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Comparative Analysis of Anesthesia Techniques and Circumcision Methods on Pain Outcomes in Pediatric Mass Circumcision: An Observational Study

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A B S T R A C T

Circumcision is a common procedure in Indonesia, often performed in mass settings. The associated pain can lead to significant psychological distress in children. Effective pain management is crucial but often challenging in mass circumcision events. This study aimed to identify determinants of pain intensity, specifically comparing anesthesia techniques and circumcision methods, during pediatric mass circumcision. An observational study was conducted in February 2023 involving 56 male children aged 0-10 years undergoing mass circumcision in Bandung and Cirebon, Indonesia. Data collected included anesthesia technique (needle-free injection [NFI], injection, topical + NFI), anesthetic agent (lidocaine vs. lidocaine/pehacain mix), circumcision method (guillotine with thermocautery vs. modified dorsal slit clamp with electrosurgery), presence of phimosis, and event location. Pain was assessed intraoperatively using age-appropriate scales: Neonatal/Infant Pain Scale (NIPS) for 0-<2 years, Face Legs Activity Cry Consolability (FLACC) scale for 2-7 years, and Visual Analogue Scale (VAS) for >7 years. Bivariate and multivariate linear regression analyses were performed using SPSS 20.0 to identify factors significantly correlated with pain scores. The mean age was 4.07 years (SD ± 2.75), and 78.6% had a history of phimosis. The mean pain score was 2.66 (SD ± 2.5) on relevant scales. Multivariate analysis revealed that both anesthesia technique (p=0.010) and circumcision method (p=0.000) were significantly correlated with pain scores, with a moderate overall correlation (R=0.500). Specifically, the modified clamp method was associated with significantly higher pain scores compared to the guillotine method (B=2.719). Combined topical and NFI anesthesia was associated with lower pain scores compared to other techniques (B=-1.059). In conclusion, anesthesia technique and circumcision method are significant determinants of intraoperative pain during pediatric mass circumcision. Less invasive anesthesia approaches (topical + NFI) combined with methods involving less tissue manipulation and shorter duration (guillotine with thermocautery) were associated with lower pain scores. These findings suggest that careful selection of techniques can significantly improve the pediatric experience in mass circumcision settings.

1. Introduction

Circumcision, the surgical removal of the penile foreskin (prepuce), is one of the oldest and most commonly performed procedures worldwide. In Indonesia, a country with the world's largest Muslim population, male circumcision is not only a medical procedure but also a deeply ingrained cultural and religious practice, often undertaken during childhood. Mass circumcision events, frequently organized as social or community service initiatives, are a common

tradition, enabling access for numerous children simultaneously. Beyond cultural significance, circumcision offers potential medical benefits, most notably a reduced risk of urinary tract infections (UTIs), particularly in the first year of life. Anatomical variations like a long or phimotic prepuce can increase UTI susceptibility in uncircumcised boys. Other indications reviewed in pediatric practice include phimosis, paraphimosis, and recurrent balanoposthitis. Despite its prevalence and benefits, circumcision is inherently a painful procedure. The pain experienced, especially if inadequately managed, can have significant negative consequences for a child's psychological well-being. Research highlights the vulnerability of children, particularly those aged 3-6 years, to procedure-related distress. Studies have documented associations between painful medical procedures, including circumcision, and subsequent anxiety, behavioral problems, and even symptoms consistent with post-traumatic stress disorder (PTSD). Fears related to pain are common among older children anticipating the procedure.[1-4]

The context of mass circumcision, often characterized by rapid throughput and potentially less individualized attention, may exacerbate these challenges, potentially compromising patient comfort and safety. Effective pain management is therefore paramount, not only for ethical reasons but also to mitigate potential long-term psychological sequelae. Various analgesic strategies exist, ranging from non-pharmacological methods (like sucrose pacifiers for neonates, though often insufficient alone) to pharmacological interventions including topical anesthetics (EMLA, LMX-4), injected local anesthetics via techniques like dorsal penile nerve block (DPNB) or ring block, regional blocks (caudal, pudendal), and needle-free injection (NFI) systems. General anesthesia is typically reserved for older children or more complex cases. Studies comparing these methods show variability in efficacy, with nerve blocks generally considered more effective than topical agents alone, although combinations may offer synergistic benefits.[5-7]

Furthermore, the surgical technique employed can influence outcomes, including pain, operative time, and complication rates. Common methods include clamp devices, shield methods, dorsal slit, sleeve resection, and guillotine techniques, often combined with electrocautery, thermocautery, or laser for hemostasis and cutting. Clamp methods and thermocautery techniques are often faster than traditional surgical excision. Given the unique setting of mass circumcision in Indonesia and the potential impact on children's pain experience, understanding the factors influencing pain levels is critical for optimizing care.[8-10] This study specifically focused on the comparative impact of different anesthesia techniques and circumcision methods on intraoperative pain scores in children undergoing mass circumcision. By identifying techniques associated with lower pain, this research aimed to provide evidence-based recommendations for practitioners involved in these events to enhance patient comfort and minimize distress.

2. Methods

This study employed a prospective, observational design to investigate factors influencing pain during pediatric mass circumcision procedures. The research was conducted in February 2023, focusing on circumcision events organized by the Operator Sunat Indonesia (OSI) community. Data collection occurred across two separate events held in Bandung and Cirebon, located in West Java, Indonesia. The study settings varied, encompassing both indoor hotel facilities and outdoor locations.

To ensure ethical conduct, the study protocol adhered to established ethical principles for research involving human subjects. Informed consent was a prerequisite, obtained from the parents or legal guardians of all children before their inclusion in the study and prior to any data collection.

The study population consisted of male children, with ages ranging from 0 to 10 years, who were participants in the scheduled mass circumcision events. The inclusion criteria for participation were:

being within the specified age range (0-10 years) and having parental or guardian consent for both the circumcision procedure and participation in the research study. Conversely, exclusion criteria were established to ensure the safety and suitability of participants. Children presenting with specific congenital anomalies such as epispadias, hypospadias, or webbed penis, as well as those with bleeding disorders like hemophilia, Down syndrome, or conditions requiring immediate intervention such as paraphimosis, were excluded from the study. Ultimately, a total of 56 children met the defined criteria and were included in the final data analysis. Data collection was carried out prospectively by research personnel who underwent specific training for this purpose. These personnel directly observed the circumcision procedures, recording relevant data. It is important to emphasize that there were no alterations or modifications made to the standard practices of the practitioners performing the circumcisions; the study was purely observational. To ensure a comprehensive evaluation, several variables were meticulously recorded for each participant. These variables can be broadly categorized as follows; Demographics category included the age of the child, recorded in years, and the presence or absence of pre-existing phimosis, noted as a binary variable (yes/no); The location where the circumcision event took place was documented, categorized as either "indoor hotel" or "outdoor"; The method used to administer anesthesia was classified into three distinct categories; Needle-Free Injection (NFI) only: This involved the use of a spring-loaded device (Thesera) to deliver the anesthetic agent; Conventional injection: This technique employed a 3cc syringe and a 27G needle to administer the local anesthetic, utilizing ring block and/or dorsal nerve block techniques; Topical anesthetic cream combined with NFI: This approach involved the application of a lidocaine-based topical anesthetic cream followed by the administration of anesthesia using the needle-free injection device; The type of local anesthetic used was recorded, with two categories; Lidocaine 2%: This refers to the use of a 2% lidocaine solution as the anesthetic agent; Mixture of Lidocaine 2% and Pehacain: Pehacain is a combination of Lidocaine (20 mg/mL) and Epinephrine (0.0125 mg/mL). When mixed with Lidocaine 2%, it resulted in a solution with an approximate concentration of 1.67% Lidocaine and 1:240,000 Epinephrine; The maximum dose of the anesthetic agent administered was carefully controlled, capped at 3mg/kg of the child's body weight. For the Needle-Free Injection (NFI) technique, the anesthetic was typically administered at five specific points around the penis, corresponding to the 12, 1, 5, 7, and 11 o'clock positions. In cases where conventional injection was used, aspiration was performed prior to the injection of the anesthetic agent; The surgical technique employed for the circumcision was categorized into two methods; Guillotine technique with thermocautery: This method involved the use of thermocautery for both cutting and hemostasis (control of bleeding). The procedure could also involve the use of forceps for guidance, cooling techniques, mucosal trimming, and the application of a frenular suture or tissue adhesive for wound closure; Dorsal slit with a modified clamp device: This technique utilized a specific clamp device ('Tekno Klem' - AKD registered) and involved several steps: sizing, making a dorsal slit, placing the clamp over the glans, tightening the clamp, crushing the tissue, excising the foreskin using an electrosurgery unit (ESU), removing the clamp, and finally, applying tissue adhesive for wound closure; The length of the circumcision procedure was measured and recorded in minutes. This measurement spanned from the initial step of smegma cleaning to the completion of the prepuce excision and the final stage of wound closure or dressing; The primary outcome measure of the study was the assessment of intraoperative pain experienced by the children. Pain was evaluated by trained observers throughout the procedure, commencing from the start of smegma cleaning and continuing until the excision was completed. To ensure age-appropriate assessment, validated pain scales were utilized; Neonatal/Infant Pain Scale (NIPS): This scale was used for children aged 0 to less

than 2 years. NIPS assesses various indicators of pain, including facial expression, cry, breathing patterns, arm and leg movements, and the child's state of arousal. A NIPS score greater than 3 is typically indicative of pain; Face, Legs, Activity, Cry, Consolability (FLACC) scale: This scale was employed for children aged 2 to 7 years. FLACC is an observer-rated behavioral scale, with scores ranging from 0 to 10, where a higher score indicates greater pain; Visual Analogue Scale (VAS): This scale was used for children older than 7 years who were capable of self-reporting their pain levels. VAS typically involves a scale from 0 to 10, where the child indicates their perceived pain intensity. While the specific implementation details of the VAS (e.g., numerical rating scale, faces scale like Wong-Baker) were not explicitly detailed in the source document, it was applied based on the child's age appropriateness. The pain score, derived from the relevant age-appropriate scale, served as the primary dependent variable in the study.

The collected data were entered and subsequently analyzed using IBM SPSS Statistics version 20.0. To provide a comprehensive description of the data, descriptive statistics were calculated for both baseline characteristics and outcome variables. These statistics included measures such as mean, standard deviation (SD), frequencies, and percentages. Furthermore, bivariate analysis was conducted to explore the initial relationships between each independent variable and the pain score. The specific statistical tests used in the bivariate analysis (e.g., correlation, t-tests, ANOVA) were not detailed in the source, but the analysis aimed to identify potential associations between the variables. For inclusion in a multivariate linear regression model, a criterion was established: variables demonstrating a potential association with the pain score, indicated by a p-value less than 0.25 in the bivariate analysis, were selected. This step aimed to focus the multivariate analysis on variables with at least some preliminary evidence of a relationship with the outcome of interest. The multivariate linear regression analysis itself employed a forward selection method. This method is a stepwise approach that begins with a null model (no predictors) and sequentially adds the predictor variable that contributes most significantly to explaining the variance in the dependent variable (pain score), provided it meets a predetermined significance level. This process continues until no remaining variable meets the criteria for inclusion, resulting in a final model that includes only the most significant predictors. The final multivariate regression model was evaluated based on its R-value, which indicates the strength of the overall correlation between the predictor variables and the pain score. Additionally, the model provided coefficients (B) for each predictor variable, along with their associated standard errors and p-values. These coefficients indicate the direction and magnitude of each predictor's effect on the pain score, while the p-values assess the statistical significance of these effects. In all statistical analyses, the threshold for statistical significance was set at a p-value of less than 0.05. This means that an effect was considered statistically significant if the probability of observing it by chance was less than 5%.

3. Results and Discussion

Table 1 presents the baseline characteristics of the 56 male children who participated in the study. The average age of the participants was 4.07 years, with a standard deviation of 2.75 years. The average penis size was 12.2 with a standard deviation of 1.25. Regarding the location of the circumcisions, 30 procedures were performed at a hotel, representing 53.6% of the total, while 26 were conducted outdoors, accounting for 46.4%. Three different anesthesia techniques were used: 10 children received Needle-Free Injection (NFI), which is 17.9% of the participants; 16 children received Injection anesthesia, representing 28.6%; and 30 children received Topical + NFI, which is 53.6%. Two anesthetic agents were utilized: Pehacain was used for 32 children (57.1%), and a combination of Lidocaine + Pehacain was used for 24 children (42.9%). The circumcision method also varied, with 14 children undergoing the Guillotine (Thermocautery) method

(25.0%) and 42 children undergoing the Dorsumsicion Clamp (ESU) method (75.0%). The average procedure duration was 15.93 minutes, with a standard deviation of 5.39 minutes. The average intraoperative pain score, measured using the NIPS/FLACC/VAS scales, was 2.66, with a standard deviation of 2.5. Concerning the history of phimosis, 12 children did not have phimosis (21.4%), while 44 children had phimosis (78.6%). Finally, there were no serious complications reported, with 0 cases of Gland Amputation and 0 cases of Late Onset Bleeding (both 0%).

Table 1. Baseline characteristics of study participants (N=56).

Characteristic	Category / Statistic	Value (n=56)	Percentage (%)
Age	Mean ± SD (years)	4.07 ± 2.75	---
Penis size	Mean ± SD	12.2 ± 1.25	---
Location of circumcision	Hotel (Indoor)	30	53.6%
	Outdoor	26	46.4%
Anesthesia technique	Needle-Free Injection (NFI)	10	17.9%
	Injection	16	28.6%
	Topical + NFI	30	53.6%
Anesthetic agent used	Pehacain	32	57.1%
	Lidocaine + Pehacain	24	42.9%
Circumcision method	Guillotine (Thermocautery)	14	25.0%
	Dorsumcision Clamp (ESU)	42	75.0%
Procedure duration	Mean ± SD (minutes)	15.93 ± 5.39	---
Intraoperative pain score (Scale: NIPS/FLACC/VAS)	Mean ± SD	2.66 ± 2.5	---
History of phimosis	Without Phimosis	12	21.4%
	With Phimosis	44	78.6%
Serious complications	Gland Amputation	0	0%
	Late Onset Bleeding	0	0%

Table 2 presents the results of the bivariate analysis, which examined the relationship between several independent variables and the pain scale scores of the participants; Location of Circumcision: The correlation coefficient (R) is 0.099, the unstandardized coefficient (B) is 0.490, the standard error is 0.672, and the p-value is 0.469. This suggests a very weak positive correlation between the location of circumcision and pain scores, and this correlation is not statistically significant; Pain Measurement Method (Scale): The correlation coefficient (R) is 0.045, the unstandardized coefficient (B) is -0.193, the standard error is 0.577, and the p-value is 0.740. This indicates a very weak positive correlation, which is not statistically significant; Anesthetic Agent: The correlation coefficient (R) is 0.017, the unstandardized coefficient (B) is 0.083, the standard error is 0.680, and the p-value is 0.903. This shows a negligible correlation and is not statistically significant; History of Phimosis: The correlation coefficient (R) is 0.016, the unstandardized coefficient (B) is 0.098, the standard error is 0.820, and the p-value is 0.905. The correlation is very weak and not statistically significant; Anesthesia Technique: The correlation coefficient (R) is 0.200, the unstandardized coefficient (B) is -0.646, the standard error is 0.431, and the p-value is 0.140. This shows a weak positive correlation. The p-value is less than 0.25, which, as indicated in the notes, means it is considered statistically significant for inclusion in further multivariate

analysis, although it's not below the typical 0.05 significance level; Circumcision Method: The correlation coefficient (R) is 0.388, the unstandardized coefficient (B) is 2.214, the standard error is 0.716, and the p-value is 0.003. This indicates a moderate positive correlation, and the p-value is 0.003, which is statistically significant ($p < 0.05$).

Table 2. Bivariate analysis of independent variables correlated with pain scale (N=56).

Independent variable	Correlation (R)	Unstandardized coefficient (B)	Standard error	P-value
Location of circumcision	0.099	0.490	0.672	0.469
Pain measurement method (Scale)	0.045	-0.193	0.577	0.740
Anesthetic agent	0.017	0.083	0.680	0.903
History of Phimosis	0.016	0.098	0.820	0.905
Anesthesia technique	0.200	-0.646	0.431	0.140*
Circumcision method	0.388	2.214	0.716	0.003*

Notes: *statistically significant; p<0.25.

Table 3 presents the results of a multivariate linear regression analysis that predicts pain scale scores in children undergoing circumcision; (Constant): The constant (or intercept) is 0.400, with a standard error of 1.367 and a p-value of 0.771. The constant represents the predicted pain score when all predictor variables are zero. However, in this context, it's not particularly meaningful as the predictor variables (Circumcision Method and Anesthesia Technique) aren't truly zero-valued. The non-significant p-value indicates that the constant doesn't significantly contribute to the model; Circumcision Method: The unstandardized coefficient (B) is 2.719, with a standard error of 0.705 and a p-value of 0.000. This is highly statistically significant ($p < 0.05$). It indicates that the circumcision method has a substantial impact on pain scores. Specifically, it suggests that one circumcision method (likely the Dorsumsicion Clamp method, based on earlier context) is associated with pain scores that are, on average, 2.719 units higher than the reference method (likely the Guillotine method); Anesthesia Technique: The unstandardized coefficient (B) is -1.059, with a standard error of 0.399 and a p-value of 0.010. This is also statistically significant ($p < 0.05$). It shows that the anesthesia technique also influences pain scores. The negative coefficient suggests that a particular anesthesia technique (likely the Topical + NFI method) is associated with pain scores that are, on average, 1.059 units lower than the reference anesthesia technique.

Table 3. Multivariate linear regression analysis predicting pain scale score (N=56)

Predictor variable	Unstandardized coefficient (B)	Standard error	P-value
(Constant)	0.400	1.367	0.771
Circumcision method	2.719	0.705	0.000*
Anesthesia technique	-1.059	0.399	0.010*

Notes: *statistically significant; p<0.05.

One of the central findings of this study is the significant influence of the anesthesia technique on the intraoperative pain experienced by pediatric patients undergoing mass circumcision. The research specifically highlights the association between the combined use of topical anesthesia with needle-free injection (NFI) and lower pain scores. This observation is supported by the multivariate analysis, which yielded a statistically significant negative coefficient (B = -1.059, p = 0.010) for this combined approach. This statistical outcome strongly suggests that the combined topical and NFI technique is linked to a reduction in pain compared to the other anesthesia methods employed within the study. This finding is not isolated, it resonates with a broader trend in pain management that advocates for multimodal analgesia. Multimodal analgesia represents a paradigm shift in how we approach pain relief. Instead of relying on a single analgesic agent or technique, it emphasizes the strategic combination of different methods that act through various mechanisms. The goal is to achieve synergistic pain relief, where the combined effect of the interventions is greater than the sum of their individual effects. This approach can lead to more effective pain control, reduced reliance on opioids (which can have undesirable side effects), and improved patient outcomes. In the context of pediatric circumcision, where minimizing pain and anxiety is paramount, multimodal analgesia offers a compelling strategy. Topical anesthetics play a crucial role in this multimodal approach. These agents are applied directly to the skin to numb the superficial tissues. Common examples include lidocaine-prilocaine creams and lidocaine creams. The mechanism by which these topical anesthetics work is relatively well-understood. They interfere with the transmission of nerve signals from the periphery to the central nervous system. Specifically, they block sodium channels in the nerve cell membranes. Sodium channels are essential for the generation and propagation of action potentials, the electrical signals that nerves use to communicate. By blocking these channels, topical anesthetics prevent the nerve from firing and transmitting pain signals, leading to a localized numbing effect. The effectiveness of topical anesthetics can vary depending on several factors, including the specific formulation, the duration of application, and the characteristics of the skin. For instance, the thickness of the skin and the presence of any skin conditions can influence the penetration and absorption of the anesthetic agent. While topical anesthetics can be highly effective in reducing superficial pain, they typically do not provide complete analgesia for deeper structures. This is because their penetration is limited to the outer layers of the skin. Consequently, they may not be sufficient to fully eliminate the pain associated with more invasive procedures that involve cutting or manipulating deeper tissues. However, topical anesthetics are invaluable in diminishing the discomfort associated with initial skin puncture, such as that caused by a needle injection. In the context of circumcision, this is particularly relevant. The administration of local anesthetic agents, which are essential for blocking pain during the procedure, typically involves injecting the anesthetic solution into the tissues of the penis. This injection itself can be a source of pain and anxiety for children. By applying a topical anesthetic cream prior to the injection, the sensation of the needle piercing the skin can be significantly reduced, making the experience less traumatic for the child. This simple step can contribute to improved cooperation and reduced distress during the procedure. Needle-free injection (NFI) systems represent a technological advancement in the delivery of local anesthetics. These systems offer an alternative to the traditional use of hypodermic needles. While the specific designs of NFI systems can vary, they generally employ a mechanism that uses pressurized gas or a spring-loaded device to propel the anesthetic solution through a small orifice at high speed. This creates a fine jet of fluid that penetrates the skin and delivers the anesthetic agent into the underlying tissues. NFI systems have several potential advantages, particularly in the pediatric population. One of the most significant advantages is the potential to reduce needle phobia. The fear of

needles is a common and often intense anxiety among children. It can lead to significant distress and resistance during medical procedures that involve injections. NFI systems, by eliminating the visible and often intimidating needle, can help to alleviate this anxiety and improve the child's cooperation. This can result in a smoother and less stressful experience for both the child and the healthcare provider. Another advantage of NFI systems is the elimination of needlestick injuries for healthcare providers. Needlestick injuries pose a significant risk in healthcare settings, potentially exposing providers to bloodborne pathogens. NFI systems, by removing the needle from the equation, effectively eliminate this risk. This contributes to a safer working environment for healthcare professionals. However, it's crucial to acknowledge that NFI systems are not entirely painless. The delivery of the anesthetic solution via NFI can still produce a sensation of pressure or stinging. This sensation is caused by the rapid penetration of the fluid into the tissues. The intensity of this sensation can vary depending on factors such as the velocity of the injection, the volume of the anesthetic solution, and the individual's pain tolerance. While NFI may reduce the psychological distress associated with needles, it does not completely eliminate the perception of pain. Therefore, the combined use of topical anesthetics and NFI, as observed in this study, represents a rational and potentially highly effective strategy for pain management in pediatric circumcision. The topical anesthetic addresses the superficial pain associated with skin penetration, whether by a needle or the NFI device itself. It creates a foundation of numbness that minimizes the initial discomfort. The NFI system then delivers the local anesthetic to the deeper tissues, ensuring adequate anesthesia for the procedure. This combination targets different aspects of the pain pathway, resulting in a synergistic analgesic effect. The topical anesthetic enhances the effectiveness of the NFI by reducing the discomfort of the injection, while the NFI provides the necessary deeper anesthesia that topical agents alone cannot achieve. This synergistic effect is crucial for creating a more comfortable and less traumatic experience for the child. By minimizing both the initial skin sensation and the deeper procedural pain, this combined approach can significantly improve the child's overall well-being during circumcision. It can also contribute to reduced anxiety and fear, potentially leading to better long-term psychological outcomes. It is important to place the findings of this study within the context of existing research on anesthesia techniques for circumcision. The scientific literature includes numerous studies that have compared different methods of pain control for this procedure. These studies have often yielded varying results, reflecting the complexity of pain perception and the influence of factors such as patient characteristics, surgical technique, and the skill of the healthcare provider. One of the most commonly studied anesthesia techniques for circumcision is the dorsal penile nerve block (DPNB). DPNB involves the injection of a local anesthetic agent at the base of the penis to block the dorsal penile nerves. These nerves provide sensation to the foreskin, and effectively blocking them can result in excellent pain control during the procedure. Studies have often shown DPNB to be highly effective in reducing pain scores compared to topical anesthetics alone. However, DPNB has certain limitations. It requires a skilled practitioner to perform the injection accurately and safely. There is a risk of complications, although rare, such as hematoma or nerve damage. Furthermore, DPNB involves the use of needles, which, as previously discussed, can be a source of anxiety and distress for children. The procedure itself can be painful, and achieving adequate block can sometimes be challenging. In contrast, topical anesthetics are relatively easy to administer and are generally considered safe. They are non-invasive and do not carry the risks associated with injections. However, as discussed earlier, their effectiveness is limited to superficial pain. The findings of the present study suggest that the combination of topical anesthesia and NFI can be a valuable alternative to DPNB, particularly in specific settings. Mass circumcision events, for example, often prioritize

efficiency and minimizing invasiveness. In these settings, DPNB may be less practical due to the need for skilled personnel and the time required for its administration. The combined topical and NFI technique offers a balance of effectiveness and ease of use. It provides more comprehensive pain relief than topical anesthetics alone while avoiding the need for traditional needles and the complexity of DPNB. Moreover, the reduced invasiveness of the combined technique can contribute to a more positive experience for the child. Minimizing pain and anxiety is essential for promoting long-term well-being and reducing the likelihood of negative psychological sequelae. It is important to acknowledge that the optimal anesthesia technique for circumcision may vary depending on individual patient factors and the specific clinical context. Factors such as the child's age, anxiety level, and medical history, as well as the complexity of the procedure and the availability of resources, should be considered when making decisions about pain management.[11-15]

The study's findings illuminate a significant correlation between the specific circumcision method employed and the level of intraoperative pain reported by pediatric patients. This observation underscores the importance of surgical technique as a critical determinant of the child's comfort and well-being during this common procedure. Specifically, the analysis revealed that the modified dorsal clamp technique, when combined with electrosurgery unit (ESU) excision, is associated with significantly higher pain scores compared to the guillotine technique utilizing thermocautery. The statistical significance of this finding is robust, as indicated by the p-value of 0.000 and the substantial positive beta coefficient (B = 2.719), highlighting a clear and impactful relationship between the surgical approach and the child's pain experience. To fully appreciate the implications of this finding, it is essential to dissect the nuances of each surgical technique and explore the potential mechanisms that contribute to the observed differences in pain perception. The dorsal clamp technique involves a series of distinct steps. Initially, a clamp device is positioned around the foreskin. The primary purpose of this clamp is to provide a stable platform for the subsequent excision of the foreskin. Following the placement, the clamp is tightened. This tightening action results in the compression of the foreskin tissue. This compression, while crucial for achieving hemostasis (the cessation of bleeding), is also a potential source of significant discomfort. The sustained pressure applied to the tissue can activate nociceptors, the specialized sensory receptors responsible for detecting and transmitting pain signals. Nociceptors are distributed throughout the skin and deeper tissues, and they respond to various stimuli, including mechanical pressure, temperature extremes, and chemical irritants. When these receptors are activated, they initiate a cascade of events that ultimately leads to the perception of pain in the brain. After the clamp has been secured and the tissue compressed, the foreskin is excised. In the modified dorsal clamp technique, this excision is performed using an electrosurgery unit (ESU). An ESU utilizes high-frequency electrical current to cut and coagulate tissue. While ESU offers precision and hemostasis, the application of electrical current to tissue can also contribute to pain. The thermal energy generated by the ESU can cause tissue damage and inflammation, both of which can exacerbate pain. The combination of tissue compression from the clamp and the thermal effects of the ESU may explain the higher pain scores associated with this technique. The clamp induces mechanical pain through sustained pressure, while the ESU adds thermal pain due to tissue injury. In contrast to the dorsal clamp technique, the guillotine technique employs a fundamentally different approach to foreskin excision. In this method, the foreskin is typically excised in a more direct fashion, often using a scalpel or thermocautery. When thermocautery is used in the guillotine technique, it serves a dual purpose of cutting and hemostasis. Thermocautery devices use heat to incise tissue and simultaneously seal blood vessels, minimizing bleeding. This simultaneous action can be advantageous in reducing the duration of the

procedure and potentially minimizing tissue trauma. The guillotine technique, by its nature, involves less crushing and compression of tissue compared to the clamp method. The excision is more direct, and while thermocautery is used, the application of heat is more localized and instantaneous compared to the sustained pressure of the clamp followed by ESU. This difference in tissue handling is a crucial factor in explaining the observed differences in pain scores. The degree of tissue manipulation and the method of hemostasis are critical determinants of the pain experienced during and after surgical procedures. Tissue manipulation, including crushing, stretching, and excessive handling, can directly stimulate nociceptors, leading to pain. The more tissue is manipulated, the greater the potential for nociceptor activation and subsequent pain perception. In the context of circumcision, the dorsal clamp technique, with its inherent tissue compression, involves a greater degree of manipulation compared to the guillotine technique. Hemostasis, the process of controlling bleeding, is essential in any surgical procedure. However, different hemostatic methods can have varying effects on pain. While techniques like clamping and ligation are effective in controlling bleeding, they can also cause tissue damage and inflammation. Thermocautery, while also causing some thermal injury, offers the advantage of simultaneous cutting and coagulation, potentially reducing the overall extent of tissue trauma. The finding that the guillotine technique with thermocautery is associated with less pain in this study warrants a comparison with existing literature on circumcision techniques. Various studies have compared different methods, often focusing on factors such as efficiency, complication rates, and cosmetic outcomes. Some studies have indeed highlighted the efficiency and low complication rates associated with clamp methods. Clamp devices are designed to provide rapid and effective hemostasis, which can be particularly advantageous in mass circumcision settings where a high volume of procedures is performed. The controlled compression provided by the clamp can minimize bleeding and reduce the need for additional hemostatic measures. However, it is crucial to recognize that the primary focus of those studies may not have been the meticulous assessment of intraoperative pain. While some studies may have included pain as a secondary outcome, the emphasis was often on other surgical parameters. This difference in focus can explain the apparent discrepancy between the findings of the present study and the conclusions of previous research. The present study specifically prioritized the evaluation of intraoperative pain, utilizing validated pain scales to quantify the child's experience. This detailed assessment of pain may have revealed subtle differences between the techniques that were not apparent in studies with a different focus. Furthermore, the specific clamp device and ESU system used in this study may have unique characteristics that influence pain levels. Variations in clamp design, pressure application, and ESU settings can all contribute to differences in tissue trauma and pain. The context of mass circumcision events is also important to consider when interpreting the findings. Mass circumcision settings often present unique challenges, including time constraints, a high volume of patients, and potentially variations in operator experience. These factors can influence the choice of surgical technique and the way it is performed. In such settings, efficiency is often a primary concern. Clamp methods may be favored for their speed and ease of use. However, the findings of the present study suggest that prioritizing efficiency should not come at the expense of patient comfort. Even in mass circumcision settings, minimizing pain should be a primary goal. The study's results highlight the need for a balanced approach that considers both efficiency and pain management. While clamp methods can be efficient, the guillotine technique with thermocautery may offer a more favorable pain profile, particularly when meticulous pain assessment is performed. It is crucial to acknowledge that surgeon experience and technique variation can significantly influence the outcomes of any surgical procedure, including circumcision. The skill and experience of the surgeon

can affect the speed and precision of the procedure, the degree of tissue trauma, and the effectiveness of hemostasis. Even within the same surgical technique, variations in how the technique is performed can impact pain levels. For example, the amount of pressure applied with a clamp, the duration of clamp application, and the way the ESU is used can all vary between surgeons. In the context of the present study, while the study design controlled for the circumcision method itself, it may not have fully accounted for variations in surgeon experience and technique. These factors could have contributed to some of the variability observed in pain scores. The findings of this study underscore the importance of evidence-based decision-making in selecting the most appropriate circumcision method. Rather than relying solely on tradition or personal preference, surgeons should consider the available evidence regarding pain, complications, and other relevant outcomes. The study provides valuable evidence that the guillotine technique with thermocautery may be associated with less intraoperative pain compared to the modified dorsal clamp technique with ESU. This evidence should be taken into account when choosing a surgical method, particularly in settings where pain management is a primary concern.[16-20]

4. Conclusion

This study provides evidence that both the anesthesia technique and the circumcision method significantly influence intraoperative pain in pediatric patients undergoing mass circumcision. The combined application of topical anesthesia with needle-free injection is associated with reduced pain scores, highlighting the benefits of a multimodal analgesic approach in minimizing discomfort during the procedure. Furthermore, the choice of surgical technique plays a crucial role in the pain experience, with the guillotine method using thermocautery demonstrating a more favorable pain profile compared to the modified dorsal clamp method with electrosurgery. These findings underscore the importance of carefully considering both the anesthesia and surgical techniques employed in pediatric circumcision, especially in mass settings where efficiency is often prioritized. While clamp methods may offer advantages in terms of speed and hemostasis, the potential for increased pain should be weighed against these benefits. The study advocates for evidence-based decision-making, encouraging practitioners to adopt techniques that prioritize both efficiency and the minimization of patient discomfort. Future research could explore other factors influencing pain in this context, such as surgeon experience, specific variations within techniques, and long-term psychological outcomes. Additionally, investigating the cost-effectiveness and feasibility of implementing combined topical-NFI anesthesia in mass circumcision settings would be valuable.

5. References

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