Review Article

Electrosurgery use in circumcision in children: Is it safe?

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Abstract Circumcision is one of the most common procedures performed worldwide. Bleeding is one of the most common complications following male circumcision, and to decrease the risk of bleeding, electrosurgery may be utilized. However, the use of diathermy on the penis is controversial, and there are reported complications due to the use of electrosurgery for circumcision. The aim of this review is to evaluate the utilization and relative safety of monopolar and bipolar electrosurgery for circumcision in children.

Key Words: Bipolar, circumcision, diathermy, electrosurgery, monopolar

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INTRODUCTION

Male circumcision is one of the most common procedures performed worldwide. Approximately, 30% of men globally and 35% of men in developing countries are circumcised.[1-5] There is probably no other surgical procedure as universally performed by pediatric surgeons and urologists worldwide as circumcision.[6] There are several methods, techniques, and instruments used to perform circumcisions.[7-11] Regardless of which method or instruments are used, a complication rate of 0.2%–2% is reported. The most common complication following circumcision is bleeding, with a reported incidence of 0.1%–35%. Up to 6% of these complicated cases may need a second operation.[12-16]

There are several ways to decrease the risk of bleeding, such as the use of a CO_2 laser, tissue glue, epinephrine, silver nitrate, thrombin, suturing, and electrosurgery.[14-16] The use of diathermy on the penis is controversial, and there is a fear of inflicting harm caused by the electric current and resulting heat generated by electrosurgery.[17-24]

The aim of this review is to evaluate the utilization and relative safety of monopolar and bipolar electrosurgery for circumcision in children.

REVIEW AND METHODOLOGY

The following sources have been searched and relevant materials have been included:

- PubMed/MEDLINE was searched for all publications in English-language journals using the following key words alone or in combination: "electrosurgery circumcision," "diathermy circumcision," "cautery circumcision,"

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"Bovie circumcision," "monopolar circumcision," "bipolar circumcision," "cutting circumcision," "coagulation circumcision;"
- The Cochrane Database of Systematic Reviews was searched for systematic reviews using the Medical Subject Heading: "circumcision;"
- The references lists from all identified full publications.

DISCUSSION

Circumcision is one of the oldest surgical and ritual procedures.[10] Regardless of what type of procedure is performed, there may be complications. The most common postcircumcision complication is bleeding. There are many methods, techniques, instruments, and substances used to reduce the risk of bleeding.[16]

The use of diathermy for circumcision is controversial.[24] The aim of using electrosurgery for circumcision is to achieve hemostasis. It is not a new method. Heating tissue is an old method to achieve hemostasis that has been used for thousands of years. It was modernized by Bovie from Harvard in 1926. He constructed an electrosurgical unit that produced high-frequency current delivered to a cutting loop that was used for cutting, coagulation, and desiccation.[25-29] The principle is that the current is produced by a generator, which sends the current along to an active electrode. This active electrode passes the current through the tissue to create the desired effect, and then the current exits the tissue through the return electrode, which completes the electrical circuit by returning the current to the generator.[28,29] The circuit is described by Ohm's law:

$$\text{Voltage} = \text{current} \times \text{resistance}.$$

Voltage is the difference in charge between two points. Current is the rate at which charge is flowing and is measured by the flow of electrons during a given period. Voltage is the force driving a current against the resistance of the circuit. In electrosurgery, voltage is provided by the generator, and current is delivered to the tissues through the electrode tip of the instrument. Resistance is a material's (human tissues) tendency to resist the flow of charge (current). The higher the resistance, the greater the voltage needed for a current to pass through a material.[29]

The transformation of electrical current into heat energy is expressed by Joule's law:

$$\text{Energy} = (\text{current}/\text{cross-sectional area})^2 \times \text{resistance} \times \text{time}.$$

It is apparent from this formula that the heat produced is inversely proportional to the surface area of the electrode, i.e., the smaller the surface area, the more localized heat energy is produced. Larger electrodes require longer periods of current application and may cause tissue damage due to the longer application time.

The size of the electrode delivering the energy plays an important role in achieving the desired surgical effect. The smaller the contact area of the electrode, the higher the potential current concentration that can be applied to the tissue. This allows the same surgical tissue effect to be achieved at a lower power setting. Time plays an obvious role in defining the extent of the surgical effect; the duration of the generator activation is directly related to the heat produced in the tissue. As more heat is produced, there is greater potential for thermal spread to adjacent tissues.[29]

Based on the type of return electrode, there are essentially two methods for energy delivery: Monopolar and bipolar.

MONOPOLAR DIATHERMY

The monopolar instrument uses an active electrode to deliver the current, which then travels through the patient and back to the generator through a conductive grounding pad applied to the patient before beginning the procedure.

Monopolar diathermy has a potential risk when applied to the penis or end artery structures because the current might reach the base of the penis and cause coagulation. The smaller the size of the penis, the more risk there is of energy traveling to the base of the penis.[29,30] There are several published case reports of severe complications due to the use of diathermy for circumcision, including penile ablation, penile necrosis, gangrene, and burns. All of those reported complications were due to the use of monopolar diathermy.[17-21,31]

Four children have been reported who had traumatic penile loss due to the use of monopolar diathermy for circumcision. All of them underwent feminizing genitoplasty.[19] Penile necrosis secondary to electrosurgery for circumcision in a 2-year-old boy has also been reported.[20] Only stumps of the erectile bodies and strictured urethral meatus remained. The child underwent a penile shaft reconstruction after the electrosurgical burn healed.[20] We believe that complications from using monopolar diathermy for circumcision are underreported.

BIPOLAR DIATHERMY

In bipolar instruments, both the active electrode and the return electrode are integral to the surgical site. The electrosurgical energy does not travel through the patient but is confined to the tissue between the forceps.[29] The safety of using bipolar scissors to perform circumcisions has been reported.[6] Bipolar diathermy avoids the risks associated with monopolar diathermy. The only drawback from using bipolar scissors was significant edema at the circumcision site due to the high-energy settings of the generator, which subsided spontaneously.[6]

In both types of diathermy, the effect is proportional to the size of the diathermy pin. The larger the surface area, the more potential exists for damage to the penis. Needle tip pins have a smaller surface area and cause less damage to the tissues. Another important factor is the generator settings. The higher the energy setting used, the greater the risk of collateral damage to the tissue.[29,30]

CONCLUSION

Monopolar diathermy should be avoided for circumcisions. Bipolar diathermy is safe if performed under the following conditions: Small electrode tips, minimum energy generator settings, and minimum application time to the tissues.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Schoen EJ. The status of circumcision of newborns. N Engl J Med 1990;322:1308-12.
2. Wiswell TE, Tencer HL, Welch CA, Chamberlain JL. Circumcision in children beyond the neonatal period. Pediatrics 1993;92:791-3.
3. World Health Organization (WHO) and the Joint United Nations Programme on HIV/AIDS (UNAIDS) Male Circumcision: Global Trends and Determinants of Prevalence, Safety and Acceptability. Available from: http://www.who.int/hiv/pub/malecircumcision/globaltrends/en/index.html. [Last accessed on 2008 Dec 23].
4. Meeting the Demand for Male Circumcision: A Report of a Workshop. Presented at Meeting of The Forum for Collaborative HIV Research, Kampala, Uganda; 13-14 March, 2008.
5. Peng M, Meng Z, Yang ZH, Wang XH. The ultrasonic harmonic scalpel for circumcision: Experimental evaluation using dogs. Asian J Androl 2013;15:93-6.
6. Méndez-Gallart R, Estévez E, Bautista A, Rodríguez P, Taboada P, Armas AL, *et al.* Bipolar scissors circumcision is a safe, fast, and bloodless procedure in children. J Pediatr Surg 2009;44:2048-53.
7. Blandy JP. Circumcision. Frenuloplasty. In: Whitfield HN, editor. Operative Surgery: Genitourinary Surgery. 5th ed., Vol. 2. Oxford: Butterworth-Heinemann; 1993. p. 485-92.
8. O'Sullivan DC, Heal MR, Powell CS. Circumcision: How do urologists do it? Br J Urol 1996;78:265-70.
9. Dunsmuir WD, Gordon EM. The history of circumcision. BJU Int 1999;83 Suppl 1:1-12.
10. Fraser ID, Tjoe J. Circumcision using bipolar diathermy scissors: A simple, safe and acceptable new technique. Ann R Coll Surg Engl 2000;82:190-1.
11. Fraser ID, Goede AC. Sutureless circumcision. BJU Int 2002;90:467-8.
12. Moreno CA, Realini JP. Infant circumcision in an outpatient setting. Tex Med 1989;85:37-40.
13. Cuckow PM, Rix G, Mouriquand PD. Preputial plasty: A good alternative to circumcision. J Pediatr Surg 1994;29:561-3.
14. Fearne C. Point of technique. Bloodless circumcision. BJU Int 1999;83:717.
15. Niku SD, Stock JA, Kaplan GW. Neonatal circumcision. Urol Clin North Am 1995;22:57-65.
16. Kazem MM, Mehdi AZ, Golrasteh KZ, Behzad FZ. Comparative evaluation of two techniques of hemostasis in neonatal circumcision using the Plastibell device. J Pediatr Urol 2010;6:258-60.
17. Peters KM, Kass EJ. Electrosurgery for routine pediatric penile procedures. J Urol 1997;157:1453-5.
18. Belman AB. Electrocautery circumcision. Urology 1981;18:506-7.
19. Gearhart JP, Rock JA. Total ablation of the penis after circumcision with electrocautery: A method of management and long-term followup. J Urol 1989;142:799-801.
20. Stefan H. Reconstruction of the penis after necrosis due to circumcision burn. Eur J Pediatr Surg 1994;4:40-3.
21. Tucker SC, Cerqueiro J, Sterne GD, Bracka A. Circumcision: A refined technique and 5 year review. Ann R Coll Surg Engl 2001;83:121-5.
22. Azmy A, Boddy SA, Ransley PG. Successful reconstruction following circumcision with diathermy. Br J Urol 1985;57:587-8.
23. Aragona F, Ferrarese P, Glazel GP. Urological use of a disposable bipolar diathermy probe: An experimental *in vivo* study. Int Urol Nephrol 1990;22:493-7.
24. Naimer SA, Peleg R, Meidvidovski Y, Zvulunov A, Cohen AD, Vardy D. Office management of penile skin bridges with electrocautery. J Am Board Fam Pract 2002;15:485-8.
25. Bovie WT. A preliminary note on a new surgical-current generator 1928. Clin Orthop Relat Res 1995;310:3-5.
26. Smith TL, Smith JM. Electrosurgery in otolaryngology-head and neck surgery: Principles, advances, and complications. Laryngoscope 2001;111:769-80.
27. Advincula AP, Wang K. The evolutionary state of electrosurgery: Where are we now? Curr Opin Obstet Gynecol 2008;20:353-8.
28. Barrett SL, Vella JM, Dellon AL. Historical development of bipolar coagulation. Microsurgery 2010;30:667-9.
29. Massarweh NN, Cosgriff N, Slakey DP. Electrosurgery: History, principles, and current and future uses. J Am Coll Surg 2006;202:520-30.
30. Karaman MI, Zulfikar B, Caskurlu T, Ergenekon E. Circumcision in hemophilia: A cost-effective method using a novel device. J Pediatr Surg 2004;39:1562-4.
31. Uzun G, Ozdemir Y, Eroglu M, Mutluoglu M. Electrocautery-induced gangrene of the glans penis in a child following circumcision. BMJ Case Rep 2012;2012. pii: Bcr-2012-007096.