ARTICLE

Combined Analgesia and Local Anesthesia to Minimize Pain During Circumcision

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Background: Pain of circumcision is only partially relieved by single modalities, such as penile nerve block, lidocaine-prilocaine cream, and sucrose pacifiers.

Objective: To assess the effectiveness of a combination of interventions on the pain response of infants undergoing circumcision.

Methods: Cohort study. Group 1 included infants circumcised using the Mogen clamp and combined analgesics (lidocaine dorsal penile nerve block, lidocaine-prilocaine, acetaminophen, and sugar-coated gauze dipped in grape juice). Group 2 included infants circumcised using the Gomco clamp and lidocaine-prilocaine. Infants were videotaped during circumcision, and pain was assessed using facial activity scores and percentage of time spent crying.

Results: There were 57 infants in group 1 and 29 infants in group 2. Birth characteristics did not differ between groups. Infants in group 1 were older than infants in group 2 (17 days vs 2 days) ($P<.001$). The mean duration of the procedure was 55 seconds and 577 seconds for infants in group 1 and 2, respectively ($P<.001$). Facial action scores and percentage of time spent crying were significantly lower during circumcision for infants in group 1 ($P<.001$). The percentage of time spent crying was 18% and 40% for infants in groups 1 and 2, respectively. No adverse effects were observed in infants in group 1; 1 infant in group 2 had a local skin infection.

Conclusions: Infants circumcised with the Mogen clamp and combined analgesia have substantially less pain than those circumcised with the Gomco clamp and lidocaine-prilocaine cream. Because of the immense pain during circumcision, combined local anesthesia and analgesia using the Mogen clamp should be considered.

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CIRCUMCISION is performed in millions of male newborns worldwide. Despite evidence that circumcision is painful, the procedure continues to be performed without adequate analgesia.[1] Analgesics are not administered routinely by physicians because of concerns regarding the side effects of drugs and perceived lack of importance of pain.[2]

Dorsal penile nerve block (DPNB) was demonstrated previously to be effective for this procedure.[3-5] We showed that lidocaine-prilocaine cream (eutectic mixture of local anesthetics [EMLA]) can decrease the pain from circumcision.[2] In a recent study that compared EMLA with DPNB and ring block with lidocaine, both infiltration methods were superior to EMLA.[6] Sucrose given with a pacifier was shown to have some benefits[7,8] and acetaminophen may be helpful for postoperative pain.[9]

Combination interventions are more effective than single interventions. Stang et al[10] found that DPNB and a pacifier dipped in sucrose were more effective than DPNB and a pacifier dipped in water. Mohan et al[11] found that sucrose and EMLA together were better than either sucrose or EMLA alone. Using EMLA prior to DPNB decreased needle penetration pain but did not improve overall analgesia achieved by DPNB in older children.[12]

A recent study demonstrated that pain from circumcision is affected by the technique used to perform the procedure. In that study, the Mogen clamp was associated with less pain than the Gomco clamp.[13] This may have been at least in part caused by the shorter procedure time associated with the Mogen clamp technique. In addition, infants premedicated with the DPNB during circumcision with the Mogen clamp had less pain than infants circumcised using the same method who were not given an analgesic.

SUBJECTS AND METHODS

The study underwent ethical review in our institution, and written consent was obtained by the parents of infants that participated. The study was a cohort design with 2 study groups. The first group included infants circumcised using the Mogen clamp and combined analgesics (group 1). The analgesics administered before the circumcision included 0.5 mL of 80-mg/mL acetaminophen (administered orally 45 minutes before the clinic appointment); 1 or 2 g of EMLA on the foreskin and abdomen (applied 60 minutes prior to the procedure); and 2 subcutaneous injections of 1.1 mL of 0.5% lidocaine at the 10:30 and 1:30 positions (ie, DPNB) after EMLA was removed and 10 minutes before the circumcision.

The acetaminophen was administered to infants by their parents at home. They were given an information pamphlet and spoke to an office nurse before the scheduled appointment. Infants were last fed at home before the procedure. On arrival to the clinic, EMLA was applied by an office nurse. Part of the dose was placed on the penis and the remainder on a Tegaderm dressing. Then the penis was extended upward and gently pressed on the abdomen and the dressing was placed over the penis and taped to the abdomen. The cream and dressing were removed after 1 hour. During the infant's stay in the waiting room, a 3×3-cm folded gauze embedded with three fourths of a teaspoon of sugar and dipped in grape juice was placed in his mouth. The gauze was replaced by a fresh one 3 different times: while in the waiting room, before the DPNB injection, and before the circumcision.

This integrated approach was developed by one of us (N.P.) and is currently in use in the clinical setting. All infants in group 1 were restrained on a circumcision board and circumcised using the analgesics and surgical technique described above (referred to as the Pollock procedure) by one of us (N.P.).

The second group included infants circumcised using the Gomco clamp and EMLA (group 2). One gram of EMLA was applied for 60 to 80 minutes prior to the procedure. The EMLA was applied using a similar technique as for group 1. Infants were not offered anything to suck on. Group 2 was taken from our previous double-blind, randomized clinical trial of EMLA.[2] Infants were fed 1 to 3 hours before the circumcision. All of the infants were restrained on a circumcision board and were circumcised by another single operator (P.R.).[2]

Since the results of our randomized controlled trial were published, EMLA has been considered the minimum standard for analgesia during routine circumcision in our institution. We chose not to perform a randomized controlled trial because these data were available for comparison and it was considered unethical to prospectively enroll infants into a group that was expected to experience more pain during circumcision.

We included healthy full-term infants without jaundice and methemoglobinemia and not receiving analgesic or sedative drugs outside of the study protocol. Infants in group 2 were circumcised in the first week of life. However, infants in group 1 also included older infants, to assess the effect of postnatal age on pain response.

Infants in both groups were videotaped during the procedure. Pain was scored from the videotape by a research assistant using the same techniques as our previous study (ie, Neonatal Facial Coding System [NFCS] and infant cry duration).[2] The circumcision procedure was divided into phases. The analyses included the baseline phase and the circumcision phase (ie, forceps application, lysis of adhesions, application of clamp, cutting foreskin, and removal of clamp).

The primary outcome was facial activity score. The facial activity score was composed of the sum of the percentage of time that 3 discrete facial actions from the NFCS (ie, brow bulge, eyes squeezed shut, and nasolabial furrow) were observed for each phase of the procedure. These facial actions are considered the most sensitive and specific to pain. As in our clinical trial, each facial action was coded as present or absent every 2 seconds for a maximum of 20 seconds per phase.[2] Then, the percentage of time that each of the 3 facial actions was observed was calculated. The 3 percentage scores were weighted equally using a ratio of 1:3 and added together for an overall facial activity score that could range from 0 to 1. The percentage of time spent crying per phase of the procedure was calculated by dividing the duration of time spent crying by the duration of time of the phase.

Adverse events (skin reactions, bleeding, and infection) were noted during the circumcision and during follow-up telephone interviews with the parents at 24 hours and 1 week after the circumcision.

SAMPLE SIZE CALCULATION

A sample size of 60 infants (30 per group) was considered sufficient based on the ability to detect a difference in pain scores between infants that was 0.8 SD, with 80% power and 95% confidence (ie, large effect size). We recruited an additional 30 infants in group 1 to account for the effects of age on pain response.

STATISTICAL ANALYSES

Infant responses during circumcision were compared between groups using repeated-measures analysis of variance, with the baseline value as the covariate. Regression analysis were used to compare responses of infants of different ages. Demographic data and adverse effects were analyzed using χ^2 test and t test as appropriate.

The ultimate goal of pain management during circumcision is to prevent pain. We hypothesized that we could approach this goal if a combination of analgesic interventions and the Mogen clamp technique were employed together. The objectives of this study were to assess the effectiveness and safety of a combination of interventions including EMLA cream, DPNB, acetaminophen, and sugar-coated gauze on the pain response of infants undergoing circumcision using the Mogen clamp technique.

RESULTS

Eighty-six infants participated in the study: 57 infants in group 1 and 29 in group 2. There were no dropouts

Demographic Characteristics*

Parameter	Group 1	Group 2
Gestational age, d	280.0 (10.9)	278.0 (9.7)
Birth weight, g	3687.9 (596.7)	3651.9 (409.4)
Postnatal age, d†	16.7 (12.6)	2.1 (0.6)
Type of delivery, % vaginal	75.4	72.4
Maternal age, y	29.7 (4.7)	31.6 (4.5)

**Values are mean ± SD unless otherwise indicated.*
†P<.001; for all other variables between groups, the value was not significant.

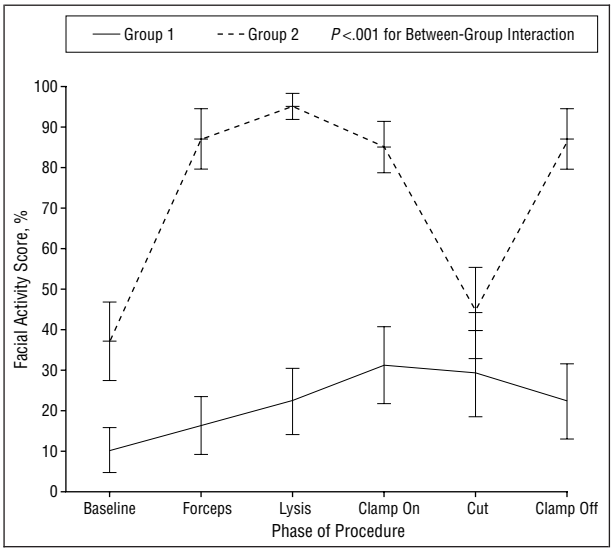

Figure 1. *The facial activity scores during each phase of the circumcision procedure. The error bars represent SDs.*

in either group. For 1 infant in group 1, the quality of the videorecording was poor and facial action coding could not be performed. Demographic data are shown in the **Table**. Other than postnatal age, there were no significant differences between the groups.

The duration of the procedure was significantly shorter for infants circumcised using the Mogen clamp compared with those circumcised with the Gomco clamp (mean [SD], 55.0 seconds [12.6] vs 576.6 seconds [64.1]) ($P<.001$).

The facial activity scores recorded during circumcision are shown in **Figure 1**. The scores were significantly lower ($P<.001$) for infants in group 1. Group 1 had significantly lower pain scores ($P<.05$) during forceps application, lysis of adhesions, and application and removal of clamp.

Infants in group 1 cried for proportionately less time than infants in group 2 during the entire procedure (**Figure 2**) ($P<.001$). The percentage of time spent crying was shorter ($P<.01$) for infants in group 1 during forceps application, lysis of adhesions, and application and removal of clamp. Twenty-six infants (46%) in group 1 did not cry at all during the procedure and 7 (12%) cried for less than 10% of the time; the mean percentage of time spent crying during the circumcision was 18% compared with 6% during baseline ($P<.05$).

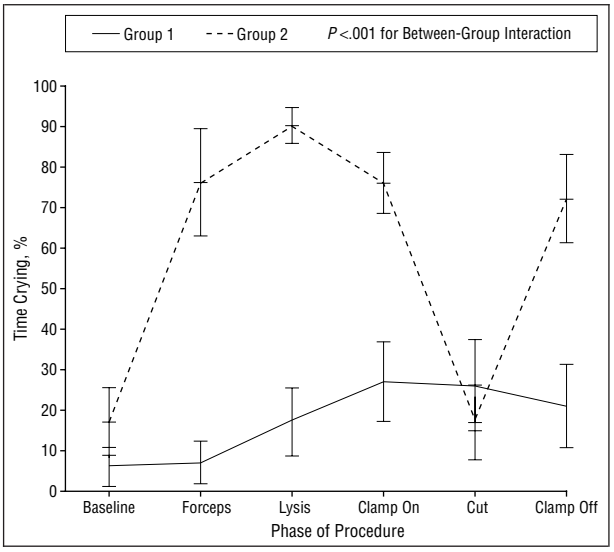

Figure 2. *The percentage of time infants spent crying during each phase of the circumcision procedure. The error bars represent SDs.*

Postnatal age and percentage of time crying during the entire procedure were not correlated ($r=0.07$; $P=.61$). Similar results were obtained when each phase of the procedure was analyzed separately, using either facial activity scores or percentage of time crying as outcome variables.

There were no adverse effects reported in infants in group 1. One infant in group 2 had an infection at the surgical site that was treated with a topical antibiotic.

COMMENT

In this study, we evaluated pain in infants during circumcision with the Mogen clamp and a combination of local anesthetics and analgesics. The rationale for this study was that treatment strategies studied to date have not been shown to completely eliminate pain in all infants; we previously demonstrated that neonatal circumcision has long-term effects on infant pain response to routine 4- and 6-month vaccination.[14] We postulated that decreasing the duration of circumcision and providing maximal analgesia would minimize pain for the infants and thus prevent potential long-term sequelae. Our results demonstrated that this "holistic" approach was associated with a significantly shorter procedure time and less pain than circumcision using the Gomco clamp and EMLA. However, infants continued to exhibit some pain responses during the procedure. It is unclear how much of their responses are caused by pain from the procedure vs discomfort from being restrained. Furthermore, it is not known whether the approach used in this study prevents changes in future infant pain behaviors at routine vaccination.

Our study was designed to examine the overall effectiveness of combined analgesia and anesthesia on infant pain response rather than the effectiveness of each specific analgesic. In comparison with a study of the Mogen clamp and DPNB plus pacifier analgesia,[13] infants in this study cried for proportionately less time (18% vs 31%), suggesting that the additional analgesics (EMLA,

sucrose, and acetaminophen) helped minimize pain. In the previous study, however, 56% of infants did not cry during the procedure[13] compared with 46% in this study. In another study of the Mogen clamp and DPNB analgesia, more infants cried during the procedure (73%)[15] than in this study.

We used a larger volume of lidocaine for anesthesia (at half the concentration) compared with other published studies in the literature. We did this to facilitate diffusion of the drug to the target site of action. We observed no complications in infants treated with combination analgesia. Our data are consistent with previously published safety data on DPNB and EMLA for use in neonates.[16,17] Concurrent use of EMLA, DPNB, and acetaminophen did not lead to a clinically significant risk of methemoglobinemia. These data add to a recently published study demonstrating no additive effect of acetaminophen on methemoglobin concentrations in 10 neonates treated with acetaminophen 12 hours before receiving EMLA.[18]

We evaluated the effect of postnatal age on infant pain response to determine if the analgesic regimen was appropriate for newborns after the first few days of life. We found no differences in infant responses between newly born and older infants up to 72 days of age. These results suggest that the analgesic regimen evaluated is equally effective in newborn and older infants. It also demonstrates that the different mean gestational ages between the study groups did not contribute to the differences in pain response detected by us.

Provisions were made to maintain similar conditions in the environments of infants in both groups while they were undergoing the procedure. It is possible that some differences in infant responses may be because of differences between the surgeons. However, both physicians perform circumcisions on a daily basis and are skilled in the technique they use. The results obtained in this study for infants circumcised with EMLA and the Gomco clamp are sufficiently similar to previous studies using EMLA and the Gomco clamp[19] to suggest that the skill of the surgeon did not explain differences between groups. Similarly, the results obtained for the infants circumcised with combined analgesia and the Mogen clamp are somewhat similar to previous studies of DPNB and the Mogen clamp.[13]

CONCLUSION

We believe that if circumcision is to be performed, it should be done using the least painful method. We have demonstrated that circumcision with the Mogen clamp and combined analgesia is safe and minimizes pain from this procedure.

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