

NUPERCAINE SPINAL ANESTHESIA FOR ABDOMINO-PERINEAL RESECTION OF THE RECTUM: A NEW TECHNIC

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ANESTHESIA for the operation of abdomino-perineal resection of the rectum (Miles' operation) (1) must of necessity provide adequate relaxation for surgical manipulation deep in the pelvis, as well as a duration which will outlast a frequently prolonged operating time and thus protect the patient from shock during the perineal stage of the operation. It is at this time, when the maximum effect of most spinal anesthetic agents has been passed and the anesthetic action is on the wane, that the patient exhibits shock most frequently. If he can be given an anesthetic that will give a sufficiently long effect in the abdomen, and that will have a still longer action on the lumbo-sacral nerves when the abdominal effect is beginning to wear off, it will mean that the action of the intercostal muscles will return sooner, so that breathing is easier and deeper, and this, in turn, will have a steadying effect upon the blood pressure. At the same time the full anesthetic action is still present in the lumbar and sacral nerves, and when the operator leaves the abdomen and starts the perineal removal, the patient is still adequately protected from shocking impulses from that region.

Procaine will not protect the lower segments for the length of time required by the average operator. Pontocaine will suffice for quite a number of operations. However, for anything that is to last more than two hours from the time of injection of the anesthetic, nupercaine by the combined heavy and light solution technic herein outlined has, in my experience, proved most satisfactory.

The light, dilute solution of nupercaine (1:1500 in 0.5 per cent saline) is a very satisfactory agent for upper abdominal surgery as it attacks the thoracic nerve roots most powerfully and gives admirable relaxation for operations in this region. However, it has been my experience that it is not nearly as powerful in its effect on the sacral and lumbar roots. This is probably due to a difference in the amount of myelination of these latter nerve roots, which makes them more difficult to anesthetize, and requires the use of a stronger concentration of the drug than that required for thoracic and upper abdominal anesthesia. Such was my experience with very light nupercaine (1:1500) coupled with the immediate tipping of the patient into pronounced

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Trendelenburg position to ensure the bulk of the drug being distributed to the lumbar and sacral roots. To my mind it never gave comparable pelvic relaxation to that obtained by pontocaine-glucose solution (2), but the prolonged anesthetic action of nupercaine possessed certain advantages which I was loath to give up. The present technic which I have developed was suggested to me by a visit to Doctor M. D. Nosworthy at St. Thomas' Hospital, London, in 1936. At that time, Nosworthy was employing a combined technic (3), using two solutions of nupercaine: one hypobaric and the other isobaric—or nearly so. The two solutions he was using were (a) the light 1:1500 nupercaine in 0.5 per cent saline (Howard Jones' solution) with a specific gravity of 1.0036 and (b) the isobaric concentrated 1:200 nupercaine in an isotonic buffered solution (Keyes and McLellan solution) (4) with a specific gravity of 1.0059. To make certain of producing sacral as well as thoracic anesthesia for long abdominal operations which necessitated working deeply in the pelvis, he suggested that 10 cc. of 1:1500 nupercaine should be injected between lumbar 3 and lumbar 4 and 0.8 cc. of 1:200 nupercaine immediately afterwards. When the patient was turned over to lie flat on his face, the 1:1500 light solution of nupercaine was attending to the thoracic roots in the usual way while the concentrated isobaric 1:200 solution produced sacral and lumbar anesthesia. At the end of five minutes the patient was turned over on to his back and maintained in slight Trendelenburg position for operation. This procedure gave him better results than the injection of a larger quantity of the light 1:1500 nupercaine coupled with the immediate tilting of the table into a marked Trendelenburg position.

At once I saw the possibilities of this method if applied to the operation of radical abdomino-perineal resection of the rectum, but it was some time before I attempted the modifications resulting in the technic described here. The method employed by Nosworthy implied the routine use of the "lying down" method of Howard Jones (5). However, by this time I was leaning more and more to the use of the "sitting up" method of Etherington Wilson (6) on account of its time-saving features and its minimal manipulation of the patient. As a result of using it wherever at all possible, I gave my attention to modifying Nosworthy's method to suit my own particular preference. By reversing the order of the injections of the solutions of nupercaine and employing the heavy 1:200 nupercaine solution of R. J. Silverton (7) (in 6 per cent glucose to make it definitely hyperbaric with specific gravity 1.023), this was accomplished. This method has been previously outlined by me in the *Canadian Medical Association Journal* of February, 1941 (8) but will now be given in detail, and its merits in this particular operation (radical abdomino-perineal resection of the rectum) evaluated in the light of our experience with it in 33 consecutive operations in which it was employed.

COMBINED HEAVY AND LIGHT NUPERCARINE SPINAL ANESTHESIA
(For Abdomino-Perineal Resection of the Rectum)

In this technic I make use of the sitting-up method first described by Etherington Wilson with additions and modifications of my own to satisfy the requirements of this particular operation. The technic employed differs in no essential from that described by Etherington Wilson except that of dosage and time allowance and the addition of a small quantity of heavy concentrated nupercaine to anesthetize the lumbar and sacral roots. The maximum dosage of the light 1:1500 nupercaine to be injected is calculated by allowing 1 cc. of nupercaine solution for each inch of back length, as measured from the spinous process of the seventh cervical vertebra to the interiliac line with the back in full flexion, up to a maximum of 20 cc. of nupercaine. It has been found by measuring adult backs in this manner that the length varies between 16 and 22 inches. In practice we have found that smaller doses than this suffice for the abdominal part of the abdomino-perineal resection and the usual dose employed is about 15 cc. of the light solution irrespective of back length, except in extremely long backs. The difference in back lengths obviously necessitates a different time allowance for the light nupercaine to rise in the heavier spinal fluid proportionate to the length of the back. Thus for a 16-inch back I allow forty-five seconds from the commencement of the injection for the anesthetic to reach the level of D5, and for a 22-inch back I allow upwards of sixty seconds to reach the same level. Ephedrine hydrochloride, grains $1\frac{1}{2}$, contained in 1 per cent novocaine solution for local infiltration, is injected at the site of the proposed lumbar puncture (between L3 and L4) five minutes before the actual tap. The lumbar tap and injection of the two warmed nupercaine solutions (104 F.) are always done with the patient in the sitting position, the tap always being made through the third lumbar interspace. The patient is placed in the sitting position with his feet hanging over the end of the table, and with the back well flexed forward. After the ephedrine has been given subcutaneously at the third lumbar interspace the spinal puncture is performed at that level. Since nupercaine is precipitated out in the presence of alkali, the syringe and needles to be used are first rinsed with slightly acidified sterile water (5 minims N/10 HCl to 250 cc. distilled water). The nupercaine solutions are always delivered into the spinal canal at a constant temperature of 104 F., the ampules having previously been placed in a sterile water-bath of that temperature. The injection is made slowly and deliberately, the rate being about 1 cc. per second in the case of the relatively large volume of light nupercaine (about 15-20 cc.).

First, about 1.5 cc. of warmed 1:200 nupercaine (in 6 per cent glucose to make it definitely heavier than spinal fluid) is injected very slowly and it immediately settles down into the bottom of the spinal

canal and attacks the sacral and lumbar roots powerfully. At the end of two minutes the maximum distribution of the concentrated nupercaine solution to this area is assured and the syringe is then disconnected and replaced by a syringe containing 15-20 cc. of warmed light nupercaine (1:1500), which is injected rather slowly in order not to swirl the dependent solution of heavy nupercaine. The time of the beginning of the injection is noted and the light solution is allowed to rise from forty-five to sixty seconds from the commencement of the injection, depending upon the height of anesthesia desired and the length of the back. At the conclusion of the specified period, the patient is promptly lowered backward and placed in a very slight Trendelenburg position (10°) and maintained this way throughout the operation in order to prevent further upward spread of the light nupercaine. A marked Trendelenburg position is contraindicated, as the heavy 1:200 nupercaine-glucose solution might spread up too high above the sacral and lumbar roots where it is most needed, but a slight Trendelenburg tends to an adequate spread of the heavy solution over the lumbar roots and not a definite restriction to the sacral roots. This, of course, means a more prolonged relaxation in the lower abdomen over and above that afforded by the light nupercaine gravitated to the sacral end of the spinal canal by the Trendelenburg position. The sacral nerves have been adequately taken care of by the original sitting position during injection. After twenty to thirty minutes from the time of injection of the anesthetic the patient may be placed in the steepest Trendelenburg position quite safely if it is an advantage to the operator, as the drug has become fixed by this time.

The above dosage of 1.5 cc. of 1:200 nupercaine and 15 cc. of 1:1500 nupercaine with fifty to fifty-five seconds to rise, depending on the length of the back, is adequate for the usual operation, but, on occasion, as much as 2 cc. of 1:200 nupercaine and 20 cc. of 1:1500 nupercaine have been injected without ill effects, and in one instance afforded an anesthesia of four hours and fifty minutes without supplementary anesthesia.

This last combination represents a total of 23 mg. of the drug, whereas the usually considered full dose of nupercaine for clinical use is 13 mg. (or 20 cc. of solution). Our usual dose of 1.5 cc. heavy and 15 cc. light nupercaine represents a total of about 17.3 mg. of nupercaine as compared with the 13 mg. used when a full dose (20 cc.) of light nupercaine is employed alone, as for a gastric resection. This is a striking tribute to the relative non-toxicity of nupercaine as a spinal anesthetic agent and tends to discredit laboratory results as to the supposed toxicity of nupercaine, particularly in concentrated solutions. Probably the explanation lies in the fact that the 1:200 nupercaine lying in the sacral end of the canal, and more or less restricted to that area, is absorbed much more slowly than it is when used as an agent for securing upper abdominal anesthesia, as it may be according to

R. J. Silverton's technic. It is sufficient to say that I have employed these full doses (2 cc. heavy and 20 cc. light nupercaline) on at least six occasions myself and have never noticed the least symptoms of toxicity from drug absorption. All were robust young adults with long backs approximating the maximum of 22 inches and requiring a prolonged anesthesia. The anesthesia was completely satisfactory in every way in these cases.

The technic having been described, it now remains to outline the results we have obtained with it in 33 consecutive operations in which the radical abdomino-perineal resection of the rectum (Miles' operation) was performed in one stage. These were done at the Royal Victoria Hospital, Montreal, between May 4, 1938, and November 25, 1941, by eight different staff surgeons and twelve different anesthetists all employing the same technic of anesthesia. Of these 33 patients, 19 were males and 14 females. The youngest was a 33-year old female and the oldest a 69-year old male. Their blood pressure varied from 100/60 to 166/110. The smallest dose of nupercaline was 1.5 cc. of 1:200 with 15 cc. of 1:1500, and the largest 2 cc. of 1:200 and 20 cc. of 1:1500. The anesthetic duration was estimated from the injection of the anesthetic drug to the last skin suture or application of dressing. This, of course, does not indicate the actual operating time, as considerable time is taken after the induction of anesthesia to prepare the patient for the operating theater, including catheterization. The longest unsupplemented spinal anesthetic gave a duration of four hours and fifty minutes. The average duration of the 33 operations was two hours and eight minutes (including preparation). The shortest time was one hour and fifteen minutes. However, inasmuch as 1 difficult case took over five hours, 5 cases over four hours, 7 cases over three hours, and 16 cases over two hours, there remained only 4 cases taking over one hour and less than two hours. That is to say, 13, or 36 per cent, consumed over three hours of anesthetic time for which pontocaine-glucose solution probably would have been insufficient. This rises to 29, or 88 per cent, if we count all those requiring two hours or more anesthetic time, which is sometimes too long for average doses of pontocaine (20 mg.). Some of these would undoubtedly have required anesthetic supplement with its added risk if pontocaine had been employed.

It is obviously important, therefore, to use an anesthetic that is powerful enough to outlast the expected time of anesthetic requirement (two hours or more including the time spent in preparing the patient for the operating theater after he has received his injection). Pontocaine does not always afford this. Procaine practically never does. Nupercaline is the only drug which will enable us to promise the surgeon that the anesthetic will probably outlast the operation. The whole principle underlying this technic is, first, the injection of sufficient of the heavy concentrated nupercaline to ensure a long-lasting perineal anesthesia of three to four hours' duration (i.e., between 1.5 and 2 cc.

of 1:200 nupercaine), followed by the injection of only enough light nupercaine to ensure sufficient duration to perform the abdominal part of the operation. It is even desirable that the abdominal anesthesia be worn off soon after the patient is turned on his side, as it allows better expansion and aeration of the lungs and helps to maintain blood pressure. As a rule 15 cc. of the light nupercaine is ample.

The anesthesia was a complete success in 28 cases, requiring no supplement. In 4 cases it was a partial success and required nitrous oxide supplementation toward the end. In 1 case it was a failure from the beginning and required cyclopropane and ether to perform the operation satisfactorily. Shock arising while on the operating table was evident in 5 cases and was successfully treated with intravenous saline and blood or plasma transfusion. Shock after return to the ward was reported in 4 cases. The patients quite frequently showed a marked fall in blood pressure on changing position on the table for the perineal resection, but the condition always responded to neosynephrine $\frac{1}{2}$ cc. subcutaneously accompanied by plasma transfusion. From now on we intend giving an injection of ephedrine grain $\frac{3}{4}$ or neosynephrine $\frac{1}{2}$ cc. subcutaneously about ten minutes before turning the patient and hope to avoid this fall, but as yet we are unable to report upon its efficacy used prophylactically in this manner.

There were no deaths in the operating room and no cases of respiratory embarrassment. There were four instances of postanesthetic headache, none of whom complained more than once, except one patient who reported it twice. All responded promptly to treatment with pituitrin $\frac{1}{2}$ cc. or caffeine sodio-benzoate grains $7\frac{1}{2}$. There were no other neurological complications. Two patients developed pulmonary infarction in the postoperative period with complete recovery. Five patients died postoperatively, but in only 1 case could the anesthetic have played any part. This was a woman of 63 years of age, arteriosclerotic, with a systolic murmur, basal congestive rales and myocardial damage. Her blood pressure was 130/70 and her operation lasted three hours and fifty minutes. She did poorly from the start and suffered severe hemorrhage during the operation but picked up a little with a transfusion on the table. She went into shock upon return to the ward and required another transfusion. The patient died the next day and death was attributed to postoperative shock. Her reaction to the anesthetic was good (dosage of 1.5 cc. heavy and 15 cc. light nupercaine), but with the onset of hemorrhage her pulse rose to 140 and remained high thereafter despite transfusion.

The average dose employed in the above 33 cases was 1.5 cc. of 1:200 nupercaine and 15 cc. of 1:1500 nupercaine. The average back length was 19 inches and the average time allowed for the light nupercaine to rise was fifty to fifty-five seconds. In all cases ephedrine hydrochloride grains $1\frac{1}{2}$ (9) was given five minutes before the spinal puncture was performed and served to maintain the blood pressure

quite satisfactorily. Morphine grain $\frac{1}{4}$ and hyoscine grain $\frac{1}{150}$ was the usual premedication given about thirty minutes before the spinal and repeated once during the operation if there was no evidence of shock. We almost always start an intravenous infusion of normal saline at the beginning of the operation and keep it running slowly and follow the blood pressure changes in speeding up the rate. Toward the end of the operation this is replaced by blood or plasma. Shock is noticeably absent during the operation as a result of this support.

I feel that this technic of combined heavy and light nupercaine affords a powerful long-lasting spinal anesthesia for abdomino-perineal resection of the rectum that obviates supplementary inhalation anesthesia, tends to prevent shock in the late stages of the operation, and affords maximum relaxation and operative ease to the surgeon.

SUMMARY

1. A new technic for the combined use of (a) heavy, concentrated and (b) light, dilute solutions of nupercaine is described.

2. The value of this technic for prolonged operations in the pelvis, such as the radical abdomino-perineal operation for resection of the rectum, is demonstrated.

3. The results of this technic as employed in 33 consecutive abdomino-perineal resections of the rectum are reported.

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