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5. Accretion rate was determined from the weight of rime gathered by the rod in a known time.
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Local-Regional Anesthesia during Childbirth: Effect on Newborn Behaviors

Abstract. *Administration of local-regional anesthesia during normal deliveries was correlated significantly with newborn behaviors as evaluated by the Brazelton neonatal assessment scale. Three days after birth, infants whose mothers received local-regional anesthesia were more irritable and motorically less mature than those infants whose mothers were not medicated.*

The pain-relieving drugs of labor and delivery were for many years administered to parturient women with little concern about the effects of these drugs on the other patient—the fetus. Recently, however, some serious fetal consequences of high dosages or repeated administration of maternal premedications and anesthetics have been recognized: meperidine and morphine may produce respiratory depression and the addiction-withdrawal syndrome (*1*); similarly, local anesthesia has been implicated in fetal bradycardia (*2*) and depression of respiration and circulation (*3*).

Effects of premedications on infant behaviors have also been demonstrated, especially in neonates born to mothers who received high drug dosages. Brazelton (*4*) noted the disorganizing effects of medication on the neonate, especially with regard to the effectiveness of infant nursing. Stechler (*5*) found that drug dosage was related to visual attentiveness in infants. Conway and Brackbill (*6*) found a combined effect of analgesia and anesthesia on muscle tension and on rate of extinction of the orienting reflex.

The behavioral effects of anesthetics have not been as well documented. Local anesthetic agents administered by regional routes are often assumed to be of no consequence to the healthy infant and have commonly been ignored as variables for study. Epidural anesthesia was found to affect limited neurobehavioral measures in one study (*7*), but infants whose mothers received low spinal, local, and no anesthesia were combined in the control group and the effect of analgesia administration was not controlled for statistically.

We studied the possible effects of local-regional anesthetics and analgesics administered during childbirth on behavior characteristics of infants 3 days of age. The sample consisted of 60 first-born, healthy infants between 48 and 72 hours of age. All were born of white middle-class women who had received routine antenatal care and had medically uneventful pregnancies and deliveries. The study is part of a larger longitudinal project on parent-infant interaction from the prenatal period to 1 month postpartum.

Information about labor and delivery and other birth data were obtained from hospital records: length of labor, type of delivery (spontaneous, forceps), the baby's birth weight, 1- and 5-minute Apgar scores, and analgesia and anesthesia administered. Labor times ranged from 2 to 18 hours. Forceps were used in 39 deliveries. Birth weights ranged from 2270 to 4226 g. Only five 1-minute Apgar scores were below 7, and all were normal at 5 minutes.

The analgesia score was computed from the dosage and interval between administration and delivery of the child. Drug dosage and time of administration were separately scored on a four-point scale ["4" being 150 mg or more of meperidine (or the equivalent) for drug dosage and within 1½ hours of delivery for time of drug administration]; these scores were multiplied to obtain a time-weighted dosage score. Sums of these scores for each woman comprise the analgesia variable. The most frequently administered analgesic agent was Demerol (meperidine) in conjunction with the preanesthetics Phenergan (promethazine hydrochloride) or Vistaril (hydroxyzine pamoate); morphine was given to two women. The first three drugs were considered equal in potency, and 10 mg of morphine was considered equal to 75 mg of the others. The woman with the highest analgesia score had received 50 mg of Demerol and 50 mg of Vistaril 3 hours before delivery and 75 mg of Demerol within the hour before delivery.

Anesthesia was scored as to whether or not local-regional anesthesia was administered; no woman received general anesthesia. Drug choice, dosage, and route of administration varied, but the maximum safe dose was never exceeded. Anesthetic solutions used were lidocaine, tetracaine, mepivacaine, and bupivicaine. Of the 52 women who received anesthesia, 42 were given spinal (saddle block) anesthesia. The routes of administration for the other women were pudendal (four), paracervical (one), epidural (two), both epidural and saddle block (two), and both pudendal and saddle block (one). Eight women received no anesthesia.

Infants were evaluated by the Brazelton neonatal assessment scale (*8*). This technique is more comprehensive than a standard neurological examination and assesses habituation to stimuli,

Table 1. Pearson product-moment correlations between childbirth medication scores and newborn behaviors.

Childbirth medication	Brazelton newborn scale clusters					
	Altertness		Irritability		Motor maturity	
	r	*N*	*r*	*N*	*r*	*N*
Analgesia	−.09	60	−.02	58	−.26*	61
Anesthesia	−.18	59	.26*	57	−.37†	60

* $P < .05$. † $P < .01$.

Table 2. Brazelton newborn scale cluster scores for childbirth medication groups. Numbers of subjects (N) in the same medication condition may differ because of incomplete data on some infants. Only one subject was given a low dose of analgesia but no anesthesia; data for that medication condition are not included. No subjects were administered moderate or high doses of analgesia with no anesthesia. Values for t are for comparisons between groups in the adjacent columns.

Brazelton scale cluster	No anesthesia, no analgesia	t	Anesthesia, no analgesia	t	Anesthesia, low analgesia	t	Anesthesia, moderate analgesia	t	Anesthesia, high analgesia
	Mean ± S.D. N		Mean ± S.D. N		Mean ± S.D. N		Mean ± S.D. N		Mean ± S.D. N
Altertness	39.4 ± 9.5 7	1.67	28.9 ± 15.1 15	1.17	35.5 ± 11.2 10	0.69	32.8 ± 7.3 12	1.15	29.0 ± 9.1 14
Irritability	13.5 ± 6.5 6	2.13*	20.2 ± 6.5 14	0.56	18.7 ± 6.6 10	0.01	18.7 ± 3.8 11	0.28	18.2 ± 5.4 15
Motor maturity	21.1 ± 4.1 7	2.60†	15.1 ± 5.4 15	0.10	14.9 ± 5.7 10	0.72	13.3 ± 4.4 12	0.00	13.3 ± 4.2 15

* $P < .05$. † $P < .02$.

responsivity to animate and inanimate stimuli, state and the requirements of state change, neurologic status, and motor development. A number of scale items are combined into three clusters: (i) alertness or orienting: the infant's responsivity to visual and auditory, animate and inanimate stimuli; (ii) irritability: the frequency and conditions of state changes and irritable behaviors; and (iii) motor maturity: the arcs and smoothness of the baby's movements, tremulousness, and frequency of startling.

The results show that these drugs given the mothers do affect the babies' behaviors in the neonatal period (Table 1). Administration of local-regional anesthesia is correlated significantly with decreased motor maturity and greater irritability. Jerky movements in small arcs, startles and tremulous motions, and frequent state changes and crying were more common in babies of mothers who received anesthesia. Analgesia usage is significantly related to lower scores on motor maturity.

The two medications, however, are themselves correlated ($r = .39$; $P < .01$), and their relative effects are assessed in Table 2. The most alert, least irritable, and motorically most mature behaviors were shown by those babies whose mothers received neither medication. Use of anesthesia appears to have a greater influence on the infant than does analgesia. When the effect of analgesia was controlled for by comparing babies whose mothers received no analgesia, the anesthesia and no anesthesia groups were significantly different on irritability and motor maturity scores; the difference for alertness approached significance. On the other hand, when the effect of anesthesia was controlled for by comparing the four groups of babies whose mothers received anesthesia and varying doses of analgesia, no significant differences were found on the infant measures. Also, product-moment correlations between analgesia and the three Brazelton clusters were nonsignificant when only those subjects who received anesthesia were included in the analysis.

This lack of relationship between maternal analgesia and newborn behavior does not support results of previous studies. However, higher drug dosages than these were studied in most earlier research, and there may well be medication effects in higher drug ranges.

The more crucial data are those evidencing anesthesia effects on infant functioning. It is known that anesthetic agents cross the placenta and enter fetal circulation. There is no evidence, however, that these drugs are present in infants later than 1 day after birth. Mepivacaine was detected in infants' blood as late as 24 hours after birth, and lidocaine, as late as 8 hours after birth (*9*); the infants in our study were tested at 3 days of age. It is possible that medication no longer detectable in the circulation could be bound at sites in the central nervous system.

An alternative explanation is that there is no drug effect per se, but that use of anesthesia is related to the difficulty of labor and delivery which may directly influence newborn behaviors. However, the three Brazelton clusters do not correlate significantly with other factors related to difficulty of delivery: length of labor, use of forceps (in the anesthetized group), Apgar scores, and infant birth weight. Parity and gestational age are not considerations since all mothers were primiparous and delivered full-term infants.

Use of anesthesia could also reflect a maternal factor: aspects of the mother's personality having to do with her need for medication. These personality characteristics could be transmitted genetically or in utero to the fetus and manifested in the baby's temperament. If this is so, both delivery medication scores and the Brazelton neonatal behavior scores would be dependent outcome measures of maternal personality.

In order to discriminate among these possible interpretations in future research, there must be careful records of drug agents, dosages, and times of administration, maternal and fetal physiologic responses during labor and delivery, and women's prenatal expectations and preferences for medication. Variations in normal childbirths must be understood if we are to differentiate the interrelated influences on infant behaviors.

Whatever the interpretation, it appears that anesthesia administration during childbirth is significantly related to the functioning of the newborn child. Local-regional anesthetics, although known to produce severe physiologic reactions in high doses, continue to be considered a safe choice in standard obstetric procedures. Our data raise questions about the assumption that routine usage of these anesthetic agents is inconsequential, even for the normal, healthy infant.

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