

Where refrigeration is employed it is unnecessary to place a tape about the vessels, as a tourniquet controls the bleeding. A hand saw may be more convenient than the Gigli type, and cotton or wire superior to silk as suture material. It is technically impossible to employ skin clips to unite the fascia and skin in obese patients; I prefer towel clips. . . . Dressings are applied to the stump sparingly in order to permit the use of ice bags around the stump for about four days. The stump may be defrigerated gradually by removing the ice bags individually, beginning on the third day. Generally the patient may resume normal eating after surgery with attention being given to control of pain which is thought to be less than that following other types of anesthesia. Stitches must remain in place longer than usual because refrigeration delays healing. . . . The mortality rate in the above small series is 40 per cent but with any other type of anesthesia it might have approximated 100 per cent either from the effect of the anesthetic or from postoperative shock during the recovery period." 9 references.

J. C. M. C.

ADAMS, R. C.; LUNDY, J. S., AND SELDON, T. H.: *Continuous Caudal Anesthesia or Analgesia: a Consideration of the Technic, Various Uses and Some Possible Dangers*. J. A. M. A. 122: 152-158 (May 15) 1943.

"After a preliminary trial of the method of Hingson and Edwards we devised an alternative technic. . . . After instituting this technic and using it in a number of cases we learned that Manalan of Indianapolis had employed a ureteral catheter in a number of cases to produce anesthesia and analgesia for obstetric delivery, although not as a continuous method for the relief of pain during the course of labor. Thus, as often happens in med-

ical development, two similar techniques were evolved independently by Manalan and ourselves. . . . We have used and are continuing to use the method of Hingson and Edwards and the one developed by us in both obstetric and surgical cases. Both methods have certain advantages and certain disadvantages according to our present concepts. . . . The needle is inserted into the midline of the caudal canal through the sacral hiatus, which is covered by the sacrococcygeal ligament. Its point is advanced to the level of the third sacral foramen and never higher than the level of the second sacral foramen, owing to the possibility of puncturing the dural sheath. . . . Various local anesthetic agents have been employed, but a 1.5 per cent solution of metycaine has been preferred by most authors. Isotonic solution of sodium chloride is used as the solvent, and the amount of the solution required will depend on the desired concentration of the anesthetic agent and whether or not it is supplied in a concentrated solution or in a solid form. . . .

"An alternative method of continuous caudal anesthesia entails the use of a ureteral catheter. This method was first employed in June 1942 and was evolved in order to eliminate the danger of breakage of needles and the possibility of trauma during labor. . . .

"We prefer a 1.5 per cent solution of metycaine because the duration of the resulting anesthesia is greater than the duration of anesthesia produced with procaine hydrochloride. Unless the patient's blood pressure is abnormally high, 1 cc. of a 1:2,600 solution of epinephrine is added to 66.6 cc. of the 1.5 per cent solution of metycaine. . . . For primiparas the administration of the anesthetic solution is begun when the diameter of the dilating cervix has reached 2 to 3 cm. and when the labor pains have become severe. For multiparas and when labor is advancing rapidly the solution is injected

somewhat earlier. . . . The type of anesthesia and its effects should be explained to the patient before the administration of the anesthetic agent is begun. The patient is placed in the knee-chest position or in the modified Sims position. . . . The anesthetist should face the patient. The patient is moved close to the edge of the bed or delivery table. When this method of anesthesia is used for surgical operations the patient is placed in the prone position and her hips are elevated with pillows or a sacral rest. The sacral region is sterilized widely about the proposed site of injection and the patient is draped. A skin wheal is raised over the middle portion of the sacral hiatus. A 20 gage intravenous needle  $1\frac{1}{2}$  inches long is attached to the syringe containing the anesthetic solution and is inserted through the skin wheal and through the sacrococcygeal ligament at an angle of 45 degrees. After the needle has pierced the sacrococcygeal ligament and has come to rest lightly on the anterior wall of the sacrum, 5 cc. of the solution of metycaine is injected. Even this preliminary injection into the lower part of the caudal canal sometimes will produce partial analgesia.

"This needle is withdrawn and a 13 gage Love-Barker needle, with its stylet in place and with the bevel directed upward, is inserted at an angle of about 45 degrees and introduced through the sacrococcygeal ligament. When this needle touches the anterior wall of the sacral canal its bevel is turned downward and its hub depressed, after which it may be cautiously advanced upward along the midline of the caudal canal. . . . The point of the needle is advanced to about the level of the third sacral foramen but never as high as the level of the second foramen. In many instances it is necessary to insert the needle only 1 to  $1\frac{1}{2}$  inches into the

caudal canal. After the needle has been inserted to the correct position, the stylet is removed and a number 5 ureteral catheter (woven silk or, preferably, nylon) is passed through the needle and into the caudal canal. It is advanced so that, as determined by previous measurement, its tip will rest at about the level of the third sacral foramen or between the second or third foramen. If the ureteral catheter is of the graduated type, its position at the proper level of the caudal canal may be determined more accurately.

"The catheter is then grasped distal to the needle to maintain it in the proper position while the 13 gage needle is withdrawn over it by combined pull and rotation. The catheter is left in place in the caudal canal. The patency of the catheter should be checked before it is inserted. After the 13 gage needle has been withdrawn, 5 cc. of the local anesthetic solution is injected through the catheter into the caudal canal to check the patency of the lumen of the catheter and also to test for any possible untoward reaction to a small dose before larger doses are injected. It is important during these maneuvers that the external end of the catheter be kept sterile. When the catheter is in place in the caudal canal a 22 gage Luer hypodermic needle the bevel of which has been cut off square is inserted into the catheter end and is held there with a small piece of adhesive tape. A sterile Luer cap is then applied to the hub of this needle; this will block any backflow of solution and will keep the end of the needle sterile. Before the adhesive tape is applied, the skin about the site of the catheter is painted with a solution of mastic of benzene and a small sterile piece of sponge rubber or rubber dam is slipped over the catheter and is pressed firmly against the skin, which has been painted with the adhesive preparation. This forms a tight seal around the catheter and

its point of exit and helps to prevent soiling and contamination by any secessions. Several pieces of waterproof adhesive strapping are applied to the catheter at its exit from the skin, both to hold it in position and to form a seal around the exit of the catheter to prevent contamination from vaginal or rectal soiling. The remaining portion of the catheter is curved laterally and strapped to the skin of the flank by adhesive tape, the end of the catheter being left in an accessible position for repeated injections.

"Thirty cc. of the anesthetic solution is injected very slowly, about 10 cc. at a time. This slow injection is important, since a large volume of solution injected rapidly at one time may cause pain, nausea, headache and other untoward effects which result from excessive pressure within the caudal canal or from rapid absorption of the anesthetic agent. Such reactions are an indication that the anesthetic solution has entered the caudal canal. If the anesthetic solution is warm when it is injected, its effectiveness will be increased; that is, the period of induction will be shortened and the degree of anesthesia will be increased. After the injection has been made, the patient may be turned on her back and during the course of her labor she may lie in any position in which she is comfortable. She may change her position at any time without assistance, provided the catheter has been securely fixed at its point of exit from the skin. There is little danger of dislodging it and there is no danger from trauma. Additional injections of 10 cc., but not more than 20 cc., of the solution of metycaine are administered at the first signs of reappearance of the labor pains. Once the catheter has been inserted and anesthesia obtained, the subsequent anesthesia parallels that obtained by the needle technic. The catheter is removed after the delivery or other operative procedures have

been completed and before the patient is returned to her room. The site of puncture is painted with an antiseptic solution, and a small sterile dressing is applied. . . . Variations in the bony formation of the sacrum, obese patients in whom the bony landmarks are difficult to palpate, previous injuries and deformities in the sacral region, and faulty position of the patient at the time of injection serve to increase the difficulties and the possibility of untoward effects or inadequate anesthesia.

"A common error, which occurs particularly when the patients are obese, is to miss the sacral hiatus and insert the needle over the posterior wall of the sacrum. It thus comes to lie underneath the skin overlying the sacrum, and no anesthesia will be obtained since the anesthetic solution will be deposited subcutaneously. . . . It is possible, by scraping the point of the needle along the anterior or posterior bony wall of the caudal canal, to pierce the venous plexus within the canal. Unless this is determined by aspiration before injection and the point of the needle is adjusted, it is possible to inject a toxic dose of the local anesthetic agent into the venous system. This will produce untoward and perhaps fatal reactions. . . . If the point of the needle is kept below the level of the second sacral foramen it is not likely that the needle will pierce the subarachnoid space. It is advisable to insert the needle to a point well below this level. Frequent aspirations should be carried out to see if spinal fluid can be withdrawn, before any local anesthetic solution is injected. Severe collapse and possibly death can occur if an overdose of a local anesthetic agent is administered intraspinally in this manner. . . . Breaking of a needle has occurred more frequently during the early phase of the development of the method than it has in recent months. . . . Since the point of the needle may impinge on

bone within the caudal canal, any pressure on the hub of the needle will predispose to bending of the needle or to trauma inside the canal, if not in actual breakage of the needle. If, by the patient's movements, the hub of the needle is made to move from side to side, it seems reasonable that the sacrococcygeal ligament will act as a fulcrum and that a corresponding movement will be set up in that portion of the needle within the caudal canal. It will appear that under certain circumstances this could produce trauma to the nerves and vessels. Breakage of a needle in the caudal canal may necessitate incision for removal and in some cases has necessitated laminectomy. . . .

"Unilateral anesthesia . . . has occurred in a few cases, presumably owing to lateral deviation of the point of the needle. This can usually be corrected by adjustment of the needle so that the anesthetic solution reaches the nerve trunks of the unanesthetized side. . . . Although the use of the catheter obviates the danger of breakage of the needle and of trauma, other possible complications peculiar to its use must be borne in mind. . . . The 13 gage needle through which the catheter is introduced is large and can produce trauma if two or more attempts are made to insert it. . . . If more than one puncture is required, trauma may occur. This will increase the possibility of irritation and infection. If a second puncture in a different location has been made, leakage of the local anesthetic solution through the original site of puncture has occurred. This lessens the chances of complete anesthesia and increases the possibility of infection. On this basis we do not feel that multiple punctures should be made if the first one is unsuccessful. . . . Catheters should be carefully examined for defects before use and old or cracked ones discarded. Catheters are sterilized by boiling in

an antiseptic solution. When not being used, they are stored in a container which prevents kinking or buckling. . . . Although the danger of puncturing the dura with the catheter is remote, incomplete anesthesia may result from inserting the catheter too high in the caudal canal. This causes the solution to be deposited at too high a level and thus it may not get in contact with all the sacral nerves. . . . There is nothing to prevent the catheter entering the dura when the 13 gage needle is inserted to too high a level in the caudal canal. It is both unnecessary and unsafe to insert this needle higher than the level of the third sacral foramen. . . . The catheter may become curled within the caudal canal and its tip may thus be deflected to one side or the other or backward toward the hiatus. This also may result in incorrect distribution of the anesthetic solution and lead to incomplete or unilateral anesthesia. . . . If the catheter has been advanced too far into the caudal canal and it becomes necessary to withdraw it to the proper level, the 13 gage needle should be withdrawn as well and both the needle and the catheter reinserted. If an attempt is made to withdraw the catheter without withdrawing the needle, the catheter may become caught on the sharp bevel of the needle. Traction on the catheter under such circumstances may result in shearing off its tip in the caudal canal. . . .

"The catheter may be so slender that it may be difficult to manipulate properly. . . . Very rapid injection of the anesthetic solution or the injection of a large amount of solution at any one time may produce headache, dizziness, a feeling of pressure in the legs or over the sacrum and momentary syncope-like effects. Some patients experience backache of varying duration during the postpartum period. This might be attributed to the anesthetic in some cases. In some cases

the blood pressure drops during the period of anesthesia, but this reaction seldom has been acute or alarming. . . . Such conditions as placenta previa, inertia uteri, hysterical or psychotic states and disproportion between size of the child and pelvis are definite contraindications to the use of the method. . . . Greedy and Hessel-tine said that the method is contraindicated for difficult rotation and versions, since complete uterine relaxation is desirable for these procedures. Other contraindications include a history of hypersensitivity to local anesthetic agents, infective processes over the sacrum and sacral hiatus, and congenital or traumatic malpositions of the vertebral column, especially of the sacral segment. . . . We have not found the use of epinephrine to be disadvantageous; it is omitted, however, from the local anesthetic solution if the patient has any type of hypertension or if there is a history of idiosyncrasy to the drug. There is possibly less fall in blood pressure as a result of the caudal anesthesia in cases in which epinephrine is employed. If there is no contraindication to the use of epinephrine we employ it in the following amounts: One cc. of a 1:2,600 solution or 6 minims (0.4 cc.) of a 1:1,000 solution is added to 66.6 cc. of a 1.5 per cent solution of metycaine. If total doses larger than 66.6 cc. of the 1.5 per cent solution of metycaine are required the epinephrine may be omitted from the subsequent doses, particularly if the patient's blood pressure becomes elevated above normal. One advantageous feature of this method of anesthesia is that if complete anesthesia is not obtained there does not appear to be any contraindication to the supplementary use of suitable anesthetic agents by inhalation. If the cardiovascular system is normal or nearly normal, injection may be administered while the patient is in the knee-chest or the modified Sims

position, but if a cardiovascular lesion such as severe cardiac decompensation is present the knee-chest or the knee-elbow position should not be used. If orthopnea is present, the patient cannot be placed in this position with safety and the modified Sims position will be indicated. . . .

"We have used both of these methods of continuous caudal anesthesia. Our results will be published subsequently, in addition to the results obtained in a series of cases in which operations were performed on the anus and lower part of the rectum, perineum, vagina, uterus, urogenital tract and adjacent parts. . . . Since most of the dangers, draw-backs and untoward effects have been associated with certain technical difficulties which could not be foreseen in the early phases of the work by even experienced physicians, it is suggested that for the present, at least, the use of the method be confined to institutional practice by persons trained and experienced in caudal anesthesia." 16 references.

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IRVING, F. R.; LIPPINCOTT, C. A., AND MEYER, F. C.: *Continuous Caudal Anesthesia in Obstetrics. Demonstration of Catheter Technic for Administration*. New York State J. Med. 43: 1023-1029 (June) 1943.

"Since October, 1942, we have used continuous caudal anesthesia in over 200 obstetric cases, employing the catheter instead of the malleable needle. There have been no major complications from its use. . . . Continuous caudal anesthesia cannot be used in every case of childbirth. There are certain contrindications, such as pilonidal cyst, infection near the site of injection, cases of hypotension, and patients who are known to be sensitive to the drug. We believe that placenta praevia, ablatio placentae, and dis-