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Chapter

Circumcision with Thermocautery after Local Anesthesia in Children: A Retrospective Single-Center Experience

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Abstract

This study aimed to examine the short- and long-term complications of thermocautery-assisted circumcisions with local anesthesia done in a sterile environment in operating room conditions, accompanied by literature. The participants who consecutively underwent thermocautery-assisted circumcision with local anesthesia from June 2018 to May 2019 were included in the study. As a local anesthetic, 40-mg lidocaine HCl, 0.025-mg adrenaline, and bupivacaine 5 mg/ml were used together. They were 1 month to 17 years old, had same ethnic origin, and were in the same location. The age groups were compared in terms of complications. The participant age and surgical duration means were 4.89 ± 2.08 (30 days to 17 years) years old and 7.484 ± 1.524 (5–20 min) min, respectively. Complications were observed in 53 participants or 2.9% of the whole observation set. The participants under intervals of 1–6 months and over 6 years of age had significantly lower complication rates when compared to the other participants, and this comparison was statistically significant ($P = 0.001$). The study results demonstrated that circumcision with thermocautery after local anesthesia is a viable, reliable, and effective method. It can be assumed that circumcisions in males especially may be effective in 1–6 months and over 6 years of age. Parents choose this method because it is more appropriate and eliminates the risk of general anesthesia.

Keywords: bupivacaine, lidocaine, circumcision with local anesthesia

1. Introduction

Circumcision is a surgical procedure that means the removal of the foreskin from the male penis [1]. It is mostly performed for religious reasons in Turkey. In the Western Society, since the nineteenth century, circumcision began to be performed for medical reasons, and routine circumcision practice was abandoned in 1949 with the question of the medical benefits of circumcision [2, 3]. Regardless of the reason, one out of every six men in the world is circumcised [4, 5]. Apart from medical reasons, circumcision is performed to protect against sexually transmitted diseases...
(STDs), as well as mostly for traditional and religious reasons [6, 7]. This surgical procedure is applied in almost every region of the world, although its frequency varies by region [8, 9]. Complications related to factors such as anatomical anomalies, clinical comorbidities, surgical methods used, and age of patients are seen in 1–4% of all the circumcision procedures. When circumcision is performed without sufficient experience and in inappropriate conditions, the risk of complications increases even more [7, 8]. Circumcision complications are categorized as early and late complications. Mild complications, such as pain, bleeding, edema, and inadequate skin excision, may occur in the early period, while infection, the formation of skin bridges, urinary retention, meatal stenosis, meatal ulcer, and fistulas can be examined in the late period [7, 10]. Indispensable challenges, such as death and glans amputation, may also appear, but rarely [11]. The medical basis of circumcision, when, where, and by whom, is not a complete opinion in the world, especially in Turkey.

2. Patients and methods

This research was performed in accordance with the Helsinki Declaration and with the approval of the local ethics committee (Clinical Ethics Committee of Karamanoğlu Mehmet Bey University Medical School, date 27.01.2021, issue 01.2021/01). This study was started with 2245 patients who were registered for

Figure 1.
Surgical step of thermocautery circumcision.
circumcision in our hospital’s database, but 1821 patients who came for control on the 10th day, 1st month, and 1st year after circumcision were included.

The data of patients circumcised by pediatric surgery specialists between June 2018 and May 2019 were retrospectively restored and included in the study at the Karaman Training and Educational Hospital Pediatric Surgery Clinic in Turkey. Clinicians aged 1 month to 17 years who underwent circumcision with local anesthesia were included in this sampling retrospective study. The number of patients included in the study according to age groups was as follows: 30 days to 6 months: 630 (34.6%), 6–12 months: 358 (19.7%), 1–3 years: 152 (8.3%), 3–6 years: 54 (3%), and 6–17 years: 627 (34.4%). Patients who had existed simultaneously with diseases were excluded. In addition, consent forms were obtained from the legal representatives of the patients for the use of the medical images. The patients were recorded by local voluntary agencies before the date of circumcision. The labels consisted of the following sections: name, surname, birth date, birthplace, and previous disease. All the patients were examined prior to circumcision.

All the patients were carried out by one pediatric surgery specialist. As a local anesthetic, 40-mg lidocaine HCl, 0.025-mg adrenaline, and bupivacaine 5 mg/ml were used together. A penile block was imposed on the radix and circumference of the penis; 3–5 ml of local anesthetic was conducted according to the patients’ age and weight. Regularly, the penis was cleaned with batticon and covered with a sterile surgical cover. Approximately 10 min after the injection of local anesthesia, the

Figure 2. Surgical step of thermocautery circumcision.
prepuse was pulled back to interfere with glans injury and the process was started, after observing and cleaning the external meatus and glans. The prepuse was covered using two clamps at positions 6 and 12 o’clock to design a slight strain and prepared the length of mucosa circumcised skin. It was established obliquely at an angle close to 15–20°, with its ventral part facing above. Thus, the meatus and frenulum were saved from injury. The guillotine technique was used in all the circumcisions performed with thermocautery included in our study. It is not recommended because it may cause glans incisions, but it is a method applied in current practice. In this method, after the prepuse is suspended with clamps, the surgeon pulls the glans down with the thumb and index finger of one hand and places the flat clamp on the prepuse in the other hand so that it is above the glans. The prepuse is cut with a scalpel over the clamp (Figure 1). Then, the mucosa is covered with clamps and the excess is excised (Figure 2). The skin and mucous membranes are sutured all around with separate sutures (Figure 3). In this method, it should be ensured that the glans remain under the clamp. Otherwise, there may be serious glans injuries [1]. The skin was covered and firmed on two sides by the clamp and foreskin tissue was cut just above the clamp (Figure 2) using a thermocautery device (Thermo-Med QX 2100; Thermo Medical, Adana, Turkey (Figure 4). The settings of the thermocautery device were set up according to the patient’s age: 500°C was used for patients under 2 years of age; 550–650°C was used for patients of 2–10 years of age, and 700–750°C was used for patients older than 10 years of age. After bleeding was restrained, mucosal proportion

**Figure 3.**
Surgical step of thermocautery circumcision.
in patients under 2 years of age was supplied with two 5/0 absorbable sutures at 3, 6, 9, and 12 o’clock positions. A 4/0 absorbable suture was used in patients aged 2–10 years, with four sutures at 3, 5, 6, 7, 9, and 12 o’clock positions.

Finally, in patients older than 10 years, 3/0 absorbable suture was used, with six sutures positioned at 2, 4, 6, 8, 10, and 12 o’clock. The incision line was then covered with an oxytetracycline hydrochloride–Polymyxin B sulfate antibiotic combination containing a bandage. It affects by preventing the bacteria’s cell wall and the labor of the bacteria’s proteins. Patients were observed for 2 h postoperatively and analgesics were prescribed before discharge. The first follow-up was performed by the operating team, and 10 days after the operation, the wound dressing was removed in the Pediatric Surgery Outpatient Clinic, and a return to daily life was recommended.

Afterward, the patients and their parents were advised to continue their daily life routines. In cases of excoriation due to phimosis, the application of epithelizing cream to the wound was recommended to the patient or his family. Possible complications were explained to patients and parents, and we asked them to visit the hospital if they developed any symptoms, such as penile bleeding, discoloration, or shape changes. In these cases, patients were measured, followed, and treated by the first author of this article.

They were not given oral antibiotics to use prophylactically or at home. We recommend ibuprofen to children as an anti-inflammatory analgesic 5–7 mg/kg after 1 year old and paracetamol 10–15 mg/kg before 1 year old every 8 h.
The perioperative complications group included bleeding during the circumcision or during the hospital stay. The early postoperative complications group emerged during the first 10 days after discharge from the hospital. The long-term complications group occurred in 10 or more days after discharge from the hospital. The complications related to the circumcisions were assessed with the modified Clavien-Dindo classification system [12].

The following symptoms were not measured as complications: foreskin swelling, glans penis incrustation due to a phimosis opening, or a temporary color change after local anesthesia.

3. Statistical analysis

The investigation set consisting of those patients circumcised using the thermo-cautery-assisted method was measured with the Statistical Package for the Social Sciences software (SPSS Inc., Chicago, IL, USA). The output dispersion was examined using the Kolmogorov-Smirnov test. The continuous variables were expressed as the mean ± standard deviation (range: minimum-maximum), and the appropriate categorical variables were indicated as the numbers and percentages. The chi-squared and Mann-Whitney U tests were referred to measure the categorical output and the quantitative changeable, respectively. Two-tailed \( P \) values of less than 0.05 were accepted as statistically substantial.

4. Results

The mean age of the patients was 4.89 ± 2.08 years (range: 50 days to 17 years). The average surgical duration was 7.484 ± 1.524 min (range: 5–20 min). The complication rates for the age groups of the patients included in the study were as follows: 30 days to 6 months: 2 (0.3%), 6–12 months: 17 (4.7%), 1–3 years: 22 (14.4%), 3–6 years: 10 (18.5%), and 6–17 years: 2 (0.3%). Complications were observed in 53 patients or 2.9% of the whole dataset. The complications were assessed with the modified Clavien-Dindo classification method. Two (0.11%) of the patients had bleeding from the suture line, which was classified as a perioperative complication. The bleedings were stopped immediately via cauterization. Twenty-eight (1.54%) of the patients who underwent circumcision had postoperative early complications. Eight (0.44%) infections and 12 (0.66%) bleeding cases were classified as early postoperative early complications. The infection was treated with antibiotics and dressing.

Due to a ligated artery, a 4-year-old patient had frenular artery bleeding on the first day after the circumcision, and it was controlled after taking to the operating room and opening the sutures with local anesthesia. Five of all patients who underwent circumcision bleeding were controlled by stitching up also with local anesthesia. Their ages were 11 months, 22 months, 3 years, 4 years, and 5.5 years, respectively.

Six of all patients had dorsal vein bleeding treated via vein ligation also with local anesthesia. Their ages were 10 months, 16 months, 18 months, 22 months, 3 years, and 4 years, respectively.

Seven (0.38%) of all patients developed convulsions due to local anesthesia. Their ages were 8 months, 9 months, 10 months, 10 months, 1 year, 1 year, and 1 year, respectively. Four of these convulsions were as nystagmus form and three were in the
tonic-clonic form. The reason for the high number of convulsions under 1 year of age may be allergy to bupivacaine. All the convulsions were followed by rectal diazepam (0.5 mg/kg) for 24 h. In one case (0.05%), a 2.5-year-old patient could not urinate for the first 8 h after local anesthesia, but this patient urinated spontaneously without a urinary catheter. Twenty-three (1.26%) of the patients who underwent circumcision had late complications. The penises of two patients were trapped, and they were surgically circumcised again. A total of five patients aged 7, 10, 12, 17, and 21 months during the circumcision required urethral dilatations after 1 month because of the meatal stenosis. A 1-year-old patient developed meatitis 10 days after the circumcision, while a 2-year-old patient had the same issue 1 month after the circumcision. Both children were medically treated.

Epidermal granuloma and inclusion cysts in the dorsal or ventral part of the penis were removed from the suture line with local anesthesia in four (0.22%) cases. Their ages of them were 4 months, 9 months, 14 months, and 2.5 years, respectively. After circumcision, six of seven (0.38%) cases where the mucosa adhered were opened by simply retracting, while the skin bridge in one case was cut with a scalpel under local anesthesia. Although we coagulated the vessels by holding them one by one, we saw ecchymotic changes in the skin in one case after circumcision and lacerations due to a burn at the edge of the skin during the procedure in three cases. There was no problem with the follow-up. Finally, one patient had a glans–skin bridge complication 6 months after the circumcision, and he was treated surgically.

Secondary phimosis was detected in four (0.21%) of our cases, and they were treated with circumcision revision. Their ages were 10 months, 14 months, 1.5 years, and 2 years, respectively.

Urethral injury and fistula occurred in a 4-year-old patient with a urethral ventral chord. About 1 year later, urethral fistula repair was performed under general anesthesia.

Except for four patients, complications were only observed in children older than 6 months and younger than 6 years old. The patients younger than 6 months and older than 6 years had significantly lower complication rates when compared to the other patients, and this comparison was statistically significant (P = 0.001).

5. Discussion

Circumcision has been done as a routine for all recently born males in Muslim countries. Circumcision keeps on being done for religious, cultural, and medical reasons. The prevalence of circumcision in the United States is predicted to be about 80% for males, with most of these procedures carried out in newborns [13].

A recent meta-analysis comprised 140 journal articles that came to the same outcome; early infant male circumcision has long-standing advantages. It was shown to protect against urinary tract infections, phimosis, inflammatory skin conditions, candidiasis, various sexually transmitted diseases (STDs) in both sexes, genital ulcers, and penile, prostate, and cervical cancer [14]. Unfavorable effects of circumcisions are uncommon. The low risk in comparison to the benefit demonstrates that the benefits of male circumcision surpass its risk. Adverse events of circumcision have been difficult to measure accurately. The largest studies on measuring complication rates are mostly retrospective, and their data have generally not taken into account standardizing the variables. The timing of the procedure, the technique, the person
performing the procedure, the setting, and the equipment used can all change the percentage of overall complications significantly.

Male circumcision has a low incidence of unfavorable events overall, particularly if the procedure was performed during the first year of life [15]. The risk is further decreased and might be prevented, with careful consideration of the penile anatomy and the correct use of surgical equipment by trained clinicians in sterile environments. Most of the unfavorable events of circumcision are mild and are easily treatable. Although there are different plots of the diverse circumcision methods in the literature, researchers are still negotiating the most available circumcision age and the reliable circumcision method. The applied technique should be applicable, common, and reliable, and it should cause very few or no challenges. For this purpose, we compared the thermocautery-assisted method with the other circumcision methods in terms of the early and long-term complications. The early complications included bleeding, pain, inadequate skin removal, infection, chordee, iatrogenic hypospadias, glanular necrosis, and glanular amputation. The long-term complications included epidermal inclusion cysts, suture sinus, penile adhesions, phimosis, urethrocutaneous fistula, trapped penis, meatitis, and meatal stenosis [7, 16, 17]. In addition, hydronephrosis and permanent renal damage can be caused by meatal stenosis [18]. In our study, we did not see hydronephrosis and permanent renal damage caused by meatal stenosis.

The thermocautery-assisted technique utilizes the heat energy used for cauterizing. When compared with the monopolar cautery technique, which utilize an electrical current, the thermocautery-assisted method conducts the heat locally. According to the skin features of the patient, the heat levels are adaptable on the most recently developed thermocautery devices. Former studies have shown that optimum hemostasis is accomplished with a temperature ranging between 100°C and 400°C. Although a range between 350°C and 900°C can be obtained within in vivo environments, the highest heat level is reduced by half in a bloody environment. Thermocautery devices have been used successfully in local dermatological excisions with the implementation of cardiac devices [19]. However, there have been few studies on the use of thermocauterization in circumcisions [20–23]. It has been declared that the thermocautery technique results in alike wound healing when compared to the scalpel technique [22].

Aslan et al. performed mass circumcisions with thermocautery devices in Sudan, and they reported a complication rate of 0.086% in the early postsurgical period (3 weeks). These complications included bleeding, scrotal abscess, tachycardia, and syncope after the local anesthesia injection. Up to the present moment, few data on thermocautery-assisted circumcision have been marked. However, in the study by Arslan et al., edema appeared in one-fifth of patients, which was identified as clinically inconsiderable [20]. Kazem et al. performed 3-min manual frenular compressions for bleeding control in 3760 newborn patients undergoing Plastibell circumcisions. They also used an ophthalmological thermocautery technique on a different study set including 3750 patients. While a 0.5% complication rate was observed in the first group, the thermocautery method exhibited a 0.05% complication rate [24]. Although urinary retention has been reported when using the Plastibell technique, the ophthalmological thermocautery-assisted circumcisions took longer with regard to urinary retention and wound healing [24, 25].

There are many different circumcision techniques currently in use. For example, the Plastibell circumcision technique can be applied safely in infants from newborns to 1 year olds [26]. The operation takes between 5 and 10 min, and the Plastibell is
abandoned in the penis for 1 or 2 weeks until it comes off by itself. Complications related to this method have been reported in 3% of the patients [26], and Jimoh et al. reported a complication rate of 1.1% in their Plastibell study of 2276 patients [27]. The Mogen clamp is often used among the Jewish population [28], and Young et al. reported a complication rate of 2.7% in their Mogen clamp study of 1239 patients [29]. Ali’s clamp is a tool widely used in Turkey. It consists of a whistle-shaped tube on the glans and a ring that compresses the foreskin through it. The average duration of this application is approximately 5 min. Senel et al. reported a complication rate of 2% in their Ali’s clamp study of 7500 patients [30]. They showed that Ali’s clamp is easier to apply, and the operation time was less than in the other current methods, with fewer complications [30]. Another technique uses the Shang ring, which was developed in China. It is an apparatus that compresses the foreskin between two rings; however, this method carries the risk of glans amputation [31]. The ring is removed after 5–7 days [32]. In one meta-analysis including 18 randomized clinical studies, Huang et al. reported a complication rate of 1.27% in 2589 patients circumcised using Shang rings [33]. The Gomco method uses a metal clamp with a bell-shaped tip, and Amir et al. reported a complication rate of 1.9% in their study of 1000 patients [34]. Ozen et al. reported that 13 newborns who were circumcised using the Gomco technique developed meatal stenoses. Meatoplasties were used to treat these patients [17].

The dorsal slit, guillotine, and sleeve methods are defined as open circumcision surgical techniques. For the dorsal slit method, a vertical incision is made in the forward direction; then, an appropriate amount of mucosa is selected with the foreskin and removed by cutting the tissue around the penis with scissors. Following hemostasis, the remaining skin and mucosa are stitched together. In the sleeve technique, the incision on the foreskin is done circularly with a scalpel, and the mucosal boundaries are excised. The skin is cut in the form of a band and then removed. This process is followed by hemostasis and stitching. Buwembo et al. reported a complication rate of 0.6% in their dorsal slit study of 2471 patients and a complication rate of 1.4% in their sleeve study of 2681 patients [35]. The application of monopolar diathermy runs the potential risk of coagulation due to the electrical current at the penile base. Previous studies have revealed serious complications, such as penile ablation, necrosis, and gangrene [36]. Shen et al. compared two disposable circumcision suture devices (Langhe and Daming). Complications such as bleeding, manual staple removal, and infections are frequently observed when using these devices [37]. Seven (0.38%) of all patients developed convulsions due to local anesthesia. Four of these were as nystagmus form and three were as the tonic-clonic form. The reason for the high number of convulsions under 1 year of age may be an allergy to bupivacaine. In one case (0.05%), a 2.5-year-old patient could not urinate for the first 8 h after local anesthesia, but this patient urinated spontaneously without a urinary catheter. Our observations show that children under 6 months and over 6 years of age have fewer short- and long-term complications when undergoing circumcisions. In our study, the complication rate was 2.9% in 1821 patients. The fact that the complication rates of circumcisions performed under 6 months and over 6 years of age are similar to the literature makes us think that this procedure with local anesthesia is especially more reliable in this age group in children. In a study carried out in England, 66,519 circumcisions were reported, with a complication rate of 2%. Complications were hemorrhage in 533 patients (0.8%), need for a revision in 303 patients (0.5%), and meatal stenosis in seven patients [38]. In the present study, similar to the literature, the most common early circumcision complication was found to be bleeding (0.77% of 1821 patients).
According to our observations, the circumcision line usually heals within 5 days before 6 months and 7 days after 6 months when using the thermocautery technique. We observed that the wound healing was extended to 20 days in only two patients in our data set. Their ages are 8 and 10 years old during the circumcision. In addition, urinary retention was observed in one patient in our thermocautery-assisted circumcisions.

6. Conclusion

According to our observations, the circumcision line usually heals within 10 days under 6 months of age when using the thermocautery technique. We observed that the wound healing was extended by 3 weeks in five patients in our data set, but their circumcision ages were over 1 year. Our observations show that children under 6 months and over 6 years of age have fewer short- and long-term complications when undergoing circumcisions. This chapter provides a complete evaluation of the thermocautery-assisted circumcision technique with respect to the short- and long-term complications. The patients in our dataset were followed up postoperatively for 1 month to 1 year. Since the cauterization is performed during the cutting process in the thermocautery technique, the bleeding risk is less when compared to the other methods. In recent years, in Turkey, circumcisions have been increasingly preferred for children at earlier ages, due to the belief that this leads to faster wound healing.

Urethral injury and fistula occurred in a 4-year-old patient with a urethral ventral chord. His urethral plate was very thin and weak, so urethrocathaneous fistula occurred. About 1 year later, urethral fistula repair was performed under general anesthesia. The prolongation of postoperative discharge time after general anesthesia often causes pain, nausea, and vomiting. No nausea and vomiting were observed in our cases. All our patients were discharged on the day of the operation. For adequate sedation, anxiolysis, and analgesia in circumcision cases, a safe perioperative process should be planned.

The main advantages of this technique are the cheap cost, the ability to heal the tissue in a short time, and the ability to perform it in a nonoperating room environment with local anesthesia by a specialist doctor. This can be done fairly quickly and allows for much more circumcision in all the age groups of children in areas where the cost and availability of general anesthesia are prohibited.

As a result, this technique reveals that it is a safe, practical, reliable, and effective method for performing circumcisions in children, especially under 6 months and over 6 years of age.

Conflict of interest/funding

None.
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