thoracic segment.

COMPLEMENTAL ANESTHESIA

Complemental anesthesia was used in 15 cases. In 9 an 0.5 per cent solution of pentothal was administered by intravenous drip to relieve apprehension; sensory analgesia and motor effects were completely satisfactory. In one case cited previously, 10 mg. of lucaïne in 5 cc. of distilled water produced inadequate analgesia about the anus, although, strangely, the sphincter appeared well relaxed with the administration, by drip, of 0.5 per cent pentothal. In one case, 0.5 per cent pentothal, by drip, and then cyclopropane were needed to relieve pain of traction on the testes during spermatocelectomy although the level of skin analgesia was at the eleventh thoracic segment. In one case traction on the urinary bladder during diverticulectomy produced abdominal pain which was relieved by a small amount of pentothal by intravenous drip. In this latter case, the abdominal muscles which had begun to contract with the onset of pain became well relaxed after the pain was relieved. One patient undergoing suprapubic prostatectomy to whom 30 mg. of lucaïne had been given and anesthesia obtained apparently to the ninth thoracic segment, complained of burning and stinging at the operative site at thirty-five minutes. The anesthesia was satisfactorily completed with 0.5 per cent pentothal given by drip.

VARIATIONS IN BLOOD PRESSURE

It is common knowledge that the tendency for the blood pressure to fall is much less when the height of analgesia is at the ninth thoracic segment or below than when it is above the ninth thoracic. It has been our experience that the blood pressure tends to fall more precipitously when the starting blood pressure is at 160 mm. systolic and 90 mm. diastolic or higher. As already stated, to aid in stabilizing the blood pressure, 50 mg. of ephedrine was given with the procaine in the skin wheal. No further vasopressor drug was used unless the blood pressure fell below 100 mm. systolic and 60 mm. diastolic, at which time small doses of ephedrine (5 mg.) were given intravenously. An al-

ternative technic was the intramuscular injection of a repeat dose of the vasopressor. Either of these technics was necessary in 10 of the 85 cases in which accurate data were available.

Table 3 demonstrates the variations in blood pressure balanced against height of analgesia and dose of vasopressor drug used.

It is worth while noting that of the 33 patients who obtained a level of anesthesia to the ninth thoracic segment or below, and had

TABLE 2

OPERATIONS	
Suprapubic operations on bladder and prostate	37
Operations on spermatic cord	2
Transurethral operations: bladder and prostate	16
Operations on ureter	1
Superficial operations on lower extremities: varicose veins, skin grafts, etc.	9
Inguinal herniorrhaphy	3
Operations on anus, perineum, and pilonidal cysts	7
Operations on the bones of the lower extremities	8
Cholecystectomy	1
Supravaginal hysterectomy	1
Closure colostomy	1
Vaginal hysterectomy	1
Total	87

TABLE 3

Level of Anesthesia above T9	
Blood Pressure above 160/90	
50 Mg. of Ephedrine Vasopressor:	
Rise in blood pressure or no change	4
Fall to 120/80	4
Fall to 100/60	1
Blood Pressure below 160/90	
0-25 Mg. of Ephedrine Vasopressor:	
No change in blood pressure	1
Fall to 120/80	1
50 Mg. of Ephedrine Used:	
Rise in blood pressure or no change	14
Fall to 120/80	1
Fall to 100/60	7
Fall to 80/60	5
Level of Anesthesia at T9 or below	
Blood Pressure above 160/90	
0-25 Mg. of Ephedrine Used:	
No change in blood pressure	2
Fall to 120/80	1
50 Mg. of Ephedrine Used:	
Rise in blood pressure or no change	6
Fall to 120/80	1
Blood Pressure below 160/90	
0-25 Mg. of Ephedrine Used:	
Rise in blood pressure or no change	10
Fall to 100/60	1
50 Mg. of Ephedrine Used:	
Rise in blood pressure or no change	23
Fall to 120/80	1
Fall to 100/60	2

received 50 mg. of ephedrine, 29 had either a rise in blood pressure or no change, while in 2 it fell to 120 mm. systolic and 80 mm. diastolic and in 2 to 100 mm. systolic and 60 mm. diastolic. Of 38 patients who obtained levels of anesthesia above the ninth thoracic, 18 had a rise in blood pressure or no change, 5 had a fall to 120 mm. systolic and 80 mm. diastolic, 8 had a fall to 100 mm. systolic and 60 mm. diastolic and 5 had a fall to 80 mm. systolic and 60 mm. diastolic or below. In no instance in which the starting blood pressure was above 160 mm. systolic and 90 mm. diastolic did the pressure fall below 100 mm. systolic and 60 mm. diastolic, and in 4 cases of the hypertensive group with levels above the ninth thoracic the pressure rose or did not change. Of the 66 cases with starting blood pressure below 160 mm. systolic and 90 mm. diastolic, 48 either had a rise or no change. In 15 of this group of 48, the level of analgesia was above the ninth thoracic segment.

The only other operative complications were nausea and emesis which were present in 2 cases, one of which was associated with a fall in blood pressure.

POSTOPERATIVE COMPLICATIONS

Three patients had mild headache lasting one to two days, and 2 had severe headache lasting four to six days, respectively. This is an incidence of 5.3 per cent, about the same as that encountered with other agents in our experience.

Two patients had mild nausea and emesis lasting one day, and one patient had nausea and emesis lasting two days.

Thrombophlebitis developed after operation in one case. This patient had no fall in blood pressure during operation and the relation of anesthesia to this complication is not established.

One case of mild hiccup on the second postoperative day and one case of severe hiccup lasting five days were noted.

One case of mild focal pulmonary atelectasis occurred after operation, which promptly cleared with conservative therapy.

COMMENT

The most interesting part of this study had to do with the alterations in blood pressure occasioned by the administration of the spinal anesthetic. In an interesting study of the effects of spinal anesthesia on the circulation of normal unoperated man, Smith, Rovenstine, Coldring, Chasis, and Ranges (3) presented evidence in favor of a "post-arteriolar dilatation . . . of capillaries, venules, and veins in consequence of skeletal muscle paralysis" as a chief source of the alterations in circulation, and that paralysis of thoracic and abdominal muscles abets the picture of venous embarrassment. When the drug lucaine is employed, although relaxation is adequate, muscle paresis is not as complete as with other commonly used agents, as evidenced by the ability of these patients to move their lower extremities and bring their

abdominal muscles into action at will. It is thought that the record of blood pressure variations here shown might add some clinical confirmation to this work. When one considers the type of patient who was the chief subject of this series, the record seems even more significant. At the very minimum, the ability of the patient to maintain efficient pulmonary ventilation at all times must be of some aid in stabilizing the circulation from two standpoints: (1) the normal suction effect that full and active respiratory activity exerts upon the large venous channels leading to the heart is maintained and (2) the hypoxia is avoided which may accompany a high spinal block and the attending paralysis of a major portion of intercostal activity.

It is our belief that the failure of this drug to produce complete paresis of muscles might prove disadvantageous in major intraperitoneal operations in which a potent stimulus might upset operating conditions by inducing reflex contraction of the abdominal muscles. In extra-peritoneal procedures this factor does not operate, however, and the muscular relaxation attending the analgesia is satisfactory. Two further applications of this drug in spinal anesthesia might prove to be quite valuable: (1) in obstetric analgesia, the mother is better able to cooperate during the second stage of labor by using her abdominal muscles and (2) in extrapleural thoracic procedures in which the high spinal block would not endanger respiratory activity. As yet we have had no opportunity to explore these two suggestions.

CONCLUSIONS AND SUMMARY

We have presented the results in 85 spinal anesthetics using lucaine as the anesthetic agent. Although this is a small series, all cases were carefully studied and analyzed. The drug appears to offer efficient analgesia when administered by the subarachnoid route. While the musculature in the analgesic zone is well relaxed, patients appear able to exert some voluntary control over them, indicating a predominant effect upon sensory nerve elements. Blood pressure variations appear to be less when this drug is used than when other more commonly used agents are utilized. We have commented briefly on the possible explanation for this finding, and have suggested further fields of usefulness. The incidence of complications, such as headache, ordinarily associated with spinal analgesia, appears to be about the same with this drug as with other spinal anesthetic agents.

REFERENCES

1. Hunt, W. H., and Fosbinder, R. J.: *The Anesthetic Potency of Some New Piperidine Derivatives, Anesthesiology* 1: 305-311 (Nov.) 1940.
2. Finer, G. N., and Rovenstine, E. A.: *The Application of a New Piperidine Derivative to Spinal Anesthesia: Preliminary Report, Anesthesiology* 8: 619-624 (Nov.) 1947.
3. Smith, H. W.; Rovenstine, E. A.; Goldring, W.; Chasis, H., and Ranges, H. A.: *The Effects of Spinal Anesthesia on the Circulation of Normal, Unoperated Man with Reference to the Autonomy of the Arterioles and Especially those of the Renal Circulation, J. Clin. Investigation* 18: 337, 1939.