Safety and consequences of bipolar electrocautery use in circumcision

Ahmed M. Akoula, Mohamed F. Abdelrahman, Ahmed H. Ahmed

Pediatric Surgery Unit, Department of General Surgery, Faculty of Medicine, Minia University, Minia, Egypt

Correspondence to Ahmed M. Akoula, MD, Pediatric Surgery Unit, Department of General Surgery, Faculty of Medicine, Pediatric University Hospital, Minia, Egypt.
e-mail: ahmed.akoula@yahoo.com

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Background
Circumcision is one of the oldest surgical procedures and is also one of the most commonly performed surgical procedures in practice nowadays. There are several methods and techniques used to perform circumcision. Regardless of which method is used, a complication rate of 0.2–2% is documented. Some authors reported that the use of bipolar diathermy causes less tissue damage, less bleeding, and reduced operative time.

Patients and methods
This is a prospective study about the safety of bipolar electrocautery in circumcision that included 475 infants and children presented to the outpatient clinic seeking for circumcision in the Pediatric Surgery unit, Minia University Pediatric Hospital, during the period between January and December 2021. Patient demographics and data recorded included patient age, type of anesthesia, operative time, duration of bipolar application to the prepuce, intraoperative bleeding, method of skin approximation, and any complications following circumcision.

Results
The age of our patients was 9.92 ± 9.87 months. Overall, 55.79% were operated under local anesthesia, whereas 44.21% were operated upon using general anesthesia. The electocautery application time during circumcision was 44.79 ± 14.69 s. Overall, 45.89% of cases required trimming of the mucosa due to long mucosal cuff. There were no recorded cases of bleeding nor ischemic insult to the glans or the penile skin. Postoperative penile edema was encountered in 81.68% of cases.

Conclusion
Bipolar electrocautery is a safe, easy, and bloodless method in circumcision by the crush technique. The cosmetic results are highly acceptable. Low current mode is highly recommended to decrease the duration of postoperative edema.

Keywords:
bipolar, circumcision, diathermy, electrocautery

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Introduction

Circumcision is one of the oldest surgical procedures in practice [1]. Approximately, 35% of males in developing countries are circumcised. There are several techniques used to perform circumcision [2]. Regardless of which method or instruments are used, a complication rate of 0.2–2% is documented. Bleeding is the commonest complication following circumcision. The reported occurrence of bleeding after circumcision is 0.1–35%. Up to 6% of these complicated cases may need a second operation [3–6]. There are several ways to decrease the risk of bleeding, such as compression, use of tissue glue, epinephrine-soaked gauze, silver nitrate, suturing, and electrosurgery. The use of diathermy on the penis is controversial, and there is a fear of causing harm by the electric current and generated heat by electrosurgery [2]. Bipolar electrocautery has potential advantages regarding safety and efficacy when compared with monopolar electrocautery use for obtaining hemostasis [7]. Some authors reported that the use of bipolar diathermy causes less tissue damage, less bleeding, and reduced operative time [8]. In this study, we aim to evaluate the safety, efficacy, and consequences of use of bipolar electrocautery directly in circumcision by the crush method.

Patients and methods

The study was approved by the ethical committee of the Department of Surgery of Minia University, and it was conducted at Pediatric surgery unit, Minia University Hospital, from January to December 2021. All children who presented to the outpatient clinic for circumcision during the study period were included. Children with hypospadias, buried penis, penile torsion, penile

chordae, penoscrotal web, and previously circumcised were excluded from study. Informed detailed consent was obtained from parents before joining the study.

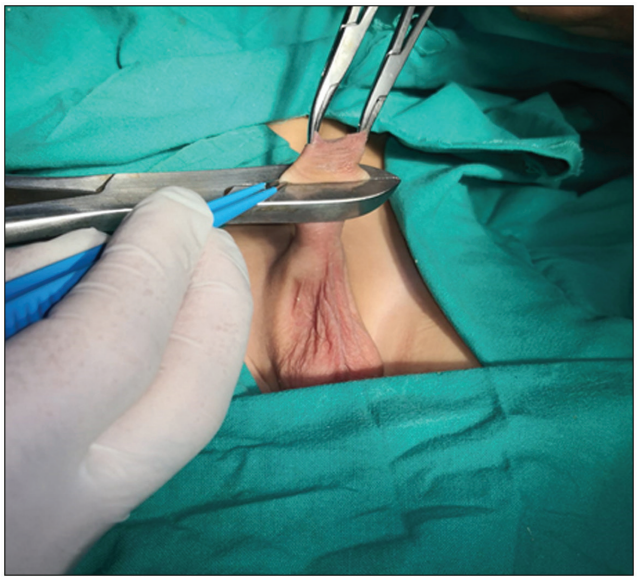
Coagulation tests were done for all children before the procedure. Children less than 6 month old were operated under local anesthesia by dorsal penile nerve block using 0.2% lidocaine as locoregional anesthesia 5 min before the procedure. Children older than 6 month were operated under general anesthesia using light sedation. The procedure started by disinfection of the operative field. Initially, the foreskin is fully separated from the glans and then the smegma was cleansed by a fine sterile gauze. The frenulum was controlled with bipolar diathermy coagulation. Two small hemostats were applied to the prepuce: one at 3 o'clock and the other at 9 o'clock. The clamps were pulled forward to make the skin over the penis mildly stretched, and four marking points were made on the skin just proximal to coronal sulcus of the glans at 12, 3, 6, and 9 o'clock. A bone cutter forceps is then applied on the skin, so that the tip of the glans was contained inside concavity of the forceps, and cutting edges of the forceps blades were closed exactly on marking points. The foreskin was cut by applying the bipolar forceps (nonstick reusable 1 mm blade tip width, 18 mm length) using a piecemeal cut with direct contact of the bipolar forceps to the bone-cutting blades and under direct vision. We used the microsetting with a power of 25 on our machine (kentamed) for cauterization and cutting the prepuce. After the cut is complete, the ventral and dorsal skin is usually adhered to each other. So, we retract the skin proximally to expose the glans and check for mucosal length and bleeding points. Any residual bleeding points were controlled with the bipolar on standard setting. Trimming of extra mucosa was done by direct use of bipolar cutting mode aiming to maintain the mucosal length to 5 ml not more. The skin and mucosa are then approximated with fine absorbable sutures (6 1 0 Vicryl). Some cases did not require mucosal trimming or suturing. Wound care was done by open dressing using local antiseptic solution and local antibiotic cream.

Postcircumcision follow-up period included two outpatient clinic visits: first visit after 1 week and the second visit after 2 weeks (Figs 1–3).

Statistical analysis

All statistical tests are done by SPSS, version 20 (IBM Corp., Armonk, New York, USA). In addition, descriptive statistical methods such as mean, SD, and range were used for quantitative variables and frequency and percentage for qualitative variables. An independent samples *t* test was used for comparison of quantitative variables between groups, whereas χ^2 test and Fisher's exact test were used for comparison of qualitative variables between groups. Statistical significance was defined as a *P* value less than 0.05.

Figure 1



A bone-cutting forceps is applied at marking points on prepuce after gentle traction of the skin by two hemostats at 3 and 6 o'clock followed by cutting the skin by bipolar diathermy forceps with direct contact of the penis to the bone cutter blades.

Figure 2

The penis immediately after circumcision.

Results

Our study included 475 patients. The mean age of patients was 9.92 ± 9.87 months. A total of 265 (55.79%) patients were operated under local anesthesia, whereas 210 (44.21%) patients were operated upon by general anesthesia. The operative time from start of the procedure till its end was 9.40 ± 3.70 min. The

Figure 3

The penis after 1 week with very mild edema.

Table 1 Age, operative time, electrocautery application time, and time of edema resolution

Variables	Mean	Median	SD
Age (month)	9.92	6.00	9.87
Operative time (min)	9.40	10.00	3.70
Electrocautery application time (s)	44.79	50.00	14.69
Time of edema resolution (days)	8.21	7.00	3.68

Table 2 Postoperative results

Variables	Yes [*N* (%)]	No [*N* (%)]
Shortening of mucosa	218 (45.89)	257 (54.11)
Sutures	259 (54.53)	216 (45.47)
Bleeding	–	475 (100.00)
Traumatic injury of the glans	–	475 (100.00)
Edema	388 (81.68)	87 (18.32)
Ischemia	–	475 (100.00)
Infection	–	475 (100.00)
Secondary phimosis	14 (2.95)	461 (97.05)

electrocautery application time during circumcision was 44.79 ± 14.69 s. A total of 218 (45.89%) cases required trimming of the mucosa after cutting due to mucosal over length. Suturing of the penile skin to mucosa was done in 259 (54.53%) cases by vicryl 6/0 interrupted sutures. No cases of intraoperative or postoperative bleeding and/or traumatic injury to the glans were recorded.

There were no recorded cases of ischemic insult to the glans or the penile shaft and no recorded cases of postoperative infection. Postoperative penile edema and redness were encountered in 388 (81.68%) patients of our cases. The mean time of edema resolution was 8.21 ± 3.68 days. Secondary phimosis was encountered only in 14 (2.95%) cases and managed by local steroids successfully. Data are summarized in Tables 1 and 2.

Table 3 Correlations between age, electrocautery application time, and period of edema resolution

Variables	Time of edema resolution	
	R value	*P* value
Electrocautery application time (s)	0.67	0.000**
Age (month)	0.69	0.000**

There was a positive correlation between time of electrocautery application and developed edema, with significant *P* value, and a positive correlation between age of the patient and developed edema, with significant *P* value (Table 3).

Discussion

Circumcision is the most widely used surgical maneuver done by pediatric surgeons. Its complications are well documented include bleeding, infection, fistula, glans necrosis, penile amputation, and/or sepsis [9].

The most common complication following circumcision is bleeding. Bleeding can occur as a result of noncontrolled subcutaneous bleeders or even from skin or mucosa edge. There are many methods used to reduce the risk of bleeding, and electrocauterization is one of the commonly used methods, but its use in circumcision is controversial [2].

The monopolar diathermy, one of electrocautery methods, uses an active electrode to deliver the current, which then travels through the patient and back to the generator through a conductive grounding pad. It has a potential risk when applied to the penis because the current might reach the base of the penis and cause coagulation with subsequent penile ischemia [2].

There are several published case reports of severe complications owing to the use of monopolar diathermy, including penile ablation, penile necrosis, gangrene, and burns [10–12].

In bipolar electrocautery, the active and return electrodes are on opposite sides of the forceps. Only the tissue between the two forceps recognizes the energy. So, there is no risk of current spreading to unintended tissues or vessels [7].

In the study, no cases of ischemic penile affection were reported. Similarly, Méndez-Gallart *et al*. [9] reported no cases of penile or glanular ischemia following use of bipolar scissor in circumcision.

Bipolar diathermy reduces the risk of bleeding by performing a precise cut in the foreskin and underlying

mucosa with vessel thermal coagulation during their division achieving hemostasis and avoiding the risks of bleeding associated with scalpel use [9].

No cases of postcircumcision bleeding were reported in our study. In concordance with that, Harty *et al.* [7] reported only 2/336 (0.6%) of bleeding following bipolar circumcision.

One of well-reported adverse effects of using bipolar electrocautery in circumcision is significant edema [9]. In our study, we reported 388 (81, 68%) cases of postcircumcision edema with a mean period of 8.2 days. Méndez-Gallart *et al.* [9] compared conventional surgical technique with bipolar scissor technique and found significant postcircumcision edema in the bipolar scissor group in comparison with the conventional surgical group.

There are multiple factors controlling the degree and duration of postcircumcision edema. The degree of edema is directly related to degree of generated heat energy, which is expressed by Joule's Law: energy=(current/cross–sectional area)^2×resistance×time [2].

According to Joule's Law, the surface area of conducting and returning electrodes (bipolar diathermy pins) is an important factor. The larger the surface area, the more the tissue damage and the more the edema [2]. For that, we used a bipolar forceps with 1-mm tip width to decrease degree and edema following circumcision.

Another important factor is the generator settings. The higher the energy setting used, the greater the risk of collateral damage to the tissue [13,14]. For that, we used low energy setting (20) on our machine (Kentamed). Similarly, El-Melfeh and colleagues used low power (12) on their machine (Valleylab) used in their study.

According to Joule's Law, the time of electrocautery application is an important factor influencing the developed edema [2]. Regarding our study, there is a significant positive correlation between the duration of postoperative edema and the time of electrocautery application. The longer the time of electrocautery application, the longer the duration of postoperative edema.

Regarding severity of postcircumcision edema, there was another significant positive correlation between age of child and degree of edema. Mostly, this is due to increased tissue thickness with subsequent increase in tissue resistance, which leads to, according to Joule's Law, more tissue damage.

We used the crushing method in our study to grasp the foreskin before cutting it. The crush method is a simple, safe, and quick method, but it requires some experience to use in order to avoid jeopardizing the glans during crushing. Because it involves pulling up the prepuce and then cutting it piecemeal, there is some risk of leaving long mucosal cuff [8]. As a result, the optimal length of the residual mucosal cuff is difficult to define objectively, though many institutions appear to accept 5 mm as an acceptable length [8]. The standard in our study was to keep the mucosal length at 5 mm. In discordance with El Mefleh and colleagues who reported no cases requiring mucosal trimming, 45.89% (218) of our cases required trimming of extra mucosa. This could be due to a difference in the application of the hemostats to the inner prepuce reducing the length of the residual mucosal cuff and thus avoiding the need for additional trimming. In our study, acquired phimosis was found only in 14 (2.95%) cases . Similarly, the study by Méndez-Gallart and colleagues reported only four (1.7%) cases of acquired phimosis.

Conclusion

The use of bipolar electrocautery in circumcision is a valuable and safe maneuver and considered an effective method regarding hemostasis in circumcision. The main drawback of this technique is penile edema, which resolves spontaneously with time.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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