CONTINUOUS SPINAL ANESTHESIA IN COLON SURGERY

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PATIENTS requiring surgery of the large bowel are frequently poor operative risks because of age and degenerative vascular disease. The depleting effects of chronic or acute obstruction, large infected ulcerating cancers, and the ravages of ulcerative colitis also increase operative risk. Under such conditions impairment of the nutritional status and deficiencies in the circulating blood volume are found.

It has seemed wrong to us to subject such patients to the depressing and otherwise deleterious effects of anesthesia by ether and other inhalation agents. Single injection spinal anesthesia has the disadvantage of adding hypotension to the already depleted circulating volume. In the past three years we have used continuous spinal anesthesia administered in fractional doses. This type of anesthesia has several outstanding advantages. (1) The anesthetic can be confined to the area to be operated upon. (2) The total dose can be "controlled" and is minimal as compared to single injection technics. (3) Hypotension can be avoided or minimized by fractional doses. (4) Operative procedures of any magnitude may be carried out with little worry over time consumption since the anesthesia may be prolonged by added injections.

Since January 1950 we have used continuous spinal anesthesia to perform 505 resections of the colon with nine deaths; a hospital mortality of 1.7 per cent. There can be little doubt that the lowered mortality or morbidity in colon surgery is partially due to safer anesthetic methods.

Continuous spinal anesthesia administered in fractional doses with the ureteral type catheter causes minimal disturbance to the physiologic balance and gives adequate analgesia and relaxation. The level and extent of anesthesia which is necessary varies with the location and the character of the lesion. These levels range from a high of T3 for splenic and hepatic lesions to S5 for rectal lesions. If anesthesia by the classic spinal technic were to be induced between these extremes, many patients would react violently to the accompanying sympathetic nervous system paralysis. The splanchnic and the vasomotor nerves for the lower extremities originate within these levels. Complete vasodilatation of the vessels of the legs causes the circulating blood volume to be depleted by bleeding into the leg veins. Accompanying this relative diminution of the circulating blood volume, stasis results with the possible

occurrence of venous thrombosis. By limiting the extent of anesthesia to a few dermatomes, these complications can be avoided. Saklad[1] has described a segmental type of spinal anesthesia produced by the ureteral catheter technic. A sensory level of anesthesia is obtained by properly placing the tip of the catheter so that analgesia is produced only within the operating zone. Frequently this involves only a few segments. Advantage may be taken of the anatomy of the spinal cord in reference to the innervation of the sympathetic nervous system. All efferent sympathetic nerves originate in the intermediolateral cell column of the spinal cord and travel over the anterior nerve roots to the sympathetic ganglia. Here the sympathetic nerves communicate by means of the sympathetic chain with other sympathetic nervous system neurons originating in the same manner two or three dermatomes above. Therefore, if the level of anesthesia would be limited to two or three segments, little or no vasomotor phenomena should be realized.

With the small fractional doses of anesthetic agent as administered in the segmental continuous spinal technic, anesthesia of the sensory and motor components of the spinal segments is complete. However, the sympathetic nerves can secure innervation from other levels. Pain and temperature anesthesia may extend into the neighboring dermatomes. The sensory and sympathetic nerves are affected first with blocking agents. With larger concentrations the motor fibers are blocked. Therefore, it may be postulated that due to the dilution of agent as it diffuses, there is little or no effect upon the sympathetic or motor components. As a result, segmental anesthesia with the ureteral catheter technic causes a sensory anesthesia of a calculated extent accompanied by adequate motor paralysis, but little or no sympathetic effect. The field of anesthesia is a restricted area of analgesia adequate for surgical manipulation but with muscle tone and vasomotor tone of the legs maintained to promote adequate circulation. This is important in the older age groups and may prevent formation of thrombus and subsequent pulmonary embolus. The disadvantage of the classical spinal anesthesia is thereby circumvented.

Method

Segmental spinal anesthesia is attained by using the ureteral type spinal catheter as introduced by Tuohy.[2] The tip is placed at a predetermined level. A 16 gauge Tuohy needle is inserted into the dural sac in a lower lumbar interspace at a 45 degree angle with the plane of the back (fig. 1a). With the needle in the subdural space, spinal fluid will flow freely. The catheter is then inserted into the needle as far as the Huber point. The level to which it is to be inserted is then measured with the catheter to the proper interspace (fig. 1b). It is then advanced with extreme care to the desired space. If paresthesia is elicited, the needle can be rotated through 45 degrees and the catheter inserted farther. A 2 cc. syringe is then fitted to the catheter with an adapter. With gentle suction, spinal fluid will be aspirated. The catheter is then securely taped in place and the patient is placed in the surgical position.

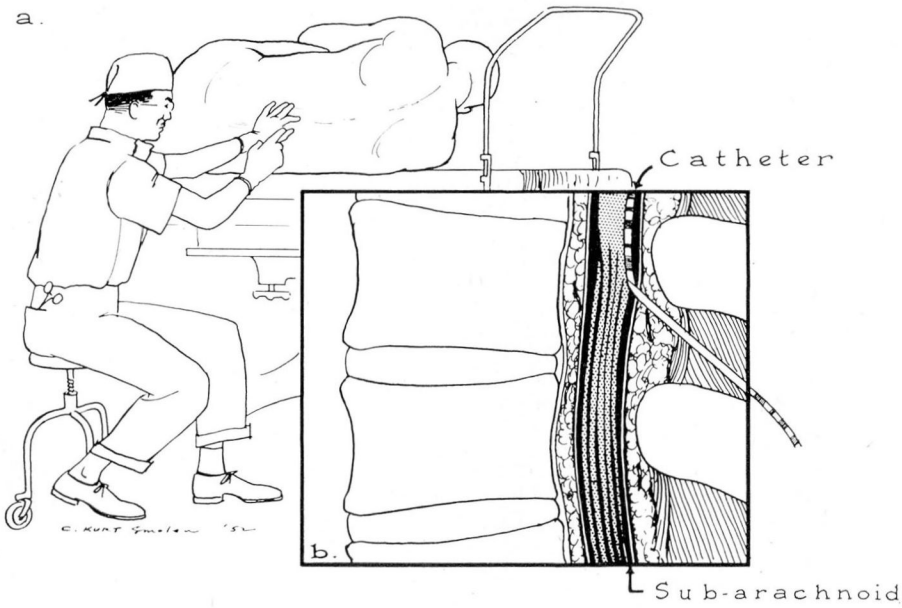

FIG. 1. (a) Position of the patient and the anesthesist for lumbar puncture. (b) Diagrammatic illustration showing placement of Huber point and the catheter lying in sub-arachnoid space.

To facilitate the administration of small doses and to prevent diffusion of effective quantities into other interspaces, a dilute solution of procaine 100 mg. and pontocaine hydrochloride 10 mg. in 10 cc. of normal saline is used. This mixture may be considered isobaric. The patient may be placed in any position without fear of diffusion throughout the spinal canal. Colon surgery frequently requires a Trendelenburg's position of 10 or 15 degrees. Administration of 1 or 2 cc. of this mixture will cause anesthesia at the determined level.

Fractional doses of the preceding mixture are administered in units of 1 cc. After the initial injection, five minutes are allowed to elapse. If no anesthesia is apparent, another unit is given. This is repeated until satisfactory anesthesia is obtained. Rarely is it necessary to administer more than three units for initial anesthesia. Subsequent or maintenance doses are administered when the patient becomes restless. Although pain sensation has not returned, muscle relaxation may soon disappear. One cubic centimeter of the procaine-pontocaine solution will give additional anesthesia for an average of 30 minutes. These subsequent doses are small and capable of prolonging anesthesia, the induction of which originally requires two to four times these amounts.

In the combined abdomino-perineal resection, it is often necessary to extend the level of anesthesia caudad. For the perineal phase in this instance, a hypobaric solution of niphanoid pontocaine (10 mg.) dissolved in water (5 cc.) is

injected very slowly in doses of 1 cc. (fig. 2). With the patient in Trendelenburg's or Kraske's position, sensory anesthesia of the lower spinal roots will occur.

Most of the complications of ordinary spinal anesthesia are circumvented with segmental continuous spinal anesthesia. The initial injection of 1 cc. (10 mg. procaine and 1 mg. pontocaine) is seldom enough to cause hypotension. With five minutes elapsing before the second injection, time is available to evaluate the patient's condition. The blood pressure and pulse are recorded, the level and extent of anesthesia determined.

Frequently, the initial injection of one unit (10 mg. procaine and 1 mg. pontocaine) produces adequate conditions for surgery. If, however, the quality or extent of analgesia and relaxation are inadequate, and the circulatory signs unaffected, the second unit is injected slowly. In most instances, this quantity of agent presents ideal surgical conditions. Continuous and cautious evaluation of the patient is mandatory. Frequent pulse and blood pressure determinations are taken and recorded.

Fluctuations in blood pressure during the segmental type of continuous spinal anesthesia are minimal when compared to the single injection technic. In most instances, the initial and temporary fall of blood pressure is absent or

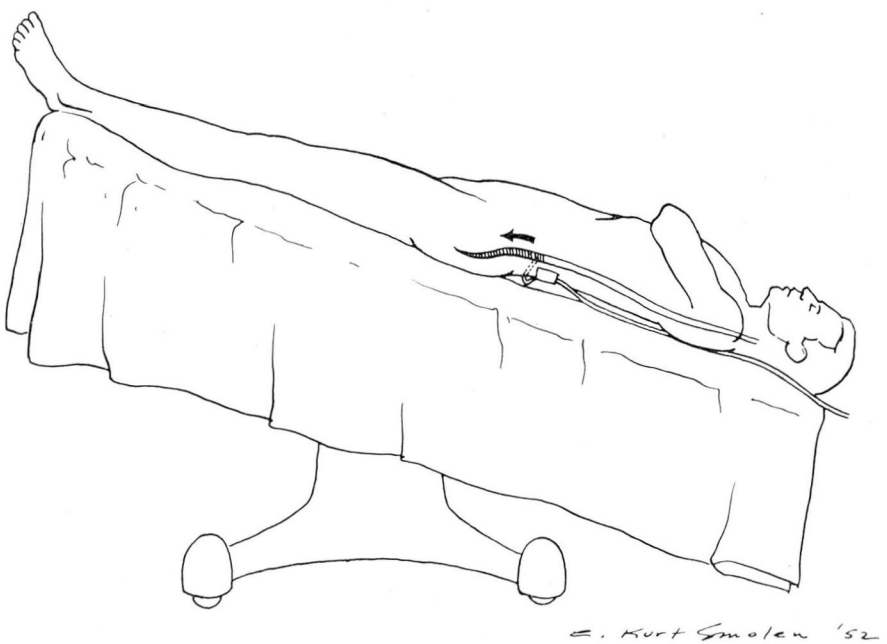

FIG. 2. Drawing showing that portion of the spinal cord where anesthesia is produced by hypobaric solution. The arrow indicates the direction in which the anesthesia will occur

insignificant. Should hypotension of severe proportions develop, a vasoconstrictor such as neosynephrin (0.2 cc. or 1.0 per cent solution in 500 cc. of 5 per cent glucose in water) will readily correct the falling blood pressure. This solution is allowed to run rapidly by intravenous drip and can be regulated to maintain normotensive levels.

Supplementary agents are indicated only when the patient is nervous and apprehensive, or when traction discomfort becomes annoying. Routine sedation of the toxic and severely ill is avoided. When necessary for pain and discomfort, nembutal or seconal is administered intravenously in doses sufficient to sedate but not to produce unconsciousness. Nausea and vomiting are treated in the same manner. In addition, any hypotension must be corrected and oxygen administered via face mask. The total dose of pentothal sodium solution, if used in a prolonged case, becomes excessive. In the aged and toxic patient, the rapidity of onset and potent action may combine to adversely effect the delicate status of an already critically ill person. Other inhalation anesthetics are seldom used and certainly not advised.

Complications

Postoperative headache is the most common complication of continuous spinal anesthesia. In a previous series[4] the incidence was reported as 9 per cent. It must be explained, however, that the incidence of spinal headaches may not be accurately determined because the patient in many instances has been acutely ill and will not assume an erect position to precipitate the encephalalgia. Compared to other reports[5] this figure is favorable.

The possibility of neuropathies as a result of lumbar puncture and the catheter technic should not be overlooked. The plastic catheter when introduced through the 16 gauge Tuohy needle may touch or even irritate a nerve root. This increased danger is accepted so that the patient may have the benefit of an otherwise extremely safe and indicated anesthesia. Peripheral neuropathies occurred in two patients (an incidence of 0.4 per cent) both of whom are improved. Other postoperative complications, such as atelectasis, urinary retention, and phlebothrombosis, are only occasionally seen. There were no deaths resulting from anesthesia.

Summary

Since January 1950, 505 colon resections have been performed under continuous spinal anesthesia. There have been nine hospital deaths or 1.7 per cent mortality. The main complication following this type of anesthesia has been postoperative headache. No patient has been incapacitated in any way. Since the anesthesia is regional and nontoxic, and since hypotension is unusual, it is considered ideal for the aged and bad risk patient.

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