Local Anesthesia for Circumcision: Which Technique Is Most Effective?

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Background and Objectives: **Circumcision is the most commonly performed surgical procedure in the United States, and it is painful. Several investigators have independently documented the reliability and safety of local anesthesia in eliminating the pain associated with circumcision. Investigations have not, however, been conducted to determine which technique is most effective in reducing the pain of the procedure. This study compares the techniques of local anesthesia for circumcision to determine which technique most safely and reliably reduces pain.**

Methods: **Fifty-six infants being circumcised were randomly assigned to one of three groups according to anesthesia technique: (1) distal branch block, (2) root block, and (3) subpubic block. Change in heart rate and oxygen saturation, as well as cry response, were recorded. Heart rate and oxygen saturation differences were analyzed utilizing Student's *t* test, whereas cry response was analyzed using the chi-square test.**

Results: **We discontinued using the distal branch block technique during the study because we were concerned about possible untoward outcomes. As a result, only data from the circumcisions of the 42 infants who were assigned to the root block and subpubic block groups were analyzed. The dorsal penile nerve root block more reliably reduced the pain of circumcision than did the subpubic technique ($P = 0.05$). There were no serious complications with any of the techniques in this study.**

Conclusions: **Compared with distal branch block and subpubic block techniques, nerve block at the penile root most reliably and safely eliminated the pain of circumcision (J Am Board Fam Pract 1997;10:13-9).**

Although opinions regarding the risks and benefits of neonatal circumcision vary, it remains the most commonly performed surgical procedure in the United States.[1,2] After the American Academy of Pediatrics (AAP) recommended against elective neonatal circumcision in 1971 and 1975, a decline in elective neonatal circumcision occurred. In March 1989, however, the AAP Task Force on Circumcision modified its opinions citing evidence that circumcision prevents urinary tract infections and urosepsis in infancy, as well as penile carcinoma and sexually transmitted infection during adulthood. This position paper has been interpreted as endorsement for circumcision.[1] Independently, Spach et al[3] published data in 1992 showing increased risk of urinary tract infections in uncircumcised adult men, further lending support for recommending the procedure. Given these publications and the popularity of nonritual circumcision in this country, it is realistic to believe that neonatal circumcision will continue to be performed frequently in the United States.

Circumcision is painful, however, and if physicians are to continue to perform the procedure, it should be accomplished in a manner that reliably eliminates the pain associated with the surgery. Numerous studies since Kirya and Werthmann's original work in 1978[4] have documented the benefit of local anesthesia for circumcision by showing marked differences in such physiologic factors as heart rate, transcutaneous oxygen saturation, and cortisol levels when nonanesthetized and anesthetized groups undergoing circumcision have been compared.[1,4-14] Similar studies have found marked alterations in cry response during the procedure in addition to modifications in behavioral adaptability and attentiveness during the 24 hours immediately following surgery.[11,12,15]

Although concerns have been raised regarding

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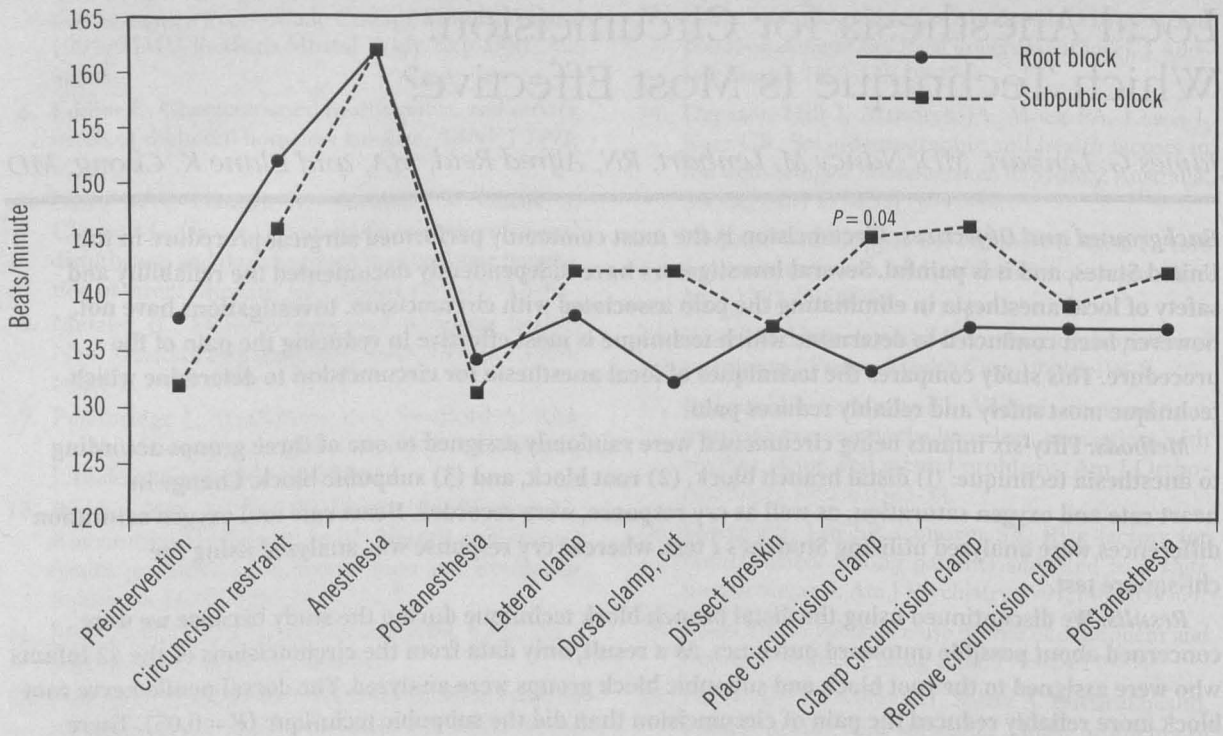

Figure 1. Comparison of mean heart rate at specific points in the procedure by method of anesthesia (n = 21 for each group).

the safety of local anesthesia for circumcision, several investigators have independently documented the reliability and safety of local anesthesia for the reduction or elimination of pain associated with the procedure.[9,11,13,16,17] These investigations of more than 2000 infants have been completed without serious complication, thus establishing the procedure's safety.[1,2,18]

After Kirya and Werthmann published their work documenting the effectiveness of dorsal penile nerve blockade for anesthesia during circumcision, three approaches to the anesthetic technique of dorsal penile nerve block have been developed:

1. Dorsal penile nerve block at the penile root[1,4,6]
2. Dorsal penile nerve block at the subpubic space[5]
3. Dorsal penile nerve block at the distal branches[7]

Masciello[7] conducted a comparative evaluation of penile root and distal branch block, and Dalens et al[5] commented at length without supporting data on the various techniques of anesthesia for circumcision. Studies have not, however, been reported that compare the efficacy of the three techniques. If circumcisions are to be performed as humanely as possible, it is incumbent that investigations be conducted to determine which technique is most effective in eliminating the associated pain.[19,20]

The purpose of our study was to evaluate the three techniques of local anesthesia for circumcision to find out which method most effectively and safely eliminated the pain associated with the procedure. The hypothesis was that differences in heart rate, oxygen saturation, and cry response would be observed when comparing the techniques. The corollary to this hypothesis was that these differences would define which technique was most effective at eliminating the pain. The impact of these findings would be considerable given the frequency with which circumcision is performed.

Methods

The three techniques of anesthesia studied were compared by randomizing 56 neonates scheduled for circumcision into one of the following three anesthesia technique study groups: (l) blockade of the dorsal penile nerve at the penile root, (2) blockade of the dorsal penile nerve in the subpu-

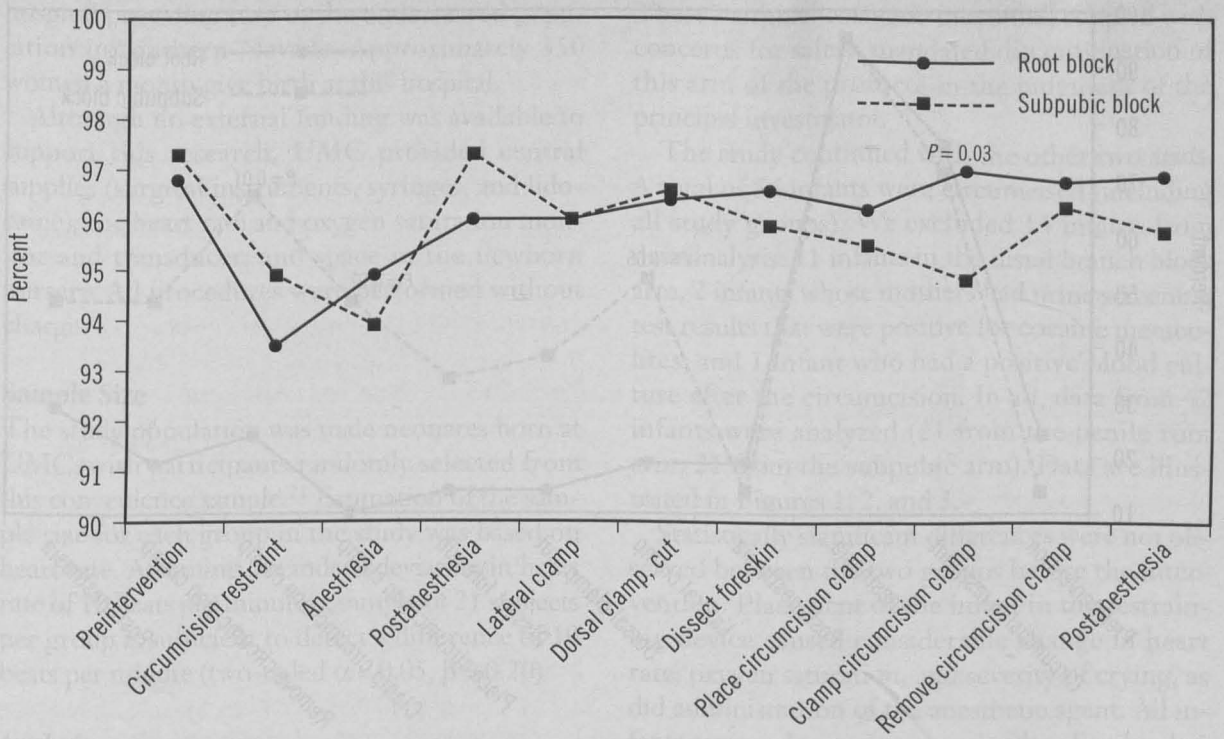

Figure 2. Comparison of mean oxygen saturation at specific points in the procedure by method of anesthesia (n = 21 for each group).

bic space, (3) blockade of the dorsal penile nerve at its distal branches.

Because many investigations have repeatedly shown the benefit of local anesthesia for circumcision, a nonanesthetized control group was not subjected to the protocol.

The following inclusion criteria were strictly observed:

1. The infant was the product of an uncomplicated pregnancy and uncomplicated vaginal or cesarean section delivery.
2. Gestational age of the infant was 36 weeks or longer but not more than 42 weeks.
3. The infant was aged less than 4 days.
4. The infant weighed more than 2500 g.
5. The infant had an Apgar score of 7 or higher at 5 minutes postpartum.
6. There were normal findings on newborn examination including reproductive anatomy.
7. Parents were literate in English.
8. Signed, informed parental consent was obtained.

Likewise, the following specific criteria were adopted for exclusion: (1) intrapartum fetal distress, (2) maternal substance abuse, (3) positive toxicology results in mother's or neonate's urine, and (4) postpartum neonatal complications.

Nutrition and water were withheld from all infants immediately before the procedure to minimize the risk of endotracheal aspiration. Before any intervention, the heart rate and oxygen saturation transducer was attached to one of the neonate's great toes, and baseline values were recorded. Infants were then dressed in warm long-sleeved shirts, and their diapers were removed in preparation for transfer to the procedure area. All procedures were carried out in a quiet, comfortable, warm environment. The device used to hold the baby for circumcision was padded with cotton batting for comfort before strapping the neonate to the board. Although all infants had their lower extremities restrained during the procedure, their upper extremities were free. Neonates were then allowed to reach their baseline heart rate and oxygen saturation levels before administration of anesthesia.

All anesthetic procedures and circumcisions were performed by the principal investigator and a nurse-research assistant experienced and trained in neonatal care. Each infant was injected bilaterally according to one of the three anesthetic techniques with 0.5 cc of 1 percent lidocaine solution without

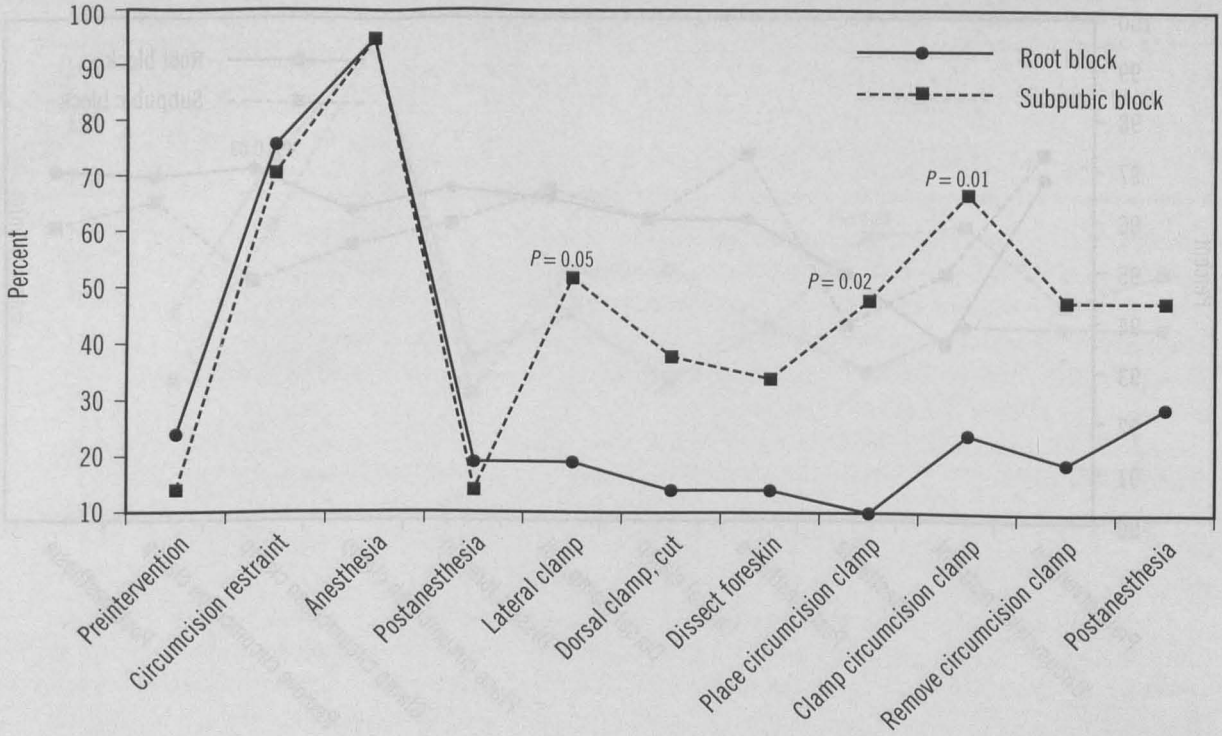

Figure 3. Comparison of percentage of infants crying at specific points in the procedure by method of anesthesia (n = 21 for each group).

epinephrine through a 25-gauge needle of appropriate length. A 5-minute interval was strictly observed between injecting the anesthetic agent and performing the circumcision. All circumcisions were performed using an appropriate-sized circumcision clamp (GOMCO Circumcision Clamp, Division of Allied Health Care Products, St. Louis, Mo) and surgical instruments. Surgical procedures and techniques were not varied during the study.

Heart rate, oxygen saturation, and cry response (pain relief variables) are consistently measured in similar studies. Accordingly, these variables were chosen as the outcome measures, and their values were monitored and recorded at specific times throughout each procedure by a research assistant stationed in a remote area and blinded to the anesthetic technique and events of circumcision. A digital electronic monitor was used to measure heart rate and oxygen saturation. Values were recorded throughout the study in the following sequence:

1. Preintervention baseline
2. Infant placed in the holding device
3. Anesthesia
4. Postanesthesia baseline at 5 minutes
5. Lateral hemostatic clamping and dissection of foreskin
6. Dorsal hemostatic clamping and cutting of foreskin
7. Dissecting foreskin
8. Place circumcision clamp
9. Engage circumcision clamp
10. Remove circumcision clamp
11. Five minutes after the procedure

For each step in the procedure, heart rate was recorded as the peak rate sustained during that step. Oxygen saturation was recorded as the nadir sustained during each interval. Crying was recorded as absent (0), minimal (1), moderate (2), or vigorous (3). All infants were observed for 30 minutes after the procedure. The surgical outcome of each circumcision was also observed during this interval, and complications, if they occurred, were so noted. Parents were telephoned 2 to 3 days after the procedure for follow-up care. Problems, if observed, were assessed by the principal investigator.

Site

This study was conducted at the University Medical Center (UMC) Las Vegas, the primary teaching hospital for the University of Nevada School of Medicine. This facility is a county-managed

hospital providing care to the underserved population in southern Nevada. Approximately 350 women a month give birth at this hospital.

Although no external funding was available to support this research, UMC provided central supplies (surgical instruments, syringes, and lidocaine), the heart rate and oxygen saturation monitor and transducer, and space in the newborn nursery. All procedures were performed without charge.

Sample Size

The study population was male neonates born at UMC, with participants randomly selected from this convenience sample.[21] Estimation of the sample size for each group in the study was based on heart rate. Assuming a standard deviation in heart rate of 10 beats per minute, a sample of 21 subjects per group is sufficient to detect a difference of 10 beats per minute (two-tailed $\alpha = 0.05$, $\beta = 0.20$).

Analysis

Heart rate, oxygen saturation, and crying were measured and recorded at the intervals defined by the study protocol. Because this convenience sample was randomly selected, data should have been normally distributed. Post hoc power analysis, based on a sample standard deviation in heart rate of 17.8 beats per minute, indicated the sample of 21 subjects per group was sufficient to detect a difference of 16 beats per minute (two-tailed $\alpha = 0.05$, $\beta = 0.20$), a difference of 2.25 percent in oxygen saturation, and a difference of 35 percent in level of crying. Confidence intervals were calculated for the variables of interest. Data analysis was facilitated utilizing Epi-Info, Version 5.01b.

Results

Midway through the study we decided to drop the distal branch block arm of the study. Our decision was based on concern for safety and cosmetic outcome. Although the technique is not difficult to perform, injecting the anesthetic agent distally along the dorsal shaft of the penis created considerable foreskin edema and made it difficult to visualize anatomic landmarks and to place the circumcision clamp. While no adverse outcomes were encountered in any of the 11 circumcisions, using this technique resulted in markedly redundant ventral foreskin remnants in 2 neonates. These marginal cosmetic outcomes, coupled with concerns for safety, mandated discontinuation of this arm of the protocol in the judgment of the principal investigator.

The study continued with the other two arms. A total of 56 infants were circumcised (including all study groups). We excluded 14 infants from data analysis: 11 infants in the distal branch block arm, 2 infants whose mothers had urine screening test results that were positive for cocaine metabolites, and 1 infant who had a positive blood culture after the circumcision. In all, data from 42 infants were analyzed (21 from the penile root arm, 21 from the subpubic arm). Data are illustrated in Figures 1, 2, and 3.

Statistically significant differences were not observed between the two groups before the intervention. Placement of the infant in the restraining device caused considerable change in heart rate, oxygen saturation, and severity of crying, as did administration of the anesthetic agent. All infants returned to preintervention baseline levels 5 minutes after anesthesia administration, at which time there were no differences between the two groups. The events during the surgical procedure after anesthesia caused significantly less change in the measured parameters than did either placement in the restraining device or administration of the anesthetic agent, a finding that was consistent for both groups.

Statistically significant differences between penile root block and subpubic block groups at $P = 0.05$ (or less) were observed for the following pain relief variables:

1. Cry response during the lateral clamp
2. Heart rate and cry response when placing the circumcision clamp
3 Oxygen saturation and cry response when clamping the circumcision device

These data support the hypothesis that different techniques of local anesthesia for circumcision provide different quality of pain relief. In this study, penile root block was superior to subpubic block.

Discussion

Circumcision, which is painful, is the most frequently performed surgical procedure in the United States. It must, therefore, be performed as humanely as possible. We report findings that provide evidence indicating which technique of

local anesthesia is most effective in relieving the pain associated with circumcision. A brief discussion of the efficacy of each technique follows.

Distal Branch Block

This technique is easy to perform, but given our concerns about safety and the cosmetic outcomes reported in this study, general acceptance of this method must be withheld until further results of research can be reported.

Penile Root Block

This technique was used in the original research on local anesthesia for circumcision. Penile root block has stood the scrutiny of several investigative studies and has been found to be safe and effective. Root block is technically easy to perform and delivery of the anesthetic agent is precise. Although some edema at the base of the penis is created by extravasation of the anesthetic fluid into the subdermal space, this edema, given its distance from the foreskin, does not interfere with performing the circumcision. In our study, this technique more effectively relieved the pain associated with circumcision than did the subpubic block and was associated with no complications, including hematoma or infection.

Subpubic Block

A subpubic block was technically more difficult to perform than either the distal branch or penile root block, and delivery of the anesthetic agent was less precise. It also was not as effective as root block. In the Dalens et al[5] research, a full 15 minutes was allowed between administering the anesthesia and performing the circumcision. Although waiting 15 minutes can increase the efficacy of the technique, the subpubic block is unlikely to engender enthusiasm as a preferred procedure if such relatively long postanesthetic intervals are needed to effectively eliminate pain. Although no serious complications were encountered with this technique in our study, bright red blood was found on an aspiration test during 2 of 21 procedures, suggesting that the needle was inserted into the dorsal penile artery. This possibility raises concerns about intra-articular injection of the agent if the aspiration test is not meticulously performed. It likewise raises issues of general safety if this technique is universally applied by those who are variably trained, fatigued, or hurried.

Conclusions

Given recent reports of the medical benefits of neonatal circumcision, it will continue to be commonly performed. It is therefore incumbent upon medical researchers to develop methods that will make the procedure as humane as possible. Measures in this study that provided greater comfort were (1) administering local anesthesia with blockade at the penile root, (2) doing the procedure in a quiet, warm environment, (3) leaving the upper extremities unrestrained, and (4) allowing sufficient time for anesthetic agent to take effect (5 or more minutes, timed). Inasmuch as hyperextension of the lower extremities while preparing for the procedure caused as much objective evidence for distress as injection of the anesthetic agent, modifications in the design of restraining boards should be researched.

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