

Recent Trends and Advances in Pain Management for Male Circumcision in Pediatric Population: Systematic ReviewKalpesh Onkar Patil¹, Vinod Kumar², Megha Sonawane³¹Assistant Professor, Neonatal & Pediatric Laparoscopic Surgeon, Department of General Surgery, MIMER Medical College, Talegaon, Dabhade, Maharashtra²Associate Professor, Department of Surgery, S.M.M.H. Government Medical College, Saharanpur, Uttar Pradesh³Lecturer, Department of Anaesthesia, MIMER Medical College, Talegaon, Dabhade, Maharashtra

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Abstract:**Background:** Circumcision is one of the oldest and most frequently performed surgical procedures done on males by pediatric surgeons. Pain management is one of the challenging tasks for both pediatric surgeons and anesthesiologists involved during the procedure of male circumcision. The aim of the present study is to systematically review the researchers conducted on pain management in pediatric male circumcision published during the past ten years.**Methods:** This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guideline. The literature search encompassed an extensive database including PubMed, MEDLINE, Science Direct and Embase. Studies published after the year 2012 were included in the analysis. The quality of included studies was assessed using appropriate tools tailored to the study design. The synthesis and analysis of data included a narrative summary of study characteristics, analgesic methods, pain scale used, surgical technique, and main study results.**Results:** Sample sizes in the selected studies ranged from 40 to over 1300 participants. Dorsal Penile Nerve Block (DPNB) was the most commonly performed regional anesthetic technique for male circumcision. Plastibell technique was the most commonly performed surgical procedures in the study. Neonatal Infant Pain Scale (NIPS) was the most commonly used pain scale in the present findings.**Conclusion:** In summary, the management of pain during and after male circumcision in the pediatric population has seen remarkable progress, reflecting a commitment to delivering safe, effective, and pain-free care to new-borns and infants.**Keywords:** Male circumcision, pediatric population, pain, newborn, pain management, anesthesia, analgesia.This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Circumcision is the world oldest and most controversial surgery. [1] Circumcision is commonly carried out in neonatal age group. [2,3] Male circumcision is a surgical procedure that involves the removal of the foreskin covering the head of the penis. It is one of the most commonly performed medical procedures worldwide, often carried out for religious, cultural, and sometimes medical reasons. Male circumcision in the pediatric population, particularly in new-borns and infants, has raised concerns about pain management. Circumcision requires patient safety, reliability, rapid recovery and adequate pain management [4].

Ensuring the comfort and safety of these young patients has been a priority for pediatric surgeons, anesthesiologists and researchers, leading to

significant advances in pain management techniques in recent years. This systematic review delves into recent trends and advances in pain management for male circumcision in the pediatric population. It is crucial to recognize that pediatric circumcision is a common practice, and improving pain management techniques has the potential to enhance the experience for both infants and their caregivers.

Male circumcision in pediatric patients has several potential benefits, including reduced risk of urinary tract infections, decreased chances of sexually transmitted infections, and lower rates of penile cancer. However, performing this procedure on infants raises ethical and medical concerns, particularly related to pain management. Infants lack the ability to communicate discomfort

verbally, necessitating vigilant pain management strategies. Recent advances in pain management for pediatric male circumcision primarily aim to minimize the pain experienced by the infant during and after the procedure. These advancements have been informed by scientific research and clinical practice. Some of the notable advances in pain management include local anesthesia, preoperative analgesia, improved techniques, postoperative pain management and parental education.

The use of local anesthesia is a fundamental advancement in pain management during male circumcision. Topical or injectable local anaesthetics, such as lidocaine, can effectively numb the area, reducing or even eliminating pain during the procedure [5]. In addition to local anesthesia, preoperative analgesia techniques have been developed. These involve administering pain-relief medications before the circumcision to ensure that the infant is comfortable and pain-free throughout the procedure [6].

Advances in surgical techniques have also contributed to reduced pain. Innovations in circumcision methods, such as the use of specialized instruments, aim to make the procedure quicker and less painful [7]. Managing pain after circumcision is equally important. Enhanced postoperative pain management strategies ensure that the infant remains comfortable during the healing process. These strategies may involve the use of mild analgesics and careful wound care [6]. Educating parents about the procedure and the importance of pain management is essential. Informed parents can make decisions that align with their child's best interests and well-being [7].

The World Health Organization (WHO) recognizes male circumcision as a valuable tool for HIV prevention and has implemented circumcision programs in countries with high HIV prevalence [8]. These programs often include pain management protocols to ensure that the procedure is safe and as painless as possible. There are several surgical techniques performed for male circumcision and post-operative analgesics are applied for pain management.

Despite of several researches conducted worldwide; no gold standard procedure has been established for male circumcision. The aim of the present study is to systematically review the researchers conducted on pain management in pediatric male circumcision published during the past ten years.

Method

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guideline [9]. We only included studies that assessed pain using specific pain scales or observed physiological and behavioural responses to pain. We focused on studies that performed circumcision in pediatric population and were written in English. We included only original research studies like randomized controlled trials (RCTs) and observational studies. We excluded reviews, meta-analyses, commentaries, editorials and short communications. Studies done on the male adults were excluded.

To identify relevant studies, we searched PubMed, MEDLINE, Science Direct and Embase databases using keywords and MeSH terms, including pain management, anesthesia, analgesia, pain, newborn, and male circumcision. Studies published after the year 2012 were included in this systematic review which compared different types of anesthesia/analgesia for pediatric circumcision or investigated the effects of different surgical techniques on pain levels. To ensure the reliability and credibility of the literature selection process, a pre-screening, or pilot literature review, was meticulously conducted. This pre-screening was performed by two independent researchers, and discrepancies were settled by a third reviewer. Each study's title and abstract were thoroughly examined to ascertain its relevance to the research objectives.

Data extraction and synthesis was performed after appropriate screening of the studies based on the inclusion and exclusion criteria. The extracted data included publication year, study type, sample size, analgesic methods, pain scale used, surgical technique, and main study results. The collected data were presented as findings of this systematic review after analysis.

Result

Initial search identified 142 studies from the databases and other sources. 121 records were screened after initial exclusion of the studies. Following an assessment of the titles and abstracts, 30 articles were selected for further consideration. Following that, 8 studies were eliminated based on the inclusion criteria and two studies were not in English. We screened 20 studies based on the inclusion and exclusion criteria.

Finally, we selected 12 studies because of non-availability of some data in the other studies [10-21]. The process of study selection is illustrated in the PRISMA study selection diagram (Figure 1).

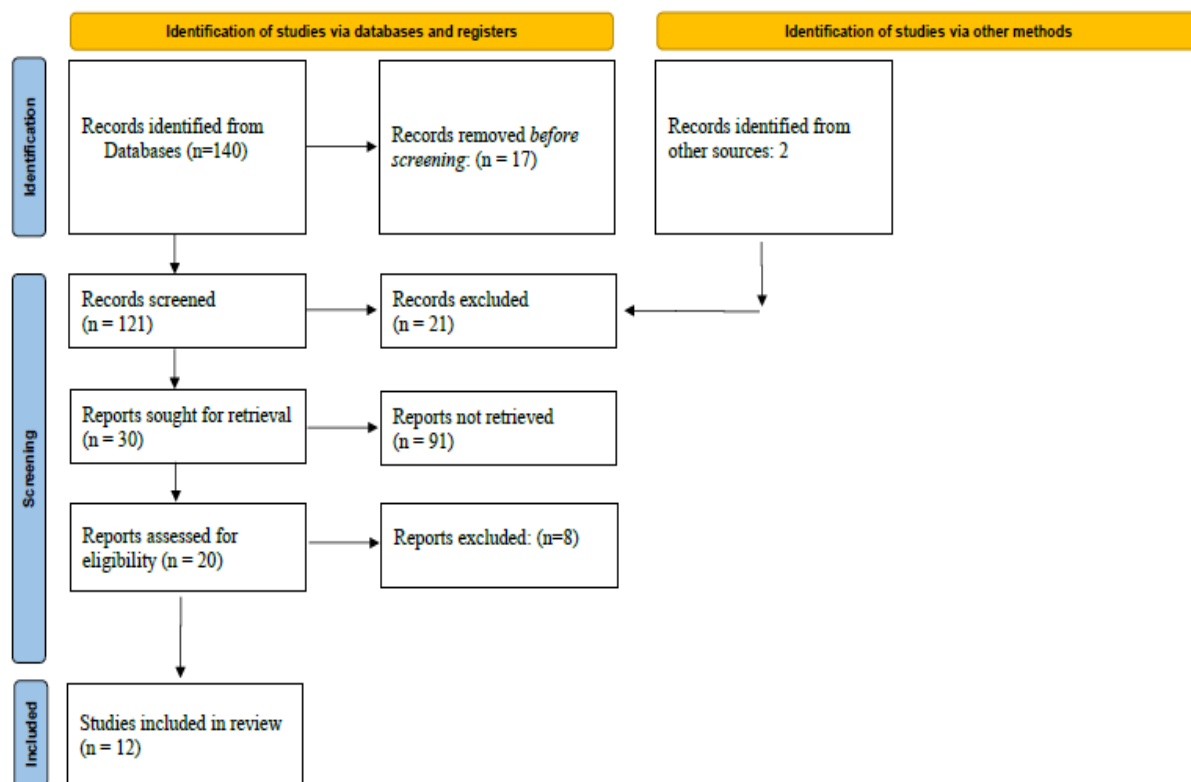


Figure 1: PRISMA Flow Chart

Table 1: Comparison of different methods used for male circumcision

Authors & Publication Year	Sample Size	Pain Scale	Technique	Result
Polat F et al. 2013 [10]	70	VAS	Ali's clamp and conventional circumcision	lidocaine hydrochloride + epinephrine and 5% tramadol
Al Qahtani R et al. 2014 [11]	90	N-PASS scores	Plastibell	EMLA cream vs. oral sucrose vs. combination of EMLA cream and oral sucrose
Karakoyunlu N et al. 2015 [12]	60	modified objective pain scale (MOPS)	dorsal slit incision technique and double incision (i.e., sleeve) technique	dorsal nerve blocks with bupivacaine
Anouar J et al. 2016 [13]	40	CHEOPS	DPNB	Bupivacaine + clonidine vs. bupivacaine
Canakci E et al. 2017 [14]	60	CHEOPS	Unknown	caudal block with bupivacaine 0.25% vs. subcutaneous morphine vs. dorsal penile nerve block with 1 mg/kg of bupivacaine
Teunkens A et al. 2018 [15]	310	Objective Pain Scale	DPNB using the Dalens technique and DPNB using the technique described by Sandeman	Postoperative piritramide and intraoperative fentanyl, the postoperative need for paracetamol or ibuprofen
Modekwe VI et al. 2019 [16]	110	NIPS	Plastibell	EMLA vs. DPNB
Wang X et al. 2019 [17]	104	Numerical Rating Scale (NRS)	Unknown	caudal block vs. DPNB
Munevveroglu C et al. 2020 [18]	500	CHEOPS	dorsal penile block and subcutaneous ring block	caudal epidural block, IV paracetamol and IV tramadol

				HCl
Spyridon P Basourakos et al. 2022 [19]	1378	Neonatal Infant Pain Scale (NIPS)	ShangRing and Mogen clamp	mixture of topical 2.5% lidocaine and 2.5% prilocaine cream
Sharara-Chami R et al. 2022 [20]	206	NIPS	Gomco	EMLA + Sucrose + RB vs. EMLA + Sucrose + RB + Music
Ihediwa CG et al. 2022 [21]	100	NIPS	Plastibell	nutritive pacifiers (NPs) versus non-NPs (NNPs) as adjuncts to local anaesthesia

Abbreviations: VAS: Visual Analogue Scale; N-PASS: Neonatal pain agitation and sedation scale; EMLA: Eutectic Mixture of Local Anesthetics; RB: Ring Block; dorsal penile nerve block [DPNB]; CHEOPS: Children's Hospital of Eastern Ontario Pain Scale; NIPS: Neonatal Infant Pain Scale. ("Gomco" stands for Goldstein Medical Company, the original manufacturer of the clamp applied in this procedure).

Table 1 shows findings of the present study. We have analyzed the studies ranged from 40 to 1378 male pediatric population. The findings of the present systematic review revealed that different surgical techniques and analgesics have been applied for pain management in pediatric male circumcision. Plastibell techniques have been used in three studies [11,16,21], Dorsal slit incision technique and double incision (i.e., sleeve) technique is applied in one study [12], Gomco technique is used by one surgeon [20], one paper [19] investigated the use of Shang Ring and Mogen clamp, while Ali's clamp and conventional circumcision technique is applied by researchers in one study [10].

The main pharmacological interventions used in the study are as follows. These analgesics are used either in combination or as single medication. EMLA (Eutectic Mixture of Local Anesthetics) is used in three studies [11, 16, 20]. Lidocaine in combination with other anesthetics is applied in two studies [10, 19], Bupivacaine in three studies [12, 13, 14], tramadol [10, 18], Paracetamol [15, 18]; Dorsal Penile Nerve Block (DPNB) [13, 15, 16, 17] which involves regional anesthesia often obtained with different doses of lidocaine or bupivacaine injected at the base of the penis. Caudal epidural block is used in one study [18] combined with IV paracetamol and IV tramadol HCl. 2.5% prilocaine is applied in one of the studies in combination with topical 2.5% lidocaine [19]. Two articles investigated the used of ring block [18, 20]. Dorsal Penile Nerve Block (DPNB) was the most commonly performed regional anesthetic technique for male circumcision.

The non-pharmacological methods used for pain management in the present study include sucrose solution [11, 20] and music [20].

The different methods used to measure pain were Visual Analogue Scale (VAS), N-PASS scores, Modified Objective Pain Scale (MOPS), CHEOPS, Objective Pain Scale, Neonatal Infant Pain Scale (NIPS), Numerical Rating Scale (NRS) and the assessment of several vital signs like heart rate, oxygen saturation, and respiratory rate changes. Neonatal Infant Pain Scale (NIPS) was the most commonly used pain scale in the present findings.

Discussion

Several different measures were used for pain management during male circumcision and postoperative care. According to Munevveroglu C [18], all circumcision methods can be grouped in four main headings: dorsal slit, Sheldon method (Circumcision shield, Mogen Clamp etc.), special circumcision clamps and open surgical methods (dorsal slit + excision, Sleeve method, guillotine prepuce excision). Several studies on male circumcision have reported that surgical methods also have an effect on postoperative analgesia. The findings of the present systematic review are comparable with several other studies. Three surgical devices are commonly used to perform male circumcision: Gomco clamp, Plastibell device, and Mogen clamp [22]. Gomco or Plastibell devices are the most widely used method for circumcision [23]. In our study also Plastibell techniques have been used in three articles [11,16,21]. In another study conducted by Salgado Filho MF et al. [24] concluded that Plastibell under general anesthesia with sevoflurane combined with 5% lidocaine and 5% prilocaine cream during circumcision of older children does not provide satisfactory perioperative hemodynamic stability or postoperative analgesia. One study investigated by Nagdeve NG et al. [27] found that Plastibell use has comparable outcomes to the conventional dissection technique for pediatric circumcision and has an advantage of shorter surgical duration but it is less comfortable in the postoperative period due to swelling, and requires greater use of analgesics. Sinkey RG et al. [28] found that Mogen clamp circumcision duration is significantly shorter than Gomco clamp. Mogen clamp is also associated with less neonatal pain physiologically by significantly lower percentage change in salivary cortisol, lower heart rate, and mean arterial blood pressure. There was no difference in CRIES scores.

Rao JM et al [25] found that the modified circumcision using disposable circumcision suture device is a simple, safe, faster, and effective procedure with a relatively lower complication rate and better cosmetic results and may become the better alternative to the conventional technique for the children. The sleeve technique provides lower pain scores and a reduced incidence of agitation after elective male circumcision [12]. Polat F et al [10] found that tramadol may not provide effective local anesthesia in male circumcision. Clonidine can be used in dorsal penile nerve block to improve and to prolong its analgesic effects after male circumcision [13].

Teunkens A et al. [15] in a study performed DPNB using the Dalens technique and DPNB using the technique described by Sandeman. Al Qahtani R et al. [11] found that the combination of sucrose and EMLA cream revealed a higher analgesic effect and minimal adverse response to pain than either EMLA cream or sucrose alone during neonatal circumcision.

Some studies also incorporated non-pharmacological measures such as music, sucrose solution, and nutritive pacifiers (NPs) and non-NPs (NNPs) to manage pain besides using surgical techniques and analgesics. Sharara-Chami R et al. [20] in 2022 concluded that music, delivered in their study has no effect in mitigating pain in neonatal circumcision. They found that the combination of EMLA + Sucrose + RB is highly effective for managing pain during circumcision. In their previous trial conducted in 2017 [26], they found the same result that the combination of Eutectic Mixture of Local Anesthetics (EMLA) + Sucrose + Ring Block (RB) was significantly effective in reducing pain during circumcision.

Ihediwa CG et al. [21] compared nutritive pacifiers (NPs) versus non-NPs (NNPs) as adjuncts to local anaesthesia in male neonatal circumcision using the Plastibell technique and concluded that additional pain control was superior in NPs than in NNPs during male neonatal circumcision. Al Qahtani R et al. [11] assessed the effectiveness of eutectic mixture of local anaesthetic (EMLA) cream compared with oral sucrose and both in alleviating pain in neonatal circumcision. They grouped 90 new-born males into three groups (30 each). Each group received a different type of analgesics like EMLA cream (Group A), oral sucrose (Group B) or combination of EMLA cream and oral sucrose (Group C). Their findings revealed that the combination of sucrose and EMLA cream provided a higher analgesic effect and minimal adverse response to pain than either EMLA cream or sucrose alone during neonatal circumcision.

The present systematic review has some limitations as some of the analyzed studies didn't specify the surgical techniques applied. The retrieved data

showed heterogeneity in terms of sample size, pain scales, analgesics used and surgical techniques performed.

Conclusion

Recent advances in pain management for male circumcision in the pediatric population have significantly improved the experience for infants and their families. Local anesthesia, preoperative analgesia, improved surgical techniques, and postoperative pain management strategies have all played a role in reducing pain and discomfort associated with this common procedure. These advancements underscore the commitment of pediatric surgeons, anesthesiologists and researchers to prioritize the well-being of pediatric patients. Pediatric circumcision remains a topic of ongoing research and development, with the aim of further enhancing pain management techniques and ensuring the best possible care for infants undergoing this procedure.

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