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Management of Post-Circumcision Glans/Penile Necrosis

Yusuf Arikan and Ali Ayten

Abstract

Circumcision is the surgical removal of the skin covering the glans and is one of the oldest and most common surgical procedures in the world. Although there is evidence that the first circumcision was performed in Egypt in 4000 BC, according to some anthropologists, it dates back to the 10th millennium BC. The purpose of medical circumcision is to obtain enough foreskin to expose the glans penis and to prevent medical problems caused by the foreskin. Although it is known that the complications arising from these procedures are not well documented, the complication rates in the literature vary between 1 and 15%, when evaluated according to age, the rate of post-circumcision complications in newborns is reported to be approximately 0.2-0.6% and this rate is 10 times higher between the ages of 1-9. Various complications such as bleeding, infection, incomplete and insufficient circumcision, hematoma, penile adhesion, urinary retention, glanular injury, necrosis and urethral narrowing have been reported. In this book section, one of the complications, penile necrosis, will be explained in the light of the literature.

Keywords: Circumcision, Glans Necrosis, Penile Necrosis, Complication, surgical technique

1. Introduction

Male circumcision is among the most commonly performed procedure for traditional, religious, and medical reasons in the world [1]. Circumcision is the process of surgically cutting the foreskin, called the prepuce, covering the glans penis, in a certain shape and length, and exposing the tip of the penis. While it is estimated that 25% of men are circumcised all over the world, this rate is 99% in Turkey and Africa [2, 3]. Circumcision operations, which have been performed in many societies from the past to the present, are now performed by doctors from various specialties [4]. Although circumcision is not a simple procedure, it is still widely performed by insufficient educated, uneducated, and unlicensed individuals. Recently, with the increasing awareness of the society, the number of circumcisions performed by traditional circumcisers tended to decrease and the number of applications made to specialist surgeons increased significantly [3, 5].

Many techniques have been described for the circumcision operation. The main purpose of circumcision is to achieve a better cosmetic result [6]. In the literature, complication rate is between 1 and 15% after circumcision. According to age assessments, the incidence of complications after circumcision in newborns according to age assessment is reported as approximately 0.2-0.6% and this ratio is more than 10 times in the range of 1 to 9 years [7, 8]. If surgical procedures

for circumcision are performed step by step, complications are extremely rare. However, complications such as bleeding, infection and scar formation can still be seen. Apart from these complications, complications such as penile necrosis, which are much rarer but difficult to treat and manage, can also be seen [3, 5].

The most common causes of penile necrosis after circumcision include dorsal nerve block with local anesthetic agents, increased compression of the wound dressing, and the use of inappropriate surgical techniques and devices [9]. Although there are various medical and surgical treatment options in the literature in patients with penile necrosis, there is still no consensus on treatment management. Data in the literature on penile necrosis could not go further than case series. The aim of this study is to provide a medicolegal presentation of the findings and results acquired in the evaluation of a high volume of cases for the first time.

2. Circumcision time

It has been widely reported that as the age of the patient increases, complications of circumcision occur more frequently. Bleeding is more common in the “mini puberty” period of infancy that starts at 4 weeks and extends to 3 months. This is thought to be due to hormonally-mediated increase in penis and foreskin size and vascularization [10]. Banieghbal reported only two minor bleeding complications requiring suturing in a recent prospective, observational study of 583 neonatal circumcisions. Both occurred in 3-week-old infants. He reported that, based on the use of the Neonatal Pain Scale, the ideal framework for ‘painless’ circumcision is first week of life [11]. Horowitz and Gershbein found no complications in 98 babies circumcised with the Gomco clamp in the first month of life and supported neonatal circumcision. However, when they circumcised 3-8 months old children with the Gomco clamp, they found the rate of bleeding requiring suture or fulguration at a rate of 30% [12].

3. Circumcision techniques

3.1 Dorsal-ventral slit technique

After preparing the penis and foreskin, the devascularized tissue is cut with the help of a clamp on the dorsal part. Although the glans becomes visible after this application, it is generally not preferred alone because a good cosmetic result is not obtained and continues with the foreskin excision. Similar situation made from ventral face also applies to the operation [13].

3.2 Sleeve technique

The skin of the penis is incised by marking at a sufficient length. A second incision is made by retracting the foreskin and marking the mucosa just below the coronal sulcus. The tissue in between is removed. Bleeding control is achieved with the help of cautery or by tying. Wound lips are closed with absorbable sutures [14].

3.3 Guillotine

The foreskin is suspended from the dorsal and ventral side with the help of a clamp. The areas previously marked on the foreskin are pulled towards the glans tip. The foreskin is clamped with a straight clamp. While doing this, make sure that

the glans is not compressed. The foreskin remaining distal to the clamp is cut with a scalpel and the clamp is removed. After bleeding control, the ends are tied with absorbable sutures [15].

3.4 Special circumcision clamps (Gomco clamp, Mogen clamp, Plastibell, etc.)

It is mostly preferred in newborn circumcisions. In the United States, the Gomco clamp, plastibel and Mogen clamp are mostly used. The procedure is similar for the Gomco clamp and the plastic sleeve. After the necessary penile preparation is made, a dorsal slit is made. The bell part of the Gomco clamp is placed over the glans. The other plane of the clamp is removed from the hole in the foreskin to the marked place and the screw is tightened. After waiting for a few minutes, the foreskin is cut out from the distal of the clamp with the help of a scalpel (cautery should not be used). The clamp is opened and removed from the penis. Usually the edges are squeezed together so there is no need for bleeding control and suturing. The application in the Mogen clamp is generally similar. However, dorsal slit is not required in this method [16, 17].

3.5 Circumcision with diathermic knife

This method, which has been brought to the literature by us especially with its application in bleeding diathesis, consists of the combination of the guillotine principle and a special clamp and a cutting tool that delivers thermal energy.

First, the penis is cleaned and the foreskin is separated from the glans. Similar to the guillotine method, the foreskin is suspended from the dorsal and ventral side with the help of a clamp. The foreskin is clamped with the help of a clamp prepared for this purpose, so that it does not get into the glans. The foreskin is cut out from the distal of the clamp with the help of a thermo-cautery (diathermic knife). The clamp is opened and the ends are sutured with absorbable sutures. This method does not require additional bleeding control. There is no electric current at the tip of the thermo-cautery used, and it works with thermal principles [18].

As a special case, children with bleeding disorders should not be circumcised if possible. However, this is often not possible in societies such as our country, where circumcision is seen as a requirement of masculinity. While these children should be circumcised by a physician under appropriate conditions, in some cases, families may risk having the child circumcised without taking adequate precautions and have serious bleeding problems. The current treatment principles of bleeding disorders include the social and cultural integration of patients into the society. For this purpose, it is recommended to provide circumcision under safe conditions for patients who request [18].

4. Circumcision complications

Indications for circumcision generally develop due to medical, religious and cultural reasons. Post-circumcision complications are classified as early and late complications. Early complications are bleeding, pain, inadequate skin excision, surgical site infection, and these complications are usually treated conservatively or medically. Chordee, iatrogenic hypospadias, penile necrosis and glandular amputation are among the serious early complications. Late complications include epidermal inclusion cysts, urinary retention, skin bridge formation between the penile shaft and glans, cordial, penile adhesions, phimosis, hidden penis, urethro-cutaneous fistula, and meatal strictures. Most of these complications can be avoided by paying attention to surgical principles and specific techniques used [19, 20].

5. Glans and penile necrosis

Among these complications, glans ischemia or necrosis is rarely seen. Although not all causes of post-circumcision necrosis are presented here, this is multifactorial. In the pathogenesis of necrosis, the use of vasoconstrictive agents containing local anesthetic drugs, certain surgical methods, attachment of vascular structures during the procedure, excessive monopolar cautery use, wound bandage compression during nocturnal penile erections and post-circumcision infections are blamed [21, 22]. Circumcision is a surgical procedure and therefore should only be done by a doctor. Today, it is known that it is done by unlicensed circumcisers in most countries [7]. Complications are more common in circumcisions performed by unlicensed circumcisers. While the complication rate is 1% in circumcisions performed by specialist physicians, it reaches 10% when performed by unlicensed health technicians and reaches 85% when performed by traditional circumcisions [3].

5.1 Etiological factors

5.1.1 Local anesthesia

Peripheral nerve blocks are one of the most commonly used regional anesthesia methods. It allows many surgical procedures to be performed painlessly. The analgesia obtained by injecting the local anesthetic solution into the target tissue peripheral nerve or nerve plexus bed occurs simply by blocking sodium transport across the neuron cell membrane. Today, the increasing demand for circumcision under local anesthesia has increased the frequency of local anesthesia use in children [23].

Although rarely encountered, accidental injection of high doses of local anesthetic into the systemic circulation or tissue spaces can lead to serious complications. The most important of these, and the most common cause of mortality, local anesthetic toxicity is 20 to 25 minutes of the drug injected into the tissue bed at a dose higher than the safe limit. It occurs with the systemic circulation in it [2]. Its main target is the central nervous system (CNS) and cardiovascular system (CVS), whose blood supply is primary in the body. The more sensitive CNS is affected early and first manifests with restlessness (agitation, confusion) and tinnitus. Later, non-specific findings such as metallic taste in the mouth, perioral numbness, speech impairment, diplopia and convulsions are observed [24].

Local anesthesia complications that may occur in operating rooms can be detected by closely monitoring. These complications can be eliminated in the early period with appropriate medication and anesthetic support. However, the same situation may not be the case where there is no suitable equipment and support, and the unwanted consequences that may occur may bring heavy legal and conscientious burdens [25].

One of the factors that trigger the development of necrosis is the content of local anesthetic agents. Especially local anesthetic drugs containing vasoconstrictor agent reduce our blood flow to the tissue and may cause ischemia [26]. The circumcision operation is performed under local anesthesia by dorsal nerve blockage. Anesthetic drugs such as ropivacaine and lidocaine are most commonly used for dorsal nerve blockade, and when these agents are combined with vasoconstrictor drugs such as ephedrine and epinephrine, the probability of developing glans necrosis increases [27]. Apart from the vasoconstrictor effect of local anesthesia, endothelial damage due to needle insertion during dorsal nerve blockage may cause vasospasm and this may cause glans necrosis [21]. Cytochrome b5 reductase activity

is lower in newborns and premature infants compared to adults. Considering that drugs such as lidocaine are metabolized by this enzyme, it should be kept in mind that methemoglobinemia may develop in children after dorsal nerve blockage [28]. The drugs most commonly used in dorsal nerve block are Prilocaine and lidocaine, and the maximum dose is 1-2 mg/kg for prilocaine and 3 mg/kg for lidocaine. These doses may produce low levels of methemoglobin, which does not cause cyanosis, which will not cause cyanosis, but the risk of methemoglobinemia increases parallel to dose increases [29].

5.1.2 Surgical technique

Circumcision surgery can be performed with many methods and modifications of these methods. Open surgical methods such as guillotine technique, dorsal slit or Sleeve technique and special clamping methods such as Mogen clamp, Gomco clamp, Plastibell device are basic surgical procedures. In addition, less common techniques such as thermal energy or laser cutting or using adhesives instead of stitches have been also reported [30, 31]. Regarding the methods used, glans necrosis generally occurs as a result of damage caused by cautery used during circumcision performed with a Gomco clamp or a wrong-sized Plastibell ring placed on the glans penis [32, 33].

5.1.3 Cautery type

It is known that the cautery type used for bleeding control during circumcision also plays a significant role in complication development. Thermal methods are frequently used in energy sources used in surgical hemostasis and one of them is electrocautery. Electrocautery instruments are of 2 types, monopolar and bipolar. In monopolar cauterization, the current is between 2 distant electrodes and the patient himself is a complement to the circuit. Energy exits the active small electrode and leaves the body through the large collecting electrode attached to the patient's skin. There are some risks and dangers associated with this circuit system in the use of monopolar energy. The most common complication is burns [34]. In the bipolar system, without the use of a cautery plate, the only instrument contains both active and collecting electrodes. High frequency electric current passes between two electrodes whose ends are close to each other. The tissue between the two electrodes is the tissue to which electrosurgery is targeted. In bipolar, the effect on the tissue is created by using less energy than monopolar. This results in fewer potential injuries [35, 36].

Bipolar energy devices can be used safely for hemostasis in penile surgeries. In monopolar energy sources, the electric current can be transferred to the small penis hole and spread to the entire penis; thermal damage may occur as a result [37]. A case of postoperative penile necrosis due to monopolar cautery used during circumcision has been reported from Turkey [38].

5.1.4 Infection

The largest study on the complications of circumcision in the literature was conducted with 100.157 pediatric patients, and the rate of infection after circumcision was reported as 0.06% in this study. Poorly sterilized surgical instruments, insufficient sterilization of the surgical field, and poor wound dressing have been shown to cause this situation. Considering these penile necrosis risk factors, the possibility of these complications, which are severe and difficult to reverse, should be decreased both before, during, and after surgery [39].

5.2 Diagnosis

Penile necrosis is diagnosed with physical examination findings. Radiology can be assessed visually using Doppler USG for the degree of ischemia and necrosis [40]. Modern sonography equipment with high-frequency probes up to 15 MHz provides detailed visualization of penile anatomy and vascular structure in normal and pathological conditions, which are of great value in the evaluation of penile hemodynamics in patients. It should be noted that the glans skin is less vascularized than the highly vascular corpora cavernosa, and blood flow velocities and volumes in the glant may be below the threshold of a scanner [41].

Doppler USG is used not only during diagnosis but also during follow-up. Doppler USG is helpful in determining to what extent the degree of necrosis is restored with treatment. Penile necrosis may require rapid penile amputation after diagnosis or cause post-operative uromechanical complications (such as urethral stenosis and meatal stenosis) and late sexual dysfunction. Prompt treatment is essential after diagnosis to minimize these complications [40, 41].

5.3 Treatment

The main goal in the treatment of glans necrosis is to increase tissue vascularization and oxygenate ischemic penile tissue [42]. In the literature, different methods have been tried in the treatment of glans necrosis, but there is no consensus on the treatment. The pharmacological agents commonly used today are pentoxifylline (PTX), enoxaparin, iloprost, antiplatelet drugs, corticosteroids and caudal anesthesia [21, 22].

In previous studies, it was stated that the use of oral PTX will provide successful results when used in the treatment of post-circumcision glans ischemia due to the effect of prostaglandin production on ischemia–reperfusion injury and the inhibitory effect of phosphodiesterase activity causing cyclic adenosine monophosphate synthesis [22]. Other studies in the literature have reported successful use of ropivacaine, subcutaneous enoxaparin, and topical testosterone in the treatment of penile necrosis [17, 22, 43].

Another treatment method used as an alternative to medical treatment is HBOT, which is suggested as an adjuvant treatment method because it increases tissue oxygenation, neutralizes anaerobic bacteria, improves neutrophil functions, increases fibroblast proliferation, and stimulates angiogenesis [44].

When the literature is reviewed, various pharmacological agents have been used in the treatment of glans and penile necrosis after circumcision. Aminsharifi et al. [45] treated their patients using topical 10% testosterone undecanoate twice a month and found significant improvement in their patients. Ozzeybek et al. [46] used glycerol trinitrate 3 mg/kg, 2 mL) as intracavernous and Bupivacaine 0.0625% as epidural for 5 days and they saw complete improvement after 1 week. Burke et al. [27] administered intravenous iloprost (PGI₂ analogue) at 0.52 µg/h to a patient who developed glans necrosis after dorsal penile block and they observed complete recovery after 43 hours. Sara and Lowry administered low-dose molecular weight heparin infusion (25 units/kg/h) for 4 days. Tzeng *et al.* and Aslan *et al.*, [21, 22] and more recently Elemen *et al.* [47] reported 2 patients of 5 and 33 years old treated with intravenous pentoxifylline (10 mg/kg) divided in four daily doses, together with hyperbaric oxygen with 2.5 atm of pressure for 90 min-long sessions. Total reverse of the ischemia was observed in both cases.

In addition to these treatments, necrotic tissue debridement and graft application constitute one of the main treatment methods [48]. Through the debridement of necrotic tissue, the progress of the disease is quickly stopped, and successful

results are achieved. In some studies, it was reported that severe cases could be successfully managed with suprapubic diversion and delayed urethroplasty [32]. Rare cases have been reported of complete glans and phallus necrosis following multiple interventions in staged repairs [33].

6. Medicolegal aspect

As in all surgical procedures, it is the realistic and comprehensive preoperative information provided by the relevant surgeon to increase the patient (parent) satisfaction after the circumcision operation. Informed consent, if available in a standard form, should be obtained with a signature explaining the surgical technique and listing all possible complications of the operation. The consent form should include the consent of the patient/parent for circumcision, the indications for circumcision in the individual case, surgical technique, and complications that may develop in the postoperative period. Christensen-Szalamski et al. [49] showed that replacing the 'physician's policy of partial disclosure with a comprehensive disclosure of unbiased information of possible risks and complications' had no effect on the mother's decision to have their son circumcised. If the procedure is performed under local anesthesia applied by the surgeon, the risks of this should also be discussed. If a child is to be circumcised, it is desirable to get his consent by explaining the procedure in accordance with his cognitive abilities.

From a medical law perspective, a retrospective review of malpractice in urology in a study conducted in the U.S. found that only 5.2% of cases were circumcision-related (adult or pediatric). Similarly, the largest jury review of urology malpractice cases showed that 3% of cases were circumcision related [50]. In the UK, the circumcision operation can only be legally performed by doctors [51]. In Turkey and Middle East, the Ministry of Health certifies those who attend a three-month course and who prove that they have been circumcised for 10 years even if there are no health personnel. Those who are convicted of performing unlicensed circumcision generally receive a light prison sentence of one week to one month [52].

7. Conclusion

According to the literature data, the lifelong medical benefits of circumcision of boys outweigh the risks of circumcision. Although there are contradictory results about the effect of circumcision on mental health, it is seen that it varies according to culture and affects mental health positively in societies where circumcision is common. Therefore, circumcision is beneficial in terms of biological and mental health, if performed under recommended age and conditions.

As an operation commonly performed in many countries and increasingly preferred due to medical and social reasons, circumcision brings different complications. More importantly, most of these complications can be prevented by careful surgery and careful postoperative care. Although the complications are generally minor, this surgical procedure is still performed by individuals other than doctors, and the tradition of mass circumcision causes major complications. It suggests that the rate of complications will decrease if the physicians who have received circumcision penile surgery education do it.

Glans necrosis is a rare complication but causes serious cosmetic, reproductive, and psychological problems after circumcision and may occur after cautery. The preferred treatment for glanular necrosis has not been established yet, different

treatment protocols are specified in the literature. The most important point in the treatment of glans necrosis is early diagnosis and rapid intervention.

Conflict of interest

All listed authors declare that he/she has no conflict of interest.

Author contributions

Study conception and design (YA, AA), Data acquisition (YA, AA), Analysis and data interpretation (YA, AA), Drafting of the manuscript (YA, AA), and Critical revision (YA, AA).

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