Histopathological changes and surgical complications in thermocautery circumcision

Moamen S. Abdelgawaad[a], Abd El-Moniem I. El-Khateeb[a], Gamal A. Makhlouf[a], Ghada H. Mohamed[b], Mohamed G.H. Mahmoud[a]

Department of, [a]General Surgery, [b]Pathology, Faculty of Medicine, Assiut University, Assiut, Egypt

Correspondence to Mohamed G.H. Mahmoud, MSc, Department of General Surgery, Faculty of Medicine, Assiut University, Assiut 11571, Egypt. Tel: 01007717127; fax: 0225076873; e-mail: mohamedgamalhassan0@gmail.com

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Background
Circumcision is one of the most commonly performed surgical procedures worldwide. The operation excises the preputium and reveals the glans. Circumcisions are done to decrease the risk of urinary system infections, penile cancer, prostate cancer, cervical cancer, human papilloma virus, herpes simplex virus type 2, HIV, and other venereal diseases.
Aim
This study aimed to assess the outcome of using thermocautery in circumcision and the histopathological changes that occur to prepuce in comparison with the conventional surgical method.
Patients and methods
A prospective randomized study was done to assess the outcome of using thermocautery in circumcision in comparison with the conventional surgical method. The study was done at the General Surgery Department of Assiut University Hospital, which enrolled 106 male patients who were circumcised in the period between January 2021 and January 2022.
Results
When comparing both groups, we found that bleeding was present among 29.1% of cases (16 patients) operated by the standard scalpel technique, whereas no cases operated by thermocautery were recorded to have bleeding, as shown in Table 3. This was statistically significant (P<0.001). Concerning postoperative reoperation for bleeding, this was statistically significant (P=0.002). Histopathological examination of sections from the foreskin removed by a scalpel revealed a clean incision line with mild edema and mild congestion of blood vessels.
Conclusion
Thermocautery circumcision is a safe technique with low postoperative bleeding rate and less need for reoperation for bleeding. However, it causes higher rates of postoperative coagulative necrosis either full thickness or within a few millimeters.

Keywords:
histopathological, changes, surgical complications, thermocautery circumcision

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Introduction

Circumcision is one of the most commonly performed surgical procedures worldwide [1]. The operation excises the preputium and reveals the glans [2]. Circumcisions are done to decrease the risk of urinary system infections, penile cancer, prostate cancer, cervical cancer, human papilloma virus, herpes simplex virus type 2, HIV, and other venereal diseases [3]. However, it is also included in the religious practices of Muslims and Jews [4,5].

For centuries, many techniques have been used to perform circumcisions that vary according to many factors, including the socioeconomic level and the available facilities. The surgical techniques used today include the Plasti Bell, Gomco clamp, Mogen clamp, Smart clamp, Tara clamp, Shang Ring, and thermocautery [6]. Previous literature has reported a wide range of complications, ranging from 0.1 to 35% [7].

The diversity of circumcision techniques is the result of the search for more practical, cheaper, safer, and less-complicated methods. Thermocautery technique is a recent technique and is being used for the last 10 years. It does not have a widespread use because many surgeons consider its effects similar to the effects of monopolar cautery. It was shown that the thermocautery technique leads to less tissue damage compared with electrocautery techniques [8].

Patients and methods

This was a prospective randomized study conducted at the General Surgery Department of Assiut University Hospital and enrolled 106 male patients who were circumcised in the period between January 2021 and January 2022.

This research was performed at the Department of General Surgery, Assiut University Hospitals. Ethical Committee approval and written, informed consent were obtained from all participants.

Oral and written consent for participation in the study were obtained from the parent of participants.

Inclusion criteria

Male patients who underwent circumcision were included.

Exclusion criteria

Webbed penis, hypospadias/epispadias, micropenis, ambiguous genitalia, and bilateral large hydrocele were excluded.

Method of randomization

Children were randomly being divided into two groups using computer-generated random tables according to the surgical technique used.

Group A included 51 male children who underwent circumcision by thermocautery. Group B included 55 male children who underwent circumcision by the conventional surgical technique.

Patients were diagnosed clinically by inspection and palpation. Investigations were done for all the patients and included complete blood count and prothrombin time and concentration.

The surgical technique

Thermocautery group

The procedures were performed under local infiltration anesthesia with lidocaine hydrochloride 1%, which was injected at 10 and 2 o'clock positions at the base of the penis 3–8 min before circumcision in patients under 1 year of age, and under general anesthesia for those above 1 year of age. Retraction of the foreskin was performed by cleaning with povidone-iodine solution, and a thin film of lidocaine gel was applied to the glans. The foreskin was grasped with two mosquito forceps, and bone cutting was applied to the foreskin for 1 min. Heat cautery was used to cut the foreskin using a Hilton Electro Cautery Unit made in India by Impel Surgical Co. (ISO 9000: 2008) in Gurgaon, with volts 50C/S 5 Amp, and that works on AC main 220 V only. On switching on, the indicator lit up. Thereafter, a button on the handle was pressed to heat up the electrode. The intensity of heat can be regulated by turning the cautery control knob outlet terminal, which was completely insulated. We used one electrode for each case (Fig. 1).

Conventional surgical group

The procedure was performed under local infiltration anesthesia with lidocaine hydrochloride 1%, which was injected at 10 and 2 o'clock positions at the base of the penis 3–8 min before circumcision in patients under 1 year of age and under general anesthesia for those above 1 year of age.

Smegma was cleaned by separating the prepuce from the glans penis after administering antisepsis.

Then, the prepuce was held from 6 and 12 o'clock positions with two clamps. A circumcision clamp was placed by protecting the glans penis and compatible with the angle of the coronal sulcus. The prepuce was cut with a scalpel from distal of the circumcision clamp.

The wound lips were approached and sutured. The bandage was made with a foamed patch for patients considered to be at risk of developing complications such as bleeding and infection following the procedure (Fig. 2).

Figure 1

Cutting of the foreskin in thermocautery circumcision.

After the procedures

Thereafter, the skin was retracted to show the glans, and a thin film of xylocaine gel was applied to the glans. No dressing was applied. Postoperative pain was managed with paracetamol or declophin suppositories every 12 h, and fusidic acid ointment was used three to four times per day for 2–3 days. Oral antibiotics or anti-inflammatory drugs were not given as a routine. Hot bath was given daily without antiseptic.

Histopathological examination

The foreskin samples removed by scalpel or thermocautery were placed in separate labeled containers, immediately fixed at 10% neutral buffered formalin for 24 h and then dehydrated in increasing concentrations of ethanol and then routinely processed and embedded in paraffin blocks for subsequent sectioning.

Statistical analysis

We analyzed the data using SPSS (statistical package for social science, Armonk, NY: IBM Corp), version 24 for Windows software. Categorical data were described in terms of frequencies and percentages. χ^2 test was used to test the association between categorical variables. Fissure exact test was used in case of violation of the assumptions. *P* values less than 0.05 were considered statistically significant.

Figure 2

Cutting the foreskin in conventional circumcision.

Table 1 The age distribution among selected participants (*N*=106)

Age	*n* (%)
<1 year	45 (42.5)
1–<3 years	33 (31.1)
3–<5 years	15 (14.2)
6 years	6 (5.7)
7 years	2 (1.9)
9 years	3 (2.8)
14 years	2 (1.9)

Results

A total of 106 patients were eligible to participate in the study. Overall, 42.5% of them (45 patients) were below than 1 year, 31.1% of them (33 patients) were between 1 and 3 years, and 14.2% of patients (15 patients) were between 3 and 5 years old, as shown in Table 1.

They were all randomized into two groups; 48.1% of them (51 patients) were operated using thermocautery, whereas the rest were operated using the standard scalpel technique (Table 2).

When comparing both groups, we found that bleeding was present among 29.1% of cases (16 patients) operated by the standard scalpel technique, whereas no cases operated by thermocautery were recorded to have bleeding, as shown in Table 3. This was statistically significant ($P<0.001$). In these patients, bleeding was stopped through wound compression or resuturing.

When comparing between both groups concerning reoperation for bleeding, we found that only 2% of patients (one patient) operated by thermocautery required reoperation for bleeding. On the contrary, 21.8% of patients operated by a scalpel (12 patients) required reoperation for bleeding. This was statistically significant ($P=0.002$), as shown in Table 4.

Table 2 The percentage of operative techniques used among all participants (*N*=106)

Operative technique	*n* (%)
Thermocautery	51 (48.1)
Standard scalpel	55 (51.9)

Table 3 The difference between both groups concerning postoperative bleeding

Bleeding	Thermocautery (*N*=51)	Scalpel (*N*=55)	*P* value
Absent	51 (100)	39 (70.9)	<0.001[C]
Present	0	16 (29.1)	

C, χ^2 test.

Table 4 The difference between both groups concerning reoperation for bleeding

Redo	Thermocautery (*N*=51)	Scalpel (*N*=55)	*P* value
Absent	50 (98)	43 (78.2)	0.002[C]
Present	1 (2)	12 (21.8)	

C, χ^2 test.

When comparing between both groups concerning postoperative edema, we found that only 3.9% of patients (two patients) operated by thermocautery gained postoperative edema. Similarly, 5.5% of patients operated by a scalpel (three patients) gained edema. This was statistically insignificant (*P*=1.00), as shown in Table 5.

When comparing between both groups concerning postoperative infection, we found that no patients operated by thermocautery developed postoperative infection. On the contrary, 3.6% of patients operated by scalpel (two patients) developed infection. This was statistically insignificant (*P*=0.496), as shown in Table 6.

Table 5 The difference between both groups concerning postoperative edema

Edema	Thermocautery (*N*=51)	Scalpel (*N*=55)	*P* value
Absent	49 (96.1)	52 (94.5)	1.000[F]
Present	2 (3.9)	3 (5.5)	

F, Fisher exact test.

Table 6 The difference between both groups concerning postoperative infection

Infection	Thermocautery (*N*=51)	Scalpel (*N*=55)	*P* value
Absent	51 (100)	53 (96.4)	0.496[F]
Present	0	2 (3.6)	

F, Fisher exact test.

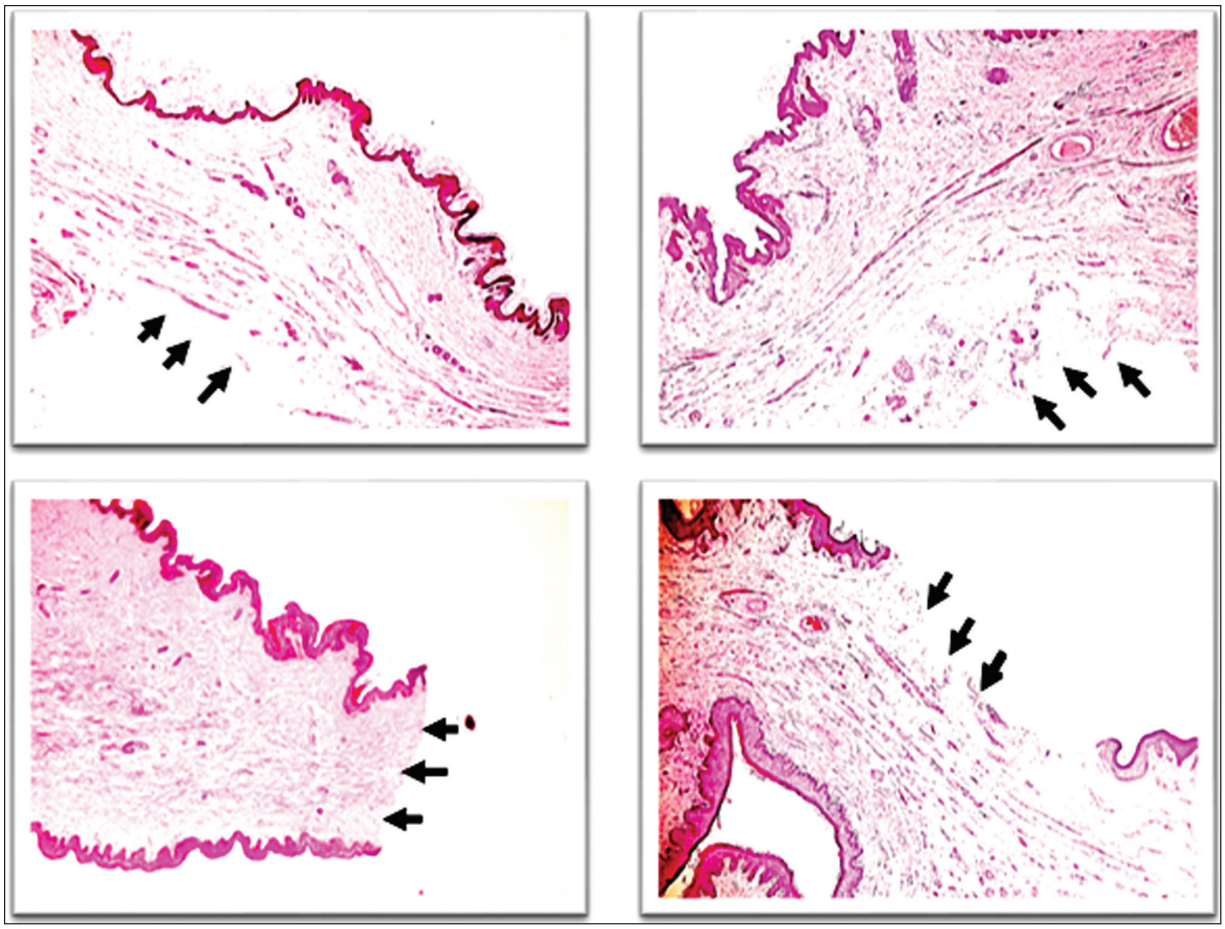
Histopathology

Histopathological examination of sections from the foreskin removed by a scalpel revealed a clean incision line with mild edema and mild congestion of blood vessels. Sections from foreskin removed by thermocautery showed the effect of heat injury in all specimens in the form of basophilic areas of coagulative necrosis of different thickness ranging from a few millimeters to full-thickness necrosis extending to the epidermis with dissociation of dermoepidermal junction. Marked congestion of blood vessels as well as intradermal hemorrhage was noted (Fig. 3).

Discussion

Circumcision is one of the most commonly performed surgical procedures worldwide [1]. The operation excises the preputium and reveals the glans [2]. Circumcisions are done to decrease the risk of urinary

Figure 3



Photomicrographs of sections from the foreskin removed by a scalpel, showing mild hyperemia and clean incision line (arrows) with no coagulative necrosis, H&E stain, and ×200.

system infections, penile cancer, prostate cancer, cervical cancer, human papilloma virus, herpes simplex virus type 2, HIV, and other venereal diseases [3]. However, it is also included in the religious practices of Muslims and Jews [4,5].

Overall, 42.5% (45 patients) of the current study population were under 1 year, 31.1% (33 patients) of them were between 1 and 3 years, and 14.2% (15 patients) of patients were between 3 and 5 years old. The two groups were matching regarding the age at the time of operation.

In the present study, postoperative bleeding was detected among 29.1% of cases operated through the standard scalpel technique, whereas no cases operated through thermocautery were recorded to have bleeding. This was a statistically significant difference (P<0.001). The use of diathermy scissors avoids postoperative bleeding by performing a precise lineal cut in the foreskin tissue with a technology that allows for coagulation of vessels before their division [9].

Similarly, thermal cautery-assisted circumcision has been compared with the classical technique in the study by Saracoglu *et al.* [1]. They concluded that the bipolar thermal cautery technique is an easy-to-perform and safe circumcision technique that may be carried out in a shorter time and in which much less bleeding occurs compared with the classical technique.

Moreover, Méndez-Gallart *et al.* [9] conducted a study to evaluate bipolar scissors circumcision by comparing it with the standard freehand scalpel procedure. It was found that median blood loss for bipolar circumcision was significantly higher than that in the standard group (P<0.001).

Fariz *et al.* [10] conducted a study to compare the incidence of bleeding and infection in patients who underwent circumcision using the bipolar diathermy technique and those who underwent conventional surgery (dorsal slit) technique for circumcision. The incidence of bleeding was significantly better in the bipolar group compared with the conventional group (3.1 vs. 19.7%, P<0.001).

Only 2% of patients operated through thermocautery required redo. On the contrary, 21.8% of patients operated through the scalpel required reoperation for bleeding. This was statistically significant (P=0.002). This comes in concordance with the higher rates of bleeding being detected in patients operated through a scalpel.

In agreement with the current study, findings of Al-Mayoof *et al.* [11], in a study assessing the risk factors for secondary phimosis in children, showed that 75% of patients with postoperative secondary phimosis were circumcised using a bone cutter with thermal cautery, whereas 25% were circumcised using a bone cutter with scalpel blade. This difference regarding the procedure of circumcision between the two groups was also significant (P=0.001).

Insignificant differences were found between the two groups regarding postoperative edema and infection. Edema occurred in 3.9 and 5.5% of patients in groups A and B, respectively. Postoperative infection did not occur among group A children, and it occurred only in 3.6% of patients in group B. Moreover, on histopathologic examination, no significant difference was found between the two groups regarding the postoperative congestion.

In concordance with the present study findings, Fariz *et al.* [10] reported that there was no significant difference in the infection rate between the bipolar group compared with the conventional group (1.3 vs. 2.7%) (P=0.457).

In the current study, histopathological examination of scalpel-removed foreskin sections revealed a clean incision line with mild edema and blood vessel congestion. The effect of heat injury was seen in all specimens in the form of a basophilic area of coagulative necrosis ranging in thickness from a few millimeters to a full-thickness necrosis extending to the epidermis with dissociation of the dermoepidermal junction. It was also observed that there is an increased congestion of the blood vessels as well as intradermal hemorrhage.Tuncer *et al.* [8] conducted a study on rat experimental circumcision model to examine the histopathological changes of scalpel, monopolar, bipolar, and thermocautery. Histopathological study showed that the depth of injury and coagulative necrosis is greater in thermal cautery compared with a scalpel, whereas collagen deposition, epithelialization, and granulation tissue formation are superior in scalpel circumcision. It was concluded that thermocautery for circumcision has been shown to be safe in rats, and when used in the human population, it may be a safe and effective technique.

Uzun *et al.* [12] in Turkey had previously reported on a case of gangrene secondary to monopolar cautery use, which led to the necrosis of penile tissue involving the glans and distal penis. However, thermocautery transfers heat into the tissues, so deeper layers are not exposed to the risk of thermal injury.

Conclusion

Thermocautery circumcision is a safe technique with low postoperative bleeding rate and less need to reoperation, However, it causes higher rates of postoperative coagulative necrosis either full thickness or within a few millimeters.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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