CONTINUOUS CAUDAL ANALGESIA IN OBSTETRICS

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Continuous caudal analgesia was developed to relieve the pains of labor and delivery. Since its beginning we have sought to improve our apparatus and refine our technic in order to provide the maximum of comfort for the mother with a minimum of risk for her and the baby.

Both Drs. J. B. De Lee and J. Whitridge Williams recognized that some obstetricians would literally follow the Biblical injunction “in sorrow shalt thou bring forth” but stated that it was the duty of the obstetrician to mitigate the sufferings of natural labor and delivery. They demanded that any anemic, analgesic or anesthetic agent possess safety for mother and child.

Since 1847, when Sir James Y. Simpson introduced ether in obstetrics, there has been a continuous search for a perfect method. Many different agents, used either alone or in combinations, have been described for this purpose. Not one has been found that completely meets the postulated criteria without at the same time altering the normal mechanism of labor.

Sicard and Cathelin, working independently, blocked the sacral and coccygeal nerves through the sacral hiatus. They found in 1901 that fluids when injected into the peridural space by this route rise to a height in direct proportion to the amount of preparation used and the speed with which it is forced into the canal. Cathelin further showed that when sufficient cocaine was injected into the sacral canal of the dog it resulted in complete anesthesia of the entire body.

Laewen and Gaza in 1911 and Schlimpert in 1913 used caudal anesthesia in Germany for obstetric cases. In America the technic has been used successfully by Meeker and Bonar in 1923; others followed: Oldham in 1925, Lundy in 1928, Henry and Jaur in 1929, Rucker in 1930, Campbell in 1933, Johnson in 1936 and Sword in 1936. In 1939 Baptist and Southworth reported the successful use of caudal anesthesia in 200 obstetric cases. Labmann and Mietus in January 1942 reported 400 obstetric cases in which caudal anesthesia was used.

These investigators confirm the practical usefulness of caudal block for delivery with comparative safety for both mother and child. Most of the writers cited described a satisfactory anesthesia resulting from an introduction of from 30 to 40 cc. of 1 or 2 per cent solution of procaine or cocaine into the extradural space of the sacral canal. Most found the duration of this anesthesia to be between forty minutes and an hour and a half.

We have sought to modify their methods so that the analgesia could be started in the early stages of labor to relieve the pain and discomfort for the parturient in this period with the added advantage of continuing this analgesia until the completion of labor and postpartum repair.

In a previous paper we wrote that we used this procedure in obstetrics only after it had been thoroughly studied in the management of twenty surgical operations on the perineum and lower extremities. We first used it in our surgical service, working with Southworth, in October 1941 for a bilateral phlebectomy. Since that time we have managed the entire course of six hundred labors and deliveries with this method without resorting to any other form of anesthesia. We believe that continuous caudal analgesia has opened a new medical horizon to the profession comparable to that developed by Lemmon and Paschal with continuous spinal anesthesia. However, we would emphasize that with our method the drug producing the analgesia is continuously bathing the nerve trunks of the sacral and lumbar plexuses within the peridural space. At no time does this medication enter the subdural space of the spinal canal. Consequently the patient is still able to move the lower extremities throughout labor, and uterine contractions continue without impediment.

THE NERVE SUPPLY TO THE UTERUS

Our solution of the problem of the relief of pain during labor and delivery has been the use of a continuous regional nerve block of both the somatic and autonomic pathways which transmit the pain impulses. At the same time we have endeavored not to interfere with the motor nerve fibers to the uterus and the
nerves to the accessory skeletal muscles which have a part in the voluntary expulsion of the baby. This we have designated continuous caudal analgesia.

Head 18 in 1893 postulated that the pain impulses of labor were transmitted through the lower thoracic and upper lumbar sympathetic ganglia. Cleland 11 in 1933 located these pathways in the human being by clinical observations following paravertebral sympathetic nerve block as coursing through the ganglia of the eleventh and twelfth thoracic segments. In more than 600 case studies we have substantiated these contentions. We have tested the level of skin analgesia in every patient receiving the caudal block. We have found that it is necessary to extend this level of analgesia up to and including the area supplied by the eleventh thoracic nerve and the iliohypogastric nerve on both sides before the patient has complete relief from labor pains. The superior extent of this area lies midway between the umbilicus and the pubis. Whenever the analgesia of the skin falls below this area on either side there is return of the sensations of abdominal cramps on that side, with the intensity increasing as the level of analgesia descends.

Sherrington, Head, De Lee, Rucker 12 and Cleland have contended that the motor nerve supply to the cervix and lower uterine segment and that they carry pain fibers from these areas and the upper portion of the vaginal vault. There is some suggestion that they also carry inhibitory fibers to the uterus by innervating the longitudinal muscle fibers of this organ. Prolonged block of these nerves through continuous caudal analgesia produces definite softening of the cervix, with more rapid effacement of the lower uterine segment and cervical dilatation as determined by rectal examinations.

Thus from this clinical study it would appear that the autonomic nerve supply to the uterus may be divided into the components presented in the accompanying tabulation.

In substantiating this work on cadavers we studied the dissection made of the peridural space in sixty cadavers after 30 cc. of methylene blue solution had been injected through the sacral hiatus. We found that in no case did this injection go higher than the sixth thoracic segment but always as high as the tenth dorsal segment. In many of them we found the structures more intensely stained on one side and to a higher level than on the other. 13

Thus our dosage tables were calculated both by neurologic studies on women in labor and by dissection studies on necropsy material. We sought to determine the required volume of solution necessary to reach the pain fibers without paralyzing other vital nervous functions.

THE MANAGEMENT OF LABOR AND DELIVERY

Continuous caudal analgesia is started when a patient is in labor and in distress. We advise that the procedure be not started until the patient is in actual distress. Best results are secured when the contractions are regular, of at least thirty seconds duration and five minutes or less apart. Often with only slight suggestion and encouragement a patient will not need much aid until she has 3 to 4 cm. dilatation. If the patient is in too severe pain, the procedure can be started earlier and absolute relief given.

Under this form of analgesia the patient is continued on her normal diet and fluid intake. Thus there is no interference in the normal metabolism of either mother or child.

It is imperative that the obstetrician have a complete evaluation of the case before the analgesia is started. He should know that there is no placenta previa, inertia uteri, uncontrollable hystera or disproportion of child to pelvis. All these are extraordinary obstetric contraindications for the use of the procedure.

We prefer to keep the patient in her own hospital room until time for delivery. She is in familiar surroundings and has her reading material, radio and visitors. Since the patient is not uncomfortable she often enjoys natural sleep and is able to conserve her energy.

An enema always precedes the administration of the analgesia unless the progress of labor is too rapid. Rectal examination gives satisfactory information without producing discomfort. Rectal examination is made with facility because of the relaxation of the anal sphincter.

Because of pronounced relaxation of the soft parts of the birth canal and outlet, progress is expedited. We have found it safe to leave the mother in bed until the presenting part can be seen by spreading the vulva.

The danger of precipitant birth is minimized as the distressing expulsive forces called into play due to pain are absent. The mother is taken to the delivery room with the apparatus in place. The perineum is prepared with tincture of green soap and an antiseptic. The patient is draped and delivery accomplished.

It has been our policy to use prophylactic episiotomy and outlet forceps. The application of forceps is facilitated by complete relaxation. In spontaneous delivery the presenting part gradually iron's out the perineum, dilates the vulva and delivers. With either operative or spontaneous delivery, care must be used to protect the mouth and nose of the child as it crosses the perineum so that there will be no aspiration. The majority of babies breathe spontaneoulsy, since there is no drug obtunding the vital mechanism of the baby. In our experience the delivery of a breech is greatly facilitated. The premature baby has a better than average chance, since it has been spared a severe dehydration period and excessive birth trauma due to resistance in the birth canal and outlet.

The third stage of labor is not prolonged and there is a noticeable decrease in blood loss. The contractile power of the uterus is not inhibited. When the patient is ready to return to her hospital bed the analgesia is discontinued.

TECHNIC FOR ADMINISTRATION

1. This method is definitely contraindicated for patients with gross deformities of the spine, particularly in the region of the sacrum; in local infection around the sacral hiatus, and for patients with a history of sensitivity to the analgesic agent.

2. The patient is placed in the modified left lateral Sims position. The sacral and coccygeal area is cleansed with soap and water and prepared with one of the antiseptic tinctures.

3. The tip of the coccyx is palpated with the middle finger of the left hand, and the thumb is used to find the U or V shaped notch indicating the sacral hiatus between the sacral cornua. This is usually about 1½ or 2 inches from the tip of the coccyx. In cases in which there was a failure of the inferior sacral arches to fuse to the bony root of the sacrum, this hiatus may be 2½ to 4 inches from the inferior caudal tip. Experience with the standard single caudal injections is a desired prerequisite for success in the use of the continuous method.

4. The middle finger of the left hand then changes place with the thumb and marks the spot for raising the initial skin wheal.

5. A special apparatus, as illustrated in figure 2, has been developed for this procedure. The analgesic agent recommended by us is 1.5 per cent metycaine in isotonic solution of sodium chloride. Two Gm. of the drug diluted in approximately 125 cc. of a saline solution in the reservoir bottle will most nearly approach this concentration. With a few cubic centimeters of this solution skin anesthesia is obtained by raising a skin wheal with a 25 gage and deeper infiltration to the sacrococcygeal ligament with a 2 inch 22 gage needle.

6. The special malleable stainless steel 19 gage needle is then inserted in the midline in the direction of the hiatus at about a 45 degree angle with the skin.

7. As soon as the bevel of the needle pierces the sacrococcygeal ligament, its reinforced metal collar is depressed through an arc of 1 to 3 cm. and the needle is thrust slowly and evenly in the midline for 1 to 2 inches within the sacral canal, where its bevel should lie inferior to the lowest extent of the dural sac.

This may be ascertained by measuring on the skin with the stilet the approximate extent of the needle. The point of the needle should always be below the level of the second sacral spine.

![Figure 1](https://jamanetwork.com/)

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Fig. 1.—The intervention of the uterus and birth canal in pregnancy: The sensory nerve fibers of the uterus constitute visceral afferent fibers and are functionally independent of the autonomic nervous system although coursed through the pelvic, hypogastric and aortic plexuses before connecting with the dorsal root ganglia of the eleventh and twelfth thoracic nerves in which their nerve cells are located. The inset shows details of the connections. The sensory supply to the cervix and upper part of the vagina travels in the sacral parasympathetic nerves. It is also functionally independent of the autonomic system. The sensory and motor supply of the lower vagina, perineum and pelvic floor travels in the pelvic and pudendal somatic nerves. The motor supply of the uterus is autonomic and involves both sympathetic and parasympathetic efferent components. Clinical evidence indicates that the motor fibers to the uterus leave the spinal cord at higher levels than the tenth thoracic nerve, whence they pass through the aortic, hypogastric and pelvic plexuses. Visceral efferent fibers believed to be motor to the circular muscle of the lower uterine segment and cervix and possibly inhibitory to the remainder of the uterus travel through the parasympathetic pelvic nerves. Clinical study verifies that (1) blocking the sacral nerve roots abolishes the pain of distention of the birth canal, paralyzes the skeletal muscle of the perineum and abolishes tone in the smooth muscle of the cervix; and (2) extending the block to include the eleventh thoracic root abolishes the pain of uterine contractions without impairing their force. It suggests that extending the block to the sixth thoracic nerve or higher may impair the strength of uterine contractions.
8. The small section of tubing with special adapter is then slipped over the collar of the needle. The Luer-Lok syringe is securely attached to the adapter. A careful aspiration is performed.

(a) Should clear spinal fluid be obtained, the needle has pierced the dura and lies within the subarachnoid space. In such event the needle should be immediately withdrawn and the case ruled unsuited for caudal analgesia for fear of producing a massive spinal injection of the analgesic drug. Anatomic anomalies with such low lying dura are rare. (In our experience this has happened only twice in more than one thousand injections.) A failure to recognize this situation would be extremely hazardous if not fatal.

(b) The withdrawal of pure blood indicates that the needle has pierced a small blood vessel in the highly vascular peripheral area. In this event the point of the needle should be moved until blood can no longer be obtained. Then the injection is continued cautiously.

Indications That the Solution Is Being Injected into the Peridural Space of the Sacral Canal

(a) The patients usually experience a sense of fulness progressing to an uncomfortable sensation in one or both legs as the solution circumscribes the perineural components of the sacral nerves. This sensation can be minimized by slower injection.

(b) There will be a progressive analgesia in the areas supplied by the coccygeal, hemorrhoidal, perineal, pudendal, ilioinguinal and iliohypogastric nerve. Analgesia should be complete in twenty minutes.

(c) There is relief of abdominal uterine cramps within five to fifteen minutes.

(d) Pronounced vasodilatation, cessation of sweating and increase in temperature of skin of feet will ensue within five to fifteen minutes after injection. This phenomenon is often noticed on one side several minutes before it occurs on the other.

Indications That the Solution Is Being Injected Outside the Sacral Canal

(a) Failure of the injection to relieve pain within thirty minutes.

(b) The appearance of an "injection tumor" superficial to the dorsum of the sacrum.

Supplementary Injections

12. The supplementary injection will depend on the rate of metabolism of the drug by the individual patient. In our experience 20 cc. of additional solution injected every thirty to forty minutes is sufficient to keep the parturient comfortable for the entire course of labor. We have continued our supplementary injections for a maximum of thirty hours and for an average of seven hours.

We consider this method of analgesia to be a specialized procedure which requires special training in order to attain uniform satisfactory results.

Statistical Summary

In the series of 100 cases of delivery handled by continuous caudal analgesia, the percentages were as follows in the U. S. Marine Hospital, Stapleton, N. Y.: primiparas 89 per cent, multiparas 11 per cent, cephalic 98 per cent, anterior 84 per cent, posterior 14 per cent, breech 2 per cent. In this series there were only 3 per cent unsatisfactory cases in which supplementary anesthesia was necessary.

Since Jan. 1, 1942 we have either managed or supervised the labor and delivery of 489 additional cases in the clinics of nineteen medical schools and teaching hospitals. In this group there were eleven breech deliveries, one set of twins and one cesarean section. Of this series 11 per cent obtained unsatisfactory analgesia, necessitating either discontinuance of the method or the addition of supplementary anesthesia. In many of these cases the technic was being practiced by residents who were learning the procedure.

In the entire series of 589 cases there were 586 live births with no maternal complications or deaths. The average length of time the analgesia was continued was six and one-half hours. The shortest was thirty-five minutes and the longest was thirty-three hours. The average metycaine dosage was 2.6 Gm. The maximum dosage given was 11 Gm.

In cases of toxic hypertension it was noted that after the analgesia had been in effect for about forty-five minutes the pressure reached a plateau which corresponded to their normal before they became toxic. This drop persisted until after delivery and in the cases observed did not return to the toxic peak. All the patients stated that they felt much better.
CONCLUSIONS

1. This method of analgesia in obstetrics embodies a comfortable and painless labor and delivery that is safe for mother and child.

2. The analgesia is accurately developed and controlled, utilizing specially developed apparatus and technique which overcome difficulties inherent in caudal anesthetics previously to their development.

3. The method can be started in any stage of labor and continued as long as necessary.

4. The vital mechanisms of the child are not obtundled.

5. Delivery of the child is expedited and facilitated.

6. The postdelivery complications, in our experience, are reduced.

7. This method involves a new analgesic technique which should be studied under those who have been trained in the method before it is employed in practice.

8. Obviously, the method depends also for its success on a high degree of obstetric competence, avoiding cases in which there are contraindications, avoiding meddlesome or hasty obstetric intervention and observing well established criteria for observation of the progress of the delivery.

CONTINUOUS CAUDAL ANESTHESIA IN OBSTETRICS

PRELIMINARY REPORT

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Continuous caudal anesthesia has a place in obstetrics. There are some dangers and contraindications to this method. Cautious but repeated experiences with the method are desirable to evaluate it. These preliminary observations with some of the advantages and disadvantages are presented in the hope that others interested in this field may become aware of our experience. In this series of 20 patients there were 3 failures; 1 of these presented a typical shock reaction.

TECHNIC

The same technic of administration was employed as originally described by Edwards and Hingson with the precaution of waiting ten minutes after a test injection of 8 cc. (90 mg.) of a 1.5 percent solution of metycaine (γ-2-methylpipperidine)-propano hydrochloride. This caution was exercised to make certain that the solution did not enter the subarachnoid space. If signs of spinal anesthesia did not develop, the remainder of the initial 30 cc. dose (22 cc.) was injected and repeated as advised by Edwards and Hingson. One of us (T. G. G.) administered the anesthesia in this entire group.

RESULTS

In our series of 20 cases (summarized in the table) 14, or 70 per cent, were completely successful, 3 were satisfactory but not ideal, and 3 were classified as failures. Of the 14 cases in which continuous caudal anesthesia was used during labor and delivery, 10 were completely successful and 3 others were termed satisfactory. There was 1 failure. In the 10 completely successful cases absolute relief from all labor pains was achieved. The tired, drawn, tense appearance which was present prior to the injection disappeared. The patients became relaxed and much at ease. They were definitely pleased with the results.

In the table cases which were called satisfactory only partial relief from labor pains was obtained but the episiotomies and low forceps operations were carried out without pain. In 1 of these there was complete relief on one side with a persistence of painful sensation on the opposite side; in the other 2 it was assumed that the drug did not reach a high enough level in the epidermal space to block all the uterine innervation.

The two abdominal sterilizations done following labors were completed successfully without straining and without pain when the tubes were crushed or the peritoneum manipulated. Likewise the abdominal hysterotomy on an eighteen weeks pregnancy was successful; the abdominal wall incision and the evacuation of the uterus took place with complete freedom from pain or distress.

The anesthesia was started on 3 patients for cesarean section. In 1 of these there was insufficient anesthesia of the abdominal wall for incision. Further attempts to anesthetize were not attempted. In another case, that of a toxemia of the hypertensive type, good skin anesthesia was obtained to the level of the xiphoid but the patient's blood pressure fell from 190 systolic to an indeterminate level before any operative procedure was attempted. She responded in thirty minutes after the administration of ephedrine hypodermically and oxygen inhalations. No further attempt with caudal anesthesia was made on this patient. The third section was performed successfully by means of the continuous caudal method.

COMMENT

In analyzing the 3 failures, then, we find that in 1 there was good anesthesia but the failure resulted because the patient went into vascular collapse following the injection. In the other cases the exact cause of the failure is difficult to determine, possibly a technical difficulty or possibly an anatomic variation.

It has been observed that if the solution is injected with the patient on her side (instead of in the knee chest position) the most dependent side is the first to become anesthetized and that the level of anesthesia extends higher on the dependent side. In some cases it seemed possible to get a higher level of anesthesia by injecting with the patient in the Trendelenburg position. There seems to be a direct proportion between the amount of drug given in a single injection and the level of anesthesia on the abdominal wall and also between the force of injection and the level of anesthesia.

The longest continuous period over which the drug was administered was eight hours, the procedure usually being started when the cervical dilatation was 5 cm. or more. Practically all the patients had blood pressure from 10 to 30 points or more, the greater falls occurring in patients with some hypertension; 2 had a secondary rise in pressure to above the previous maximum when the anesthesia wore off.

A few minor side reactions besides blood pressure changes were encountered. Two patients complained of severe pains in the back and legs after the drug

From the Department of Obstetrics and Gynecology of the University of Chicago and the Chicago Lying-In Hospital.


2. Eli Lily and Company furnished the metycaine used in this study.

Results of Continuous Caudal Anesthesia

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