Pain in Neonatal Circumcision

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Because newborn circumcision is a quick and safe surgical procedure, any method to relieve pain must be almost risk-free in order to be acceptable. General anesthesia and narcotic analgesia are not appropriate. Dorsal penile nerve block (DPNB) with lidocaine hydrochloride is probably the most effective and safest form of anesthesia for newborn circumcision currently available, but it can cause significant local and systemic reactions. Only a limited number of cases of DPNB have been reported and we feel that this procedure should be used cautiously until there is more published evidence of its safety. Alternative methods of pain relief including oral acetaminophen and topical anesthesia should also be studied. Of special interest is recent evidence that a sucrose-flavored pacifier is an effective analgesic during newborn circumcision.

Routine newborn circumcision is the most commonly performed operation in males in the United States. At the height of its popularity between the late 1940s and the early 1970s, up to 1.5 million newborn circumcisions were performed yearly, representing 85%-90% of newborn male infants in the United States.[1] In 1971 and 1975 recommendations by the American Academy of Pediatrics (AAP) suggested that routine newborn circumcision was an unnecessary procedure[2,3] and the rate of circumcision began to decrease.[4] Recently, however, the Task Force on Circumcision of the AAP found evidence of advantages as well as disadvantages to newborn circumcision[5] which could prompt a resurgence in popularity of the procedure making the question of pain relief more relevant.

When properly performed by a skilled operator, newborn circumcision is a quick and safe surgical procedure that generally takes less than 10 minutes.[6] The procedure is usually performed without anesthesia. It is recognized that infants undergoing circumcision without anesthesia feel and respond to pain.[7] In recent years, interest has increased in the use of anesthesia, particularly dorsal penile nerve block (DPNB) with lidocaine hydrochloride in reducing the pain and stress of newborn circumcision.[8-11] However, experience has been limited using local anesthesia in newborn circumcision.[12] This paper reviews the methods of relieving pain in newborn circumcision, particularly DPNB and suggests an approach to this problem.

Circumcision without anesthesia

Human newborns feel pain; all the anatomic and functional pathways necessary to perceive painful stimuli are present at birth.[7] The cortical and subcortical centers involved in pain perception are well developed by the third trimester. Infants of all viable gestational ages respond to

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painful stimuli by behavioral, cardiovascular, and hormonal changes.[6,7,9-11,13-14] In recent years, these changes have been well documented in newborn circumcision. Behaviorally, infants exhibit a cry pattern indicating distress during circumcision, as well as changes such as irritability, varying sleep pattern, and differing infant-maternal interaction for the first few minutes to hours following circumcision.[6,13,15] In a detailed study of neonatal pain cries during circumcision, Porter et al[15] described infant crying patterns before circumcision, during the various stages of the procedure, and afterward. Factors such as the perceived urgency of the cry, harmonics, pitch, variability, and peak frequencies were studies. The cry of greatest urgency was perceived during the most invasive aspect of the surgery. Within 10 minutes following completion of surgery, the crying pattern returned to preoperative baseline levels. Physiologic changes during circumcision include increased heart rate and blood pressure and decreased oxygen saturation.[9,11] All these physiologic indexes were found to return to baseline levels within 15 minutes of completion of surgery. In one study, serum cortisol concentrations rose within 30 minutes of circumcision, returning to baseline level within 150 minutes.[11] In a 1980 study by Marshall et al[6] the average length of time for performing circumcision using a Gomco clamp was 7.6 $\pm$ 1.8 minutes; the mean time for the infants to become quiet following the procedure was 13.6 $\pm$ 9.7 minutes. The Gomco clamp and the Plastibell (Holster, Inc., Libertyville, Ill) are the two most common devices used to perform newborn circumcision; results are comparable in terms of convenience, speed of the procedure, and complications.[16]

Thus, although infants respond quickly and vigorously to the pain of circumcision, resolution of the behavioral and physiologic changes is rapid and apparently complete within minutes to hours following surgery, and there is no evidence of long-term psychologic sequelae.[17] The transitory nature of these effects of pain in the normal neonate, in combination with the negligible mortality and low morbidity of the procedure, has led to a reluctance to impose the potential risks of anesthesia on this procedure, which has been quickly and safely performed on tens of millions of infant boys in the United States during the past 40 years. Any method to relieve pain in newborn circumcision must be almost risk-free to be acceptable.

Local anesthesia: dorsal penile nerve block (DPNB)

The functional immaturity of the respiratory, cardiovascular, and central nervous systems in the newborn increases the risk of narcotic analgesia and general anesthesia. A newborn anesthetic mortality rate as high as 1:1000[18] has prompted a search for safer methods of relieving neonatal pain. The potential value of DPNB was emphasized by Kirya and Werthmann in 1978.[8] It has been shown that DPNB ameliorates the stress of newborn circumcision, evidenced by decreased behavioral change and a diminished rise in pulse and blood pressure and fall in oxygen saturation.[14] Stang et al[11] showed that the adrenocortical response of circumcision was also reduced by DPNB. They believed that DPNB was a safe and easy technique that should be generally applied in neonatal circumcision.

However, experience with DPNB has been extremely limited; less than a few hundred cases have been reported, with most published series numbering only 20-30 infants.[9,11-14] Although reported experience[19] since publication of the recent Report of the Task Force on Circumcision indicates that use of DPNB is more widespread and that clinical experiences have been favorable regarding general safety, hematoma and gangrene of the skins of the glans penis have been reported.[20] Injection of lidocaine into the dorsal penile vein can cause systemic effects from mild CNS excitation at low doses to seizure activity, coma, and cardiovascular depression at high doses. Injection of lidocaine into one of the dorsal penile arteries can result in direct delivery of a high concentration of local anesthetic to the brain or heart, resulting in toxic side effects even with very low doses.[21] Systemic absorption from the tissues injected can also lead to toxicity. The recommended dose for DPNB is 2-4 mg/kg of 1% lidocaine. Because CNS side effects have been described with lidocaine doses of 6-7 mg/kg, the margin of safety in the newborn is narrow. Inadvertent use of lidocaine preparations containing epinephrine can cause arteriolar constriction with possible vascular insufficiency of the penis.[21]

In the mid-1970s, the use of lidocaine for maternal epidural analgesia during labor and delivery came into question because of studies that showed neurobehavioral changes in the newborn infants.[22,23] Plasma lidocaine concentrations in these infants were .94 .10 µg/mL. More recently, newborn infants have been shown to develop delayed brainstem auditory evoked response following the use of lidocaine for maternal epidural anesthesia for cesarean section. Plasma lidocaine concentrations in these infants were .7-.8 µg/mL. Peak plasma lidocaine concentrations following DPNB range from .1-1.6 µg/mL.[25] This concentration is clearly within the range found following maternal epidural lidocaine administration, and the concern needs to be raised that DPNB for newborn circumcision may also cause behavioral or auditory changes.

Alternative means of analgesia

Use of topical anesthesia to relieve postcircumcision pain has had some success,[26] but its use has not been reported as the sole method of analgesia in circumcision. Recently local application of a eutectic mixture* of lidocaine and prilocaine was found to be effective in pain control of unpremedicated children undergoing venous cannulation;[27] a drawback is the prolonged application time (60 min of skin contact before full efficacy). This study also underscored the difficulty in equating behavioral changes and pain in the pediatric age group. Although pain was effectively relieved by the topical mixture, cooperation did not improve with lower pain scores.[27]

Acetaminophen appears promising as an analgesic in newborn circumcision, particularly in the immediate postoperative period. Acetaminophen has been shown to be effective in relieving mild to moderate pain after minor surgery using doses of 10-15 mg/kg orally or 15-20 mg/kg rectally.[28] Administration of acetaminophen at the time of diptherial-pertussis-tetanus (DPT) immunization was found to decrease local and systemic reactions as well as behavioral changes in a randomized trial in 383 infants aged two to six months.[29] Acetaminophen has been widely used and has a broad margin of safety in infancy;[30] newborns can metabolize and excrete the drug efficiently.[31,32]

Because recovery is rapid from the effects of newborn circumcision,[6,9,11,15] it seems unlikely that acetaminophen maintenance would have to be continued for more than 24 hours, similar to its use with DPT immunizations.[29]

Other potential forms of analgesia include cryoanalgesia and limited local infiltration of the foreskin.

Recently, Blass and Hoffmeyer[33] presented evidence of the efficacy of a sucrose-flavored pacifier as an analgesic during circumcision; crying was reduced more than 50% by this benign, simple procedure. Nonnutritive sucking had earlier been shown to reduce crying during circumcision.[34] Intraoral sucrose has been shown to reduce distress vocalization and pain thresholds in infant rats,[35,36] effects reversed by opioid antagonists,[37] implying opioid mediation.[38,39] In view of the noninvasive, risk-free nature of a sucrose-flavored pacifier, this technique deserves widespread evaluation of its effectiveness.

Summary and conclusions

Newborn circumcision is a quick and safe operation with low morbidity and negligible mortality. Methods to relieve pain in this procedure must have almost no risk in order to be considered. General anesthesia or administration of narcotics can result in central nervous system and respiratory depression and are not acceptable. Dorsal penile nerve block is probably the most promising anesthetic for newborn circumcision, but it can cause local and systemic reactions and should be used with caution until large studies demonstrating its safety have been performed. Topical anesthesia and oral acetaminophen for postcircumcision discomfort would appear to be worthy of trial in routine newborn circumcision. Most significant is recent evidence that a sucrose-flavored pacifier is an effective analgesic during newborn circumcision;[33] this safe, simple technique merits further investigation.

Because the recent change in the position of the American Academy of Pediatrics may lead to an increased number of newborn circumcisions, a search for the safest, most effective form of pain relief should be encouraged.

*A eutectic mixture is the liquid formed from specific solid constituents at the lowest possible temperature.

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