CAUDAL ANALGESIA FOR VAGINAL DELIVERY

I. Organization, Medication, Technique, Maternal and Perinatal Infant Mortality

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TWENTY-FOUR hour anesthesia coverage of the obstetric service of the Palo Alto Hospital has been provided anesthesiologists in private practice since January 1, 1947. During the eleven years following that date, with no nurse anesthetists or resident anesthesiologist available, more than 15,000 of the almost 28,000 parturients received caudal analgesia for labor and delivery (table 1). Of the patients who delivered vaginally, 3,112 did so without an anesthesiologist being present, by choice of the obstetrician and patient; 7,622 patients received some variety of general anesthesia; and the remaining 15,525, or approximately two-thirds of all vaginal deliveries, were conducted under regional analgesia, with catheter caudal blocks predominating. Caudal analgesia has been preferred to saddle block in this hospital, because its duration of action may easily be prolonged to accommodate the patient through any length of labor; secondly, the incidence of postspinal headache is virtually nonexistent; and finally, there is less apt to be patient resistance to the caudal method than to spinal anesthesia. A review of 2,139 of the early caudal anesthesias in this series was presented by Downing in 1951.[1]

In this 200 to 300 bed hospital there has been a decrease in the use of general anesthesia for vaginal delivery. This has been due to the increased popularity among obstetricians and patients of caudal anesthesia and of modifications of the Natural Childbirth (Read) technique. The latter was formally introduced at this hospital in 1948.

ORGANIZATION OF THE ANESTHESIA SERVICE

Extensive use of caudal anesthesia for vaginal delivery requires proper organization of the anesthetic service.[2, 3] Without twenty-four hour coverage by anesthesiologists, large scale employment of regional analgesia is impractical unless the blocks are to be performed by the obstetricians. The latter arrangement, although sometimes satisfactory, can prove detrimental to a patient's welfare when difficulties with anesthesia and delivery arise simultaneously. Furthermore, part-time medical anesthesia coverage is illogical, limiting the benefits of regional analgesia to patients who are admitted only during certain hours of the day.

Another important factor in the practical use of caudal analgesia in the perinatal period is the presence of adequately trained labor and delivery room nursing personnel. Nurses who are trained to follow the progress of labor can be taught also to follow safely and adequately a well-established catheter caudal anesthesia. In the Palo Alto Hospital, when effective analgesia has been established in a given patient, and her blood pressure is stable, the anesthesiologist may feel free to leave her in the care of the delivery room nurses while he executes other duties. Should one of these duties require constant care of a patient elsewhere

TABLE 1

DISTRIBUTION OF DELIVERIES AT THE PALO ALTO HOSPITAL DURING THE YEARS 1947 THROUGH 1957

Total mothers delivered				27,876
Total babies born				28,162
Vaginal deliveries				26,259
No anesthesiologist present*			3,112	
Anesthesiologist present			23,147	
General anesthesias†		7,622		
Regional anesthesias‡		15,525		
Caudal blocks	15,357			
Spinal blocks	163			
Lumbar epidural	5			
Cesarean sections				1,617

* Patients delivered with the aid of self-administered trichlorethylene, local infiltration or pudendal block by the obstetrician, or without any anesthesia.

† Patients received inhalation or intravenous drugs as the primary agent with the exception of self-administered trichlorethylene.

‡ Includes those conduction anesthesias supplemented by light general anesthesia for reasons other than complete ineffectiveness of the block.

Accepted for publication July 29, 1958. Dr. Bush's address: 828 Northampton Drive, Palo Alto, California.

in the hospital, it is with the knowledge that another member of the anesthesia partnership is available within a few minutes to take care of problems which may arise. These problems are adequately handled by the nursing staff until a physician arrives, and these nurses may administer supplementary doses of local anesthetic solutions through the caudal catheter when ordered to do so by the anesthesiologist.

A competent obstetric staff is also a prerequisite to the use of caudal analgesia, for this type of anesthesia increases the incidence of forceps operations at delivery.[1] Selection of the anesthesia for vaginal delivery in uncomplicated cases is usually determined by the obstetrician after discussion with the patient, but that decision is subject to the approval of the anesthesiologist. When a complicated obstetric or anesthetic problem arises, the choice of anesthesia is made by the anesthesiologist after consultation with the obstetrician.

Medication During Labor

The majority of patients who ultimately have been given a caudal anesthesia at the Palo Alto Hospital also received hypnotic and analgesic medication during early labor (fig. 1). Pentobarbital sodium in one hundred milligram doses has been the commonest hypnotic given, although both secobarbital sodium and phenobarbital sodium were used occasionally. These drugs are normally used to provide sedation, as well as for their presumed beneficial effect in preventing toxic reactions from rapid absorption of the local anesthetic agents. During 1956 almost 85 per cent of patients who received a caudal block were given a barbiturate, and the increase of the average total dose of these drugs administered paralleled increasing lengths of labor (fig. 2).

During the past several years alphaprodine hydrochloride has been the analgesic agent of choice in the obstetric practice in this hospital (fig. 1). This is because of its rapid onset and relatively short duration of action,

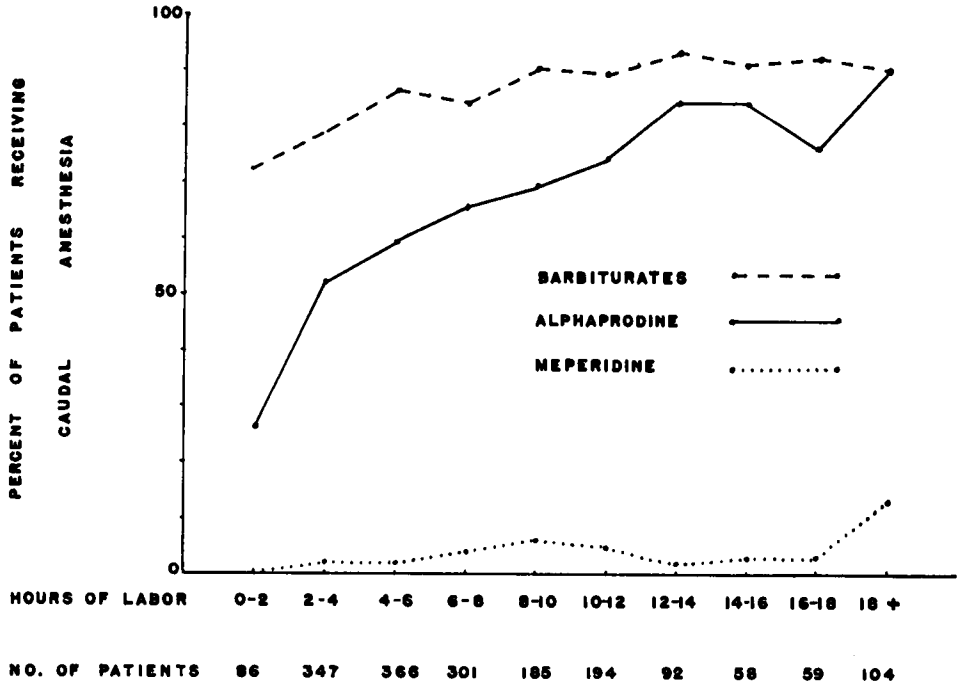

Fig. 1. Percentage of patients receiving hypnotic and analgesic medication in addition to caudal anesthesia, according to the length of labor.

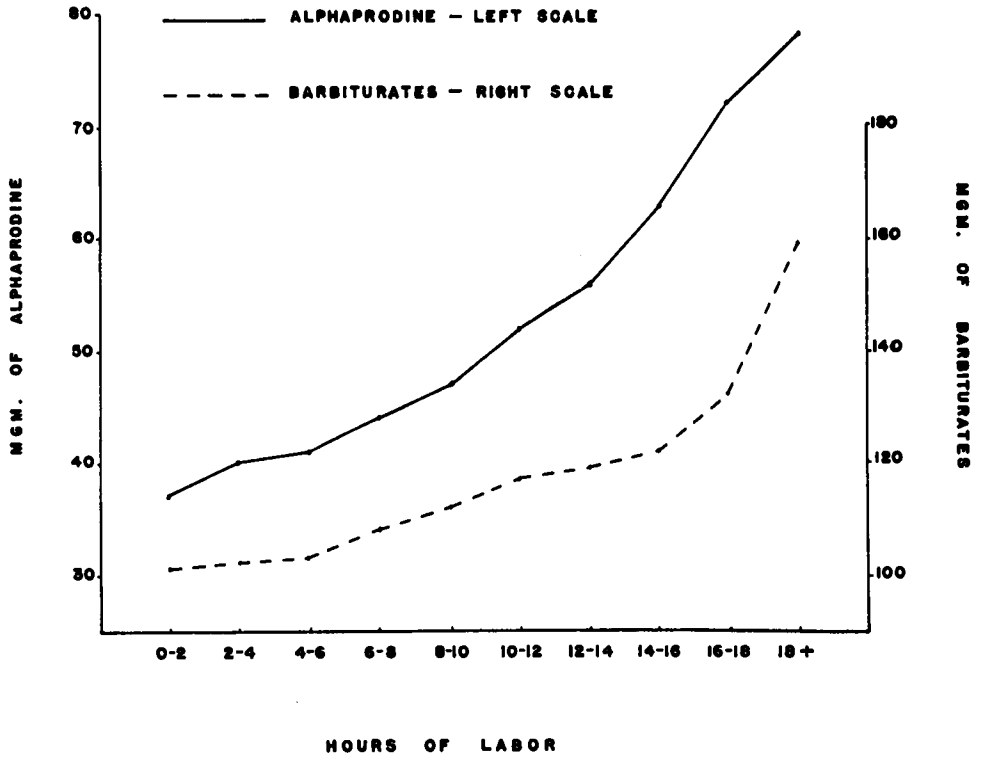

FIG. 2. Average total doses of barbiturates and *alpha*-prodine administered to patients who received caudal anesthesia, according to the length of labor.

as well as for the satisfactory pain relief it affords. Before receiving caudal anesthesia about 65 per cent of patients were given initial doses of 30 to 40 mg. of alphaprodine. Supplementary doses of 20 to 30 mg. were added when required. There was nearly a linear increase in the average total dose given as the duration of labor was prolonged (fig. 2).

Meperidine hydrochloride in 50 to 100 mg. doses was employed in only about 4 per cent of patients who received caudal anesthesia in this series (fig. 1). On some occasions both alphaprodine and meperidine were given to the same patient, particularly during longer labors. The average total doses of meperidine were not included in figure 2 because the small sample involved did not produce a curve of significance.

In occasional patients hypnotic and analgesic medications have been given following the administration of a caudal block, primarily to those in whom the analgesia has been allowed to wear off because of secondary inertia.

TECHNIQUE

The manner of administration of catheter caudal anesthesia in obstetric patients has been adequately described by a number of authors,[4-7] and need not be repeated in detail here. However, the caudal technique used differs from their descriptions in the following respects:

The majority of obstetric caudal blocks in this hospital have been performed in the labor bed with the patient lying prone over a firm cyclindrical bolster, rather than in the modified Sim's or knee-chest positions. The bolster measures approximately 9 inches in diameter and 26 inches in length and is substituted for the pillow usually placed under the patient's pelvis during the administration of a caudal block. Most pregnant women find they can lie over this bolster with comfort. In the prone position sacral landmarks and relationships are more easily palpated, and obesity is less apt to present a problem in administering

the anesthesia. Furthermore, since the anesthesiologists in this hospital prefer to perform caudal blocks for surgical procedures with the patient prone, no modification of technique is required.

The criteria for instituting a caudal anesthesia in an obstetric patient are: that she be in active labor with regularly recurring and effective uterine contractions; that the presenting part be engaged in the pelvis, and that the cervix be dilated 4–6 cm. in multiparas, and 6–8 cm. in primiparas.

Currently, the choice of anesthetic drug is limited to either lidocaine hydrochloride, 1.0 per cent, or tetracaine hydrochloride, 0.15 per cent, each with epinephrine, 1:200,000. There is approximately an 8 to 1 preference for lidocaine at the present time because it appears clinically to have a more rapid onset of action. Almost 10 per cent of these patients, however, receive both drugs during the course of their caudal anesthesias. If need for a caudal block started with lidocaine has continued longer than was initially expected and supplementary doses are required at more frequent intervals, tetracaine is often substituted because of its more prolonged action. Conversely, if a patient who has been receiving tetracaine needs a supplementary dose of anesthetic just prior to delivery, lidocaine is usually administered as the final drug so that prolonged postpartum analgesia and partial motor block may be avoided.

Initial doses average approximately 250 mg. of lidocaine or 37.5 mg. of tetracaine. Supplementary increments of 150–200 mg. of lidocaine or 22.5–30 mg. of tetracaine are added whenever the level of analgesia subsides sufficiently for the patient to feel pain associated with uterine contractions.

No arbitrary maximum total dose of local anesthetic agents has been set for the caudal blocks. It has been the objective of the anesthesia staff to make patients as comfortable as possible. In rare instances as much as 400 to 600 mg. of lidocaine or 60–90 mg. of tetracaine have been administered over a thirty to sixty minute period to achieve satisfactory analgesia. With caudal blocks lasting twelve hours or more, over 2.0 Gm. of lidocaine or 200 mg. of tetracaine have occasionally been used as a total dose. To date no serious toxic manifestations from large doses of the local anesthetic drugs have been observed.

So far as can be determined, convulsive reactions to the local anesthetic agents have occurred in only 5 of the more than 15,000 obstetric patients who have received caudal anesthesia. All of these have arisen during the injection of the initial dose of the drug. Three were sufficiently severe to require treatment with intravenous barbiturates and the other 2 subsided spontaneously before therapy could be instituted. A fresh solution of 2.5 per cent thiopental sodium is immediately available for treatment of such emergencies. In addition, minor reactions presumed to be due to the local anesthetic agents have occurred on occasions, characterized by either a mild, chill-like shaking unassociated with a sensation of being cold, or, more rarely, by transient somnolence. These minor reactions have usually followed the administration of lidocaine. None has been sufficiently severe to require more than reassurance of the patient.

Following the administration of the caudal block, the patient is placed flat on her back in a modified Fowler's position with the head of the bed elevated 25 to 35 degrees. This is done to help limit the cephalic spread of analgesia approximately to the tenth thoracic dermatome. If pain from uterine contractions is completely relieved following administration of the caudal block, and hypotension has not occurred, the analgesia level ordinarily is not measured in each patient. However, if her discomfort continues or her blood pressure falls, skin levels of analgesia are determined and appropriate therapy undertaken. Whenever the level of analgesia is inadequate on one or the other side, the patient is turned onto that side and small supplementary volumes of local anesthetic agents are given through the caudal catheter until effective anesthesia is achieved.

Hypotension, the most common complication of caudal block anesthesia in this series, is treated by raising the patient's legs or turning her toward one or the other side, or both. These maneuvers provide the patient with an autotransfusion and remove uterine pressure from the inferior vena cava to allow increased venous return to the heart. A favorable response of the blood pressure almost invariably

occurs within one or two minutes. Administration of vasopressor drugs is reserved for use in the rare case in which hypotension persists in spite of this therapy.

One hundred per cent oxygen is administered to the mother at any time during labor if the fetus exhibits signs of hypoxia, or a situation exists in which oxygen deprivation to the infant may be expected; as, for example, with severe or prolonged maternal hypotension or marked anemia. Fetal distress ordinarily is evidenced by (a) definite change in the rate or rhythm of the fetal heart sounds, (b) sudden onset of increased or decreased fetal movements, and (c) passage of meconium stained amniotic fluid after rupture of membranes in patients with vertex presentations.[8] In the absence of mechanical factors such as premature separation of the placenta, obstruction of blood flow through the umbilical cord, or tetanic uterine contractions, the increase in total oxygen carried by the maternal blood following oxygen inhalation may provide the infant with sufficient additional oxygen to prevent damage within the central nervous system or intrauterine death.[4] When the patient is taken to the delivery room, 100 per cent oxygen routinely is given by mask until after the umbilical cord is clamped in order to provide extra fetal oxygenation during the period of delivery.

Contraindications

Contraindications to the use of caudal anesthesia in the delivery room may be divided into two categories: obstetric and anesthetic. Premature separation of the placenta and severe vaginal hemorrhage with imminent or accompanying shock are obstetric emergencies which ordinarily call for prompt cesarean section. Since the induction of effective caudal anesthesia may be prolonged, and more importantly, because further decrease in circulating blood volume occurs with the onset of caudal block, this type of analgesia is not employed in patients who appear to be verging on hemorrhagic shock. Placenta previa and dystocia are not considered to be absolute contraindications to the use of caudal anesthesia. Patients with marginal placenta previa (or low lying placenta) in whom vaginal bleeding is controlled by the tamponading effect of the baby's head as labor progresses, often receive caudal anesthesia and no untoward incident has resulted. Vasodilatation in the anesthetized area[9] has not been a problem in these patients providing the initial bleeding has not produced hypovolemia.

Patients with potential dystocia to whom it is considered judicious to give a trial of labor also frequently receive caudal anesthesia during labor. These blocks may then be continued as the definitive anesthesia should the patient later require cesarean section.

Active disease of the central nervous system (with the possible exceptions of idiopathic epilepsy and herniated intervertebral discs), infection at the site of administration of the block, and subarachnoid tap with the caudal needle constitute the absolute anesthetic contraindications. Pilonidal sinus does not always preclude the use of caudal anesthesia, provided that it has not been infected and that it is possible to avoid passing the needle through the sinus tract. Abnormalities of the sacrum and obesity, while they are probably responsible for failures, do not prevent the anesthesiologist from trying to administer a block. When blood is aspirated, the caudal needle is replaced and the catheter passed beyond the bleeding point. The local anesthetic solution is then injected very slowly to prevent too rapid absorption of the drug.

Maternal Mortality

During the years 1947 through 1957, six maternal deaths occurred, a rate of 2.2 per 10,000 live births (table 2). This rate compares favorably with maternal mortality among white patients in the United States, which has decreased steadily from 10.9 (in 1947) to 3.7 (in 1954) per 10,000 live births.[10] Figures for white patients have been used for comparison because the large majority of mothers delivering in this hospital are of that category.

Of the 6 deaths (table 2) one can be considered to have been preventable (number 2) and occurred following operative hemorrhage from the uterine artery during a cesarean section-hysterectomy. Another patient (number 6), who received general anesthesia for vaginal delivery, died following rupture of an intracranial aneurysm. The remaining 4 fatalities occurred following vaginal deliveries con-

TABLE 2

MATERNAL MORTALITY OCCURRING AMONG 27,876 MOTHERS DELIVERED

Patient Number	Year	Cause of Death	Type of Anesthesia
1	1950	Terminal Hodgkin's disease Toxemia of pregnancy Premature labor	Catheter caudal
2	1952	Cesarean section-hysterectomy for complete premature separation of the placenta with Couvelaire uterus Severe shock Dead baby Operative hemorrhage	Thiopental Nitrous oxide *d*-Tubocurarine
3	1953	Pulmonary embolus	Catheter caudal
4	1954	Ruptured intracranial aneurysm	Catheter caudal Trichlorethylene
5	1954	Guillain-Barre syndrome	Catheter caudal
6	1956	Ruptured intracranial aneurysm	Nitrous oxide Cyclopropane Diethyl ether

ducted under caudal anesthesia. One of these (number 1) occurred within a week of premature delivery in a primagravida with terminal Hodgkin's Disease, in whom the pregnancy was incidental.

While the author does not believe that anesthesia can be held directly responsible for any of the other maternal fatalities, the possible relationship of the caudal blocks to those patients' deaths warrants more complete discussion.

Patient Number 3, whose death followed what her obstetrician believed was an amniotic pulmonary embolus, was a 30 year old multipara. She had developed thrombophlebitis in her left calf three weeks prior to her admission for delivery. She was treated conservatively with bed rest, elevation of the leg, supportive bandaging, and penicillin. Because of the proximity to her expected date of confinement, no anticoagulant therapy was instituted. Examination by the obstetrician before and after her full term delivery revealed no evidence of activity of the thrombophlebitic process.

During labor she received pentobarbital sodium, 100 mg., orally. A catheter caudal block requiring only a single dose of lidocaine 300 mg. with epinephrine 1 : 200,000 was administered about one and a half hours after admission. There was no decrease in blood pressure or other difficulty encountered during the course of anesthesia. Delivery was accomplished easily by a low forceps operation approximately two hours after the caudal analgesia had been started.

She was returned to the ward in good condition. One hour after delivery (at 3:05 a.m.) she began to complain of difficult breathing and her blood pressure was found to be 86/56 mm. of mercury. Phenylephrine 2.0 mg. was given intramuscularly at 3:15 a.m. Five minutes later she had a convulsion and the administration of oxygen by mask was started. At 3:30 a.m. thiopental sodium, 125 mg., was administered intravenously. Shortly thereafter she had another convulsion followed by the clinical onset of pulmonary edema. Breathing ceased in a few moments and respirations were controlled by bag and mask until the patient was pronounced dead at 4:05 a.m.

The coroner's protocol described only the gross findings in the embalmed body. Approximately 300 ml. of fluid were found in each pleural cavity. There was, in addition, reduced crepitance of the lungs which had multiple small, soft areas of purple or grey-purple discoloration. No large embolic site was found. The abdomen contained approximately 1.0 liter of watery fluid discolored by embalming solution. There was no gross evidence of rupture or laceration of the uterus or cervix.

Microscopic study of the lung was not reported, and since no section of tissue is available it is impossible to state with certainty whether this was a case of thrombotic or amniotic embolus. The latter possibility seems remote, since the symptoms of the embolic phenomenon began an hour following evacuation of the uterus. Another possible cause might have been that vasodilation and increased blood flow resulting from the caudal anesthesia could have loosened a venous clot sufficiently to permit the shower of small emboli, which apparently caused this patient's death. Since this same sequence of events may follow any type of anesthesia (or none at all) it is difficult to blame caudal block alone for this catastrophe.

Patient Number 4 was a 27 year old multipara whose previous delivery had been accomplished in another hospital under caudal anesthesia. Her past history revealed that she had suffered from intermittent severe "migraine" headaches most of her life. She was admitted on her estimated date of confinement for induction of labor. This was accomplished over a two-hour period by intramuscular injections of oxytocin. About an hour after she had begun labor (at 11:35 a.m.) she received pentobarbital, 100 mg., orally and alphaprodine hydrochloride, 40 mg., subcutaneously. At 12:55 p.m. a catheter caudal block was instituted with 250 mg. lidocaine containing epinephrine, 1 : 200,000. Her blood pressure remained at approximately the recorded admission level of 118/70 mm. of mercury during the course of anesthesia. At 2:35 p.m. a supplementary dose of lidocaine, 170 mg., was given, and at 3:20 p.m. tetracaine,

30 mg., with epinephrine, 1 : 200,000 were injected.

When she was taken to the delivery room at 5:35 p.m. the level of analgesia had subsided and she was beginning to feel some discomfort. An attempt to supplement the caudal anesthesia failed because of a leak in the catheter. The patient received self-administered trichlorethylene by inhaler. Following an easy forceps rotation, delivery was accomplished by a moderately difficult low forceps operation assisted by expulsive efforts on the part of the patient. During delivery she complained of the sudden onset of headache. Delivery of an 8 pound, 6 ounce baby occurred at 6:02 p.m. and the placenta was expelled spontaneously two minutes later. She received 10.0 international units of oxytocin after the birth of the baby and ergonovine maleate, 0.2 mg., following expulsion of the placenta, both drugs being given intramuscularly.

Upon her return to the ward at about 6:50 p.m. she vomited once and complained of a severe headache. Her blood pressure at that time was 160/70 mm. of mercury. She was given meperidine hydrochloride, 100 mg., at 7:00 p.m. Two hours later she was found to be unresponsive and "twitching" at intervals. Lumbar puncture revealed grossly bloody spinal fluid. Carotid arteriography performed showed "a large space occupying mass in the left temperofrontal area between the left middle and left anterior cerebral arteries." A burr hole was made and blood was aspirated from the intracerebral hematoma. In spite of this and other supportive therapy, she died about thirty-nine hours after delivery. No autopsy was performed.

The anesthetic management did not appear to be responsible for the rupture of this patient's intracranial aneurysm.

Patient Number 5, a 24 year old multipara, was admitted to the hospital during the early part of her eight hour labor. Her prenatal course had been uneventful, and her past history was noncontributory. The only abnormal physical finding on this admission was an oral temperature of 99.5 F. Prior to production of caudal anesthesia, she was given 200 mg. of pentobarbital orally (in 2 doses) and 40 mg. of alphaprodine subcutaneously, as well as several intramuscular injections of oxytocin to stimulate her labor. The caudal block was instituted at 10:40 a.m. with an initial dose of 200 mg. of lidocaine containing epinephrine 1 : 200,000. Ten minutes later lidocaine, 160 mg., were added, and supplementary doses of 200 and 150 mg. were given at 1:05 p.m. and 2:05 p.m. respectively. A low forceps delivery was accomplished without difficulty at 2:35 p.m., and she received oxytocin, 10 units, intramuscularly both after the birth of the baby and delivery of the placenta.

One and a half hours after delivery, her temperature was 102 F. She received one dose of penicillin and had no further fever during this admission. On her second and third postpartum days she complained of moderately severe headache only partially relieved by aspirin. The same symptoms of fever and headache had followed her first delivery eighteen months earlier. She was discharged on her third postpartum day in good condition. Four days later, however, she developed lower abdominal pain and tenderness associated with fever and discharge of foul lochia. Daily injections of penicillin and streptomycin appeared to produce a prompt therapeutic response.

Nine days following delivery she began to complain of inability to move the upper half of her body, although she could "do some things with her arms." Neurological findings at that time were essentially normal. She was readmitted the next day because of progression of her symptoms. General physical examination showed no abnormality except for a moderately tender uterus which was still enlarged above the symphisis pubis. This was associated with minimal discharge of foul lochia. Neurological examination revealed normal and equal deep reflexes of the extremities. General sensory examination to pin prick was equal bilaterally. There was definite weakness of all peripheral muscles and she had some nuchal rigidity. Lumbar puncture revealed normal spinal fluid pressure and dynamics. The fluid contained 6 polymorphonuclear leucocytes and 19 lymphocytes per milliliter, and total protein of 140 mg. per cent. Routine blood and urine examinations were within normal limits. A diagnosis of Guillain-Barre type of paralysis was made.

Two days later deep reflexes had disappeared in her legs and had become unequal in her arms. She had also developed a small area of hypalgesia over her right chest wall. Her spinal fluid pressure had increased to 220 cm. of water, with cell count and total protein remaining approximately the same as on initial examination. She became semi-comatose and developed difficulty breathing which ultimately required tracheotomy and positive pressure respiration. On the day before she died she became hyperpyrexic and her blood pressure decreased. Death occurred nine days after the onset of symptoms of weakness in her arms.

Since the etiology of the Guillain-Barre syndrome is not known, it is believed that it would be impossible to prove a correlation between this fatal outcome and the caudal anesthesia the patient received.

Perinatal Infant Mortality

There were 774 perinatal deaths among the 28,162 babies born of 27,876 mothers at the Palo Alto Hospital during the period of this report, an uncorrected incidence of 27.5 per 1,000 births (tables 1 and 3). Of these, 376

TABLE 3

DISTRIBUTION OF BIRTHS BY WEIGHT GROUPS AND PERINATAL FATE OF INFANTS ACCORDING TO THE TYPE OF ANESTHESIA

	Number of Births in Reference to Birth Weights						
	Under 1 Kg.	1–1.5 Kg.	1.5–2 Kg.	2–2.5 Kg.	Over 2.5 Kg.	No Wt. Given	Total
Vaginal Deliveries							
Regional anesthesia							(15,525)
Stillborn	5	21	5	20	53	6	110
Neonatal deaths	27	30	25	25	40	3	150
Survivals	1	34	123	562	14,692	10	15,422
Total born	33	85	153	607	14,785	19	15,682
General anesthesia							(7,622)
Stillborn	47	14	14	16	43	12	146
Neonatal deaths	28	25	16	11	37	3	120
Survivals	2	18	54	191	7,173	9	7,447
Total born	77	57	84	218	7,253	24	7,713
No anesthesiologist present							(3,112)
Stillborn	42	7	5	6	2	12	74
Neonatal deaths	35	17	10	5	6	1	74
Survivals	1	7	24	121	2,830	5	2,988
Total born	78	31	39	132	2,838	18	3,136
*Cesarean Sections**							(1,617)
Stillborn	9	2	3	4	21	7	46
Neonatal deaths	11	9	6	10	18	0	54
Survivals	1	6	21	102	1,396	5	1,531
Total born	21	17	30	116	1,435	12	1,631

* Perinatal infant mortality associated with cesarean section is included for comparison as a single group without reference to the type of anesthesia used.

TABLE 4

NEONATAL DEATH RATES PER 1,000 LIVE BIRTHS BY BIRTH WEIGHT AND TYPE OF ANESTHESIA

	Fetal Death Rates in Reference to Birth Weights					
	Under 1 Kg.	1–1.5 Kg.	1.5–2 Kg.	2–2.5 Kg.	Over 2.5 Kg.	Total
Regional anesthesia	964.3	468.8	168.9	42.6	2.7	9.6
General anesthesia	933.3	581.4	228.6	54.5	5.1	15.9
No anesthesiologist present	972.2	708.3	294.1	39.7	2.1	24.1
Cesarean sections	916.7	600.0	222.2	89.3	12.6	34.0

were stillborn (13.3 per 1,000 births) and 398 died in the neonatal period (14.3 per 1,000 live births). All deliveries of more than 20 weeks gestation including cesarean sections, multiple births, and infants with congenital defects incompatible with life are included in the tabulations.

The survival rate of infants (table 4) who weighed less than one kilogram at birth was approximately 5.0 per cent,[11] regardless of the

type of anesthesia or delivery. In this obstetric environment, premature infants weighing between one and two kilograms have the best chance to survive if their mothers receive regional anesthesia for delivery. A chi-square test computed on the neonatal deaths in this weight range between infants born of mothers in the regional anesthesia and "No Anesthesiologist Present" categories, showed significant difference at better than the half per cent level. For infants weighing more than 2 kg. at birth, there is no statistical difference in neonatal mortality between those born of mothers who received regional anesthesia and those who delivered with some modification of the Read technique. With newborns whose weight was in the one to two kilogram group, the rate of neonatal loss following general anesthesia was intermediate between that with regional analgesia and the Read technique. For those weighing more than 2 kg., general anesthesia is associated with a somewhat higher neonatal death rate than occurs with the other anesthetic methods used in this hospital for vaginal delivery.

Conclusions

From the data gathered during the eleven-year period reviewed, the following conclusions may be drawn:

Caudal analgesia for vaginal delivery is as satisfactory as any other single anesthetic method presently available both with regard to maternal comfort and welfare and infant survival. Nevertheless, caudal anesthesia is not advocated for all patients undergoing vaginal delivery. Anesthesiologists and obstetricians should suit their management of labor and delivery to the patient's situation, rather than the patient to the method. For certain women caudal analgesia is not a satisfactory choice. Aside from those who manifest specific contraindications to regional analgesia, some patients have an inordinate fear of this type of anesthesia. A few others present technical problems which make administration of caudal block difficult, if not impossible. There are some patients whose delivery follows so rapidly after admission to the hospital, that it is fruitless to attempt to provide them with regional anesthesia other than pudendal block.

Statistical evidence indicates that neonatal mortality among premature infants is appreciably less with regional anesthesia than with other anesthetic methods used in this hospital.

Several criteria must be met before caudal analgesia can be used successfully on a large scale for delivery: (a) Cooperation between anesthesiologists and obstetricians as well as an understanding of each other's problems is the basis of successful application of regional anesthesia to obstetric practice. (b) Anesthesiologists must be able to provide twenty-four hour coverage. (c) Caudal blocks must be performed in sufficient numbers for the anesthesiologists to become proficient in the technique. (d) Adequately trained nursing personnel must be available to follow the patients to whom caudal analgesia has been administered. With this help the anesthesiologist is free to conduct more than one block at a time, and, when necessary, to perform concurrently other duties in the hospital. (e) A competent staff of obstetricians is a prerequisite to the extensive use of caudal analgesia, for this type of obstetric anesthesia increases the incidence of forceps operations at delivery.

Summary

A review of the organization of the obstetric anesthetic service provided on a twenty-four hour basis by anesthesiologists in private practice in a 200–300 bed hospital has been presented. Of the 27,876 deliveries during the years 1947 through 1957, 15,357 were performed under caudal anesthesia.

The maternal death rate was 2.2 per 10,000 live births, and the uncorrected fetal perinatal loss was 27.5 per 1,000 births. Caudal anesthesia provided the infant whose birth weight was between one and two kilograms with the best chance to survive. For infants weighing over 2 kg. at birth, the use of caudal analgesia was as safe for the newborn as other methods of anesthetic management employed for vaginal delivery.

With proper organization of the staff of anesthesiologists, the presence of adequately trained nursing personnel, and a competent staff of obstetricians, caudal analgesia may be effectively employed for vaginal delivery in private practice.

The author acknowledges the technical assistance of Ronald Pyke, Ph.D., Statistics Department, Stanford University, who performed the chi-square tests on data of infant mortality.

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