

# We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

185,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index  
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?  
Contact [book.department@intechopen.com](mailto:book.department@intechopen.com)

Numbers displayed above are based on latest data collected.  
For more information visit [www.intechopen.com](http://www.intechopen.com)



# Rare Yet Devastating Complications of Circumcision

*Reem Aldamanhori*

## Abstract

Circumcision is by far the most common procedure done in hospitals of Muslim countries. Many research data have proven its benefits in protecting against numerous sexually transmitted diseases, urinary tract infections, and penile cancer in the patients and cervical cancer in partners. The procedure is quite safe, with a low overall complication rate. Most of the adverse events of circumcision are minor and can be managed conservatively. In some areas where circumcision is performed by an inexperienced individual, or are done in a non-sterile environment, or using the wrong equipment, complications requiring expert intervention are seen. Devastating results range from simple self-limiting swelling and superficial infection to the dreadful amputation to the glans or the whole phallus, necessitating an expert in reconstruction. Circumcision is a simple surgical procedure with minimal adverse events when done by competent trained medical personnel, in a well-controlled sterile environment, using the appropriate equipment.

**Keywords:** complications, circumcision

## 1. Introduction

Circumcision has been around for centuries. It is done as a routine for all newborn infant males in Muslim countries, reaching almost 100% (if no contraindications), in hospitals in Saudi Arabia. Circumcision continues to be done for a variety of religious, cultural, and medical reasons. The overall prevalence of circumcision in the United States is estimated to be about 80% for males, with most of these procedures performed in newborns [1].

A recent meta-analysis included 140 journal articles that came to the same conclusion; early infant male circumcision has immediate and lifelong benefits. 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 [2]. Adverse events of circumcisions are rare. The low risk in comparison to the benefit demonstrates that benefits of male circumcision surpass its risk.

Adverse events of circumcision have been difficult to measure accurately. The largest studies on measuring complication rate 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, the equipment used can all change the percentage of overall complications significantly. Male circumcision has a low incidence of adverse events overall, especially if the procedure was performed during the first year of life [3]. 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 adverse events of circumcision are mild and are easily treatable. Nevertheless, severe complications might occur, demanding expert reconstruction, and might have a lifelong sequel. Here we discuss some of those adverse events.

## **2. Risk factors for complications**

Routine circumcision is conventionally seen as a very low-risk surgical procedure, though every surgical procedure has inherent risks. Complication rates, although infrequent, may be influenced by several factors, including the patient's age, the patient's weight, and the experience of the health care personnel in performing the procedure.

### **2.1 Age of the patient**

The rate of procedure-related complications during and after circumcision is low overall, especially if the procedure was performed during the first year of life. However, this low risk rises 10-fold to 20-fold when performed after infancy [3]. In a recent study, where 1000 children were circumcised using Plastibell, complications such as bleeding, hematoma, and swelling of the prepuce were higher in infants than neonates [4]. The study concluded that circumcision has less adverse events if done in the 1st year of life, the younger the age, the better the prognosis [4]. Another study also showed that circumcision in the newborn period was harmless with 0% complications. However, when its performed in older infants (older than 3 months) postoperative complications such as bleeding requiring intervention has risen to 30% [5]. Another study concluded that there were substantial statistical differences in circumcision revision rates between children older than 30 days and those less than 30 days of age [6]. These articles have proven that increasing age increases the chances of developing complications related to circumcision.

In contrast to that, an article has studied the complications of circumcision in premature neonates. The rate of complications of circumcision was evaluated for three different groups, new-born circumcision at a well-baby nursery, neonatal intensive care units, and special care nursery. Babies in the neonatal intensive care units and the special care nursery had a higher probability of developing circumcision-related complications compared with those in the well-baby nursery [7]. Overall, since neonatal circumcision is an elective procedure, there is no urgency in performing it if the patient is premature, has a fever or respiratory distress, but is preferred to delay the procedure until the patient is stable.

### **2.2 Weight of the patient**

Although circumcision is an apparently harmless procedure, the weight of the patient undergoing circumcision may affect the complication rate. An investigation of neonatal circumcision revealed that patients weighing >5.1 kg might be at higher risk of bleeding and long-term complications [8]. Physically, the higher the patient's weight, the probably thicker groin fat pad he will have. Therefore, it is explained that patients with higher weight have a higher risk of developing penile adhesions and buried penis [9]. While increased weight is not a contraindication to circumcision, it should be well-thought-out to advise parents about possible

difficulties that may arise when a patient's weight is increased. Emphasis on genital hygiene is essential in patients with increased weight to help in avoiding complications.

### **2.3 Practitioner experience**

Inadequate training of clinicians contributes to complications, as practitioners without formal training may not recognize congenital malformations might be contraindications to performing circumcisions. Patients with these abnormalities should be referred to a pediatric urologist to aid in the prevention of unsatisfactory results and complications [10]. In some rural areas where ritual circumcision is performed by the local barber or a senior family member, distressing complications up to the extent of penile amputation have been described. Many cases of glans and urethral injury have been observed. Amputation of the whole shaft of the penis after traditional ritual circumcision performed by a family member or unexperienced individual have been reported necessitating reconstructive expert in reimplantation. Untrained individuals who perform circumcisions are to be held responsible for the complications that arise and need to be stopped [11].

### **3. Complications related to anesthesia**

Circumcision is one of the most popular surgical procedures around the world. Inadequate pain relief when performing this procedure in neonates may have long-standing psychological and physical implications. Insufficient pain control and submitting the patient to grave pain during the neonatal period, has proven to produce prolonged hypersensitivity to painful stimuli [12]. It was also proven that as adults, patients who have had painful neonatal surgery might require more opioid analgesia in comparison to patients with no previous neonatal surgery [12]. Even after the patient's initial tissue injury has healed, he may still experience pain extending beyond this period. This further highlights the importance of pain management in this tender young age.

Various types of anesthesia have been used to decrease painful stimuli during circumcision, decrease intraoperative patient movement, avoid intraoperative complications, and relieve postoperative pain. The different types of analgesia and anesthetic approaches that have been implemented in circumcision procedures have different efficacies. Some use topical analgesia such as lidocaine; others prefer nerve block. A recent meta-analysis has concluded that the dorsal penile nerve block was far more effective in pain control than a mixture of local anesthetics in infants during circumcision [13]. Local analgesics, though they may have fewer complications, are unpredictable. The effect local anesthetics have is directly dependent on the degree of absorption. The degree of absorption cannot be foretold as it is subjected to many factors such as skin thickness and amount of ointment applied. Another noteworthy issue is that local anesthetic creams need time to start its pain controlling properties (an average of an hour), while nerve blocks work immediately.

Local analgesia, due to the fact that they are topical, has much fewer self-limiting complications in comparison to the more invasive nerve block. While infrequent, burning, or stinging at the administration site, allergic reaction to the local anesthetic, skin discoloration, skin swelling, and neuritis might occur [14]. On the other hand, a dorsal penile nerve block is more invasive; the procedure of nerve block is itself painful. It also has a more significant risk of forming perineural hematomas.

Nerve injuries might occur secondary to intraneural injection. An allergic reaction might happen in the form of Urticaria or anaphylaxis, with the worst outcome being systemic anesthetic toxicity when accidentally injecting the local anesthetic in the systemic circulation [13].

#### **4. Complications related to technique**

The technique of circumcision is described in other chapters. Mainly, there are three devices for neonatal circumcision: the Gomco clamp, the Plastibell device, and the Mogen clamp. Additional tools are either modifications or are based on the main principles of these three devices.

##### **4.1 Device used**

Several techniques and devices have been described in the practice of circumcision. There was no statistically significant difference when comparing complications between the different methods performed. In one study, preputial stenosis was most frequently found in the traditional circumcision, while bleeding was more prevalent when using a Plastibell device [15]. A different controlled trial compared adverse events rate for circumcision using the three devices (the Gomco clamp, the Mogen clamp, and the Plastibell device) and showed that adverse events rate did not differ by the method [16].

##### **4.2 Sutures**

Different circumcision techniques differ in need to use sutures to close wounds and control bleeding. However, in some cases suturing of wound edges is inevitable. Suturing and the presence of a foreign body may result in wound infection, granulation tissue formation, stitch sinuses, foreign body reactions, and scarring. A study has shown that bleeding; excessive swelling, infection, and wound dehiscence are more commonly seen in sutured versus sutureless circumcisions [17]. The use of sutureless circumcision is an excellent alternative to the standard technique. It results in faster operative times and is a less expensive surgical option [18].

##### **4.3 Cautery**

Post-circumcision bleeding is probably the most disturbing early complication. Unfortunately, hemostatic techniques such as electrocautery are the first line of treatment, with no appreciation of their potential upsetting consequences. There is a lot of controversy in the use of thermocautery in circumcision routinely. Some studies report better cosmetic results and lower complication rates with the use of thermocautery devices. They give strict rules on the extent of cautery, the temperatures, and currents used, the type of blade, and technique of cautery [19].

On the other hand, numerous studies have reported the devastating complications following extensive cauterization. One case even reported a total loss of the whole phallus post-circumcision with the use of monopolar electrocautery. The patient had a total loss of the penis and required complete phallic reconstruction using flaps [20]. Although diathermy may seem like a necessity to control bleeding when performing circumcision, extensive use can lead to distressing outcomes [21]. Salvage surgery was carried out on five cases of post-circumcision using electrocautery. One of these infants presented to the emergency department with septic shock and multiorgan dysfunction secondary to infective gangrene of whole external genitalia [22].

## 5. Medical complications

### 5.1 Bleeding

Bleeding is the most frequent complication following circumcision [23]. To avoid excessive bleeding and the need to reoperation simple history taking is mandatory. Patients with bleeding diathesis and history of coagulopathies are not candidates for simple circumcision. Those patients need pediatric consultations and special consideration during the procedure.

The most common direct obstacle met during an elective neonatal circumcision was bleeding. It almost always requires only pressure or topical thrombin to achieve hemostasis [24]. There is no statistical difference in the rate of bleeding with different techniques used for circumcision. One study has compared the results of Plastibell clamp vs. classic dissection circumcision, and both were found to have a similar occurrence of immediate complications such as bleeding [25]. Another study has shown that a worn out, and overused Gomco clamp has less of a vessel crushing effect, hence more bleeding [26]. Another study has found that bleeding was more prevalent when using a Plastibell device [15].

Bleeding after circumcision either occurs from the frenular artery or the skin edges at the site of the incision. Caution is to be taken to avoid the frenular artery or carefully coagulate the frenulum to prevent delayed bleeding. It was formerly mentioned, that with age, the rate of postoperative complications, especially bleeding, have risen to 30% [5]. It was thought that the size and diameter of the vessels in the prepuce have increased with age hence the increased incidence of post-circumcision bleeding.

Bleeding after circumcision is generally easy to prevent, and if occurred can be stopped without difficulty. It is usually a minor event that rarely requires reoperation and intervention. A simple compression dressing is adequate, occasionally local administration of epinephrine and lidocaine might help aid in hemostasis [26]. The use of sutures or electrocautery is sometimes inevitable; caution is advised not to use excessive suturing material or electrocautery as that might lead to other complications. Rarely, the patient might need a transfusion or intravenous administration of clotting factors if bleeding diathesis were not previously discovered on the routine preoperative investigation [26].

### 5.2 Infection

Skin is a natural barrier against infection. It is expected that any breach of the skin surface may lead to infection. The presence of the penis in a wet environment (the diaper), and the proximity to stool contamination makes it a more susceptible place to infection. In spite of some precautions to avoid infections, a disruption in the skin surface may bring about infection. A study compared patients who received prophylactic antibiotics before circumcision with those who did not receive prophylaxis. Wound infection rates after circumcision with the use of prophylactic antibiotics was equal to the rate of wound infection after circumcision without the use of antibiotics [27]. Therefore, it was proven that prophylactic antibiotics did not protect against post-circumcision wound infection.

Occasionally circumcision site wound infection might occur. The rate of infection has differed from publication to the other. A systemic review has shown that the incidence of moderate to severe wound infections following circumcision depends on the practitioner and the equipment sterility [23]. It is generally minor and is demonstrated by mild swelling, erythema, redness, with signs of local inflammatory changes. It mostly resolves spontaneously with conservative measures and the emphasis on hygiene, or the simple use of topical antibiotics when necessary.

Most post-circumcision infections are self-limiting and can be treated conservatively. However, severe infection with puss formation and occasionally systemic infection might ensue. It is suspected when the patient presents with systemic symptoms such as fever, irritability, lethargy, or poor feeding. In this case, the patient needs admission, intravenous antibiotics, and wound debridement. Although infrequent, systemic post-circumcision wound infections represent a significant clinical problem. Post-circumcision infection has been reported to cause severe necrotizing fasciitis [28]. Infection of the surgical wound after the circumcision was reported to cause meningitis in the 1970s, that is not seen in the modern era of sterilization and antibiotics [29]. Post-circumcision Infectious complications must be reduced; it is feasible when done by trained and competent practitioners performing the procedure using sterile techniques [30].

## **6. Surgical complications**

### **6.1 Meatal stenosis**

Circumcision is the primary procedure done in the Muslim world. Meatal stenosis is one of the surgical complications that are not uncommon. It is reported that the incidence of meatal stenosis is rare in uncircumcised boys, and it is 10–26 times more in circumcised boys [31]. Being increasingly common, a careful meatal examination is indicated in any circumcised male with urinary symptoms [32]. The stenosed meatus is a meatus that has changed in its shape and width to a narrow circle from the previously normal slit-like meatus. This change is due to a circular scar formation. However, not all circular meatus are considered stenosed. There are accepted differences in meatal shape and width.

The development of the circular scar at the meatus causing meatal stenosis has been attributed to the ischemia of the meatus, with dividing the frenulum and using extensive cauterization [33]. In one study, 2307 children undergoing circumcision using Plastibell were split into two groups. One group where the frenulum was kept intact, and the other group where frenular hemostasis was performed in all cases by thermal cautery. Neonatal Plastibell circumcision with intact frenulum technique decreased the rate of meatal stenosis significantly in comparison to those who underwent circumcision with thermal cautery of the frenular artery [34].

Meatal stenosis is a frequent complication of circumcision. Meatal stenosis might be asymptomatic and does not necessitate surgical correction. Once the boy is toilet trained, symptoms may arise. Symptoms usually present as a thin stream that jets further away than usual. The stream might deflect upwards, and take longer than expected to empty the bladder completely. Urinary tract infection, urinary retention, and even renal failure might manifest if the diagnosis is not prompt. Surgical intervention with a dorsal slit meatotomy is the definitive treatment, with low rates of restenosis and need for reoperation [35]. The means of assessment following surgery are evaluated by the clinical improvement of symptoms and a better uroflowmetry after meatotomy compared to the preoperative uroflowmetry result [36].

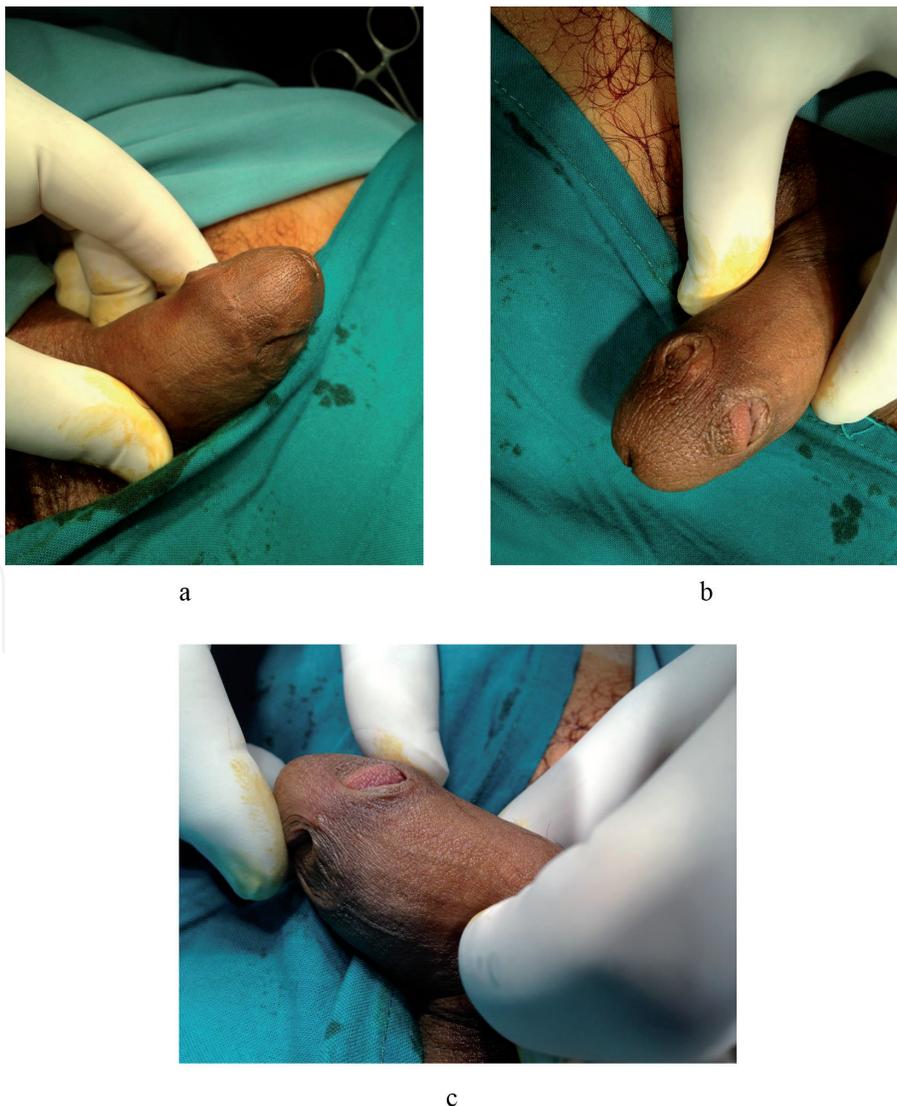
### **6.2 Skin bridges**

The skin is an organ that heals in miraculous ways. It has been shown that when there are two adjacent wounded edges of skin, or when there is skin infection between two surfaces, the skin might heal with adhesions. During circumcision, the foreskin is separated from the glans and then excised. This leaves the glans with superficial abrasions that consequently adhere to the circumcision wound, and skin

bridges form. Penile skin bridges are adhesion between injuries or wounds in the glans and the penile shaft usually after circumcision. In uncircumcised men skin bridges occur when there is no cleaning of the build-up of smegma underneath the foreskin. This leads to infection and the subsequent healing with skin bridges forming from the foreskin to the glans.

Adhesion of the skin of the penis, at the site of the circumcision incision, to the bare glans beyond the corona creates a skin bridge. It is an established complication of newborn circumcision. Skin bridges can vary from simple, transparent, flimsy, early forming skin bridge to a sizeable wide strip of skin bridge that might extend to replace the whole glans skin creating a circumferential bridge that produces a picture of a buried penis [37]. The resulting bridge of skin is cosmetically unacceptable, it may cause tethering with erections that might be painful or traumatic with penetration, it may cause penile torsion, or it could trap smegma causing recurrent inflammation or infection.

A simple pressure on the suprapubic fat pad in the clinic after circumcision follow-up is sufficient to separate the fragile transparent skin bridge. Careful dressing of this area until complete healing of the raw surfaces is essential to prevent a recurrence. More well-defined skin bridges might require reoperation with excision of the skin bridge [38]. Reconstruction of these adhesions includes separation of the skin bridge from the glans, excision of all abnormal skin, and meticulous dressing



**Figure 1.**  
(a-c) Large skin bridges covering a large surface area of the glans epithelium.

of the raw surface to prevent a recurrence. Glans epithelium subsequently heals, bringing back the typical appearance of a glans and coronal sulcus [37].

On the other hand, circumferential skin bridges might be extraordinarily disfiguring and tricky to repair. It is a challenge to divide the wide bridges from the glans without causing scarring of the glans epithelium. When the bridge is replacing a large surface area of the glans epithelium beyond the bridge, it is not merely corrected by simple bridge lysis (**Figure 1a–c**). Raw glans and an unappealing appearance of the glans might result from the correction of these types of penile skin bridges (**Figure 2**). This might need skin grafts or flaps and an expert in reconstruction [39].

In a study where a total of 277 patients were circumcised, of those patients, 26 patients experienced long-term complications, the majority being penile adhesions [8]. Buried penis, penile adhesions, and penile skin bridges are complications after circumcision that seems to occur more frequently in overweight children [9]. It was also reported that 63% of patients presenting for circumcision revision were found to have prominent suprapubic fat pads [40]. In one study where circumcised children were randomly divided into two groups depending on the method of circumcision Plastibell versus circumcision with dissection, late complications, especially adhesions, were higher in the group circumcised with dissection [25]. These limitations should be well-thought-out before new-born circumcision when counseling guardians before circumcision. Early recognition of neonatal obesity might indicate the necessity for meticulous genital hygiene to try to prevent post-circumcision complications such as skin bridges. Cautious circumcision technique, avoiding any glans injury, and proper dressing at the time of circumcision are simple actions that can prevent adherence of the distal perpetual skin flap to the glans penis [39].



**Figure 2.**  
*Raw glans and an unappealing appearance of the glans resulting from the correction of large skin bridges.*

### **6.3 Keloid formation**

Any surgical procedure carries a risk of complications. Keloid scar formation is an abnormal proliferation of the scar extending beyond the surgical area. It is characterized by local fibroblast proliferation and overproduction of collagen. It sometimes takes a few months to develop. It is more common in younger individuals and is seen as more common in some ethnicities. Keloids cause cosmetic disfiguration, and the patient is usually bothered by the appearance of the scar. Genital keloid may cause functional impairment and worsen the quality of life. Keloids in the groin, especially those affecting the penis, are extremely rare despite frequent surgeries in the genital area. Only a few cases reported in the literature [41–45], hence the actual incidence is unknown.

Keloid formation is poorly understood. Numerous concepts have been suggested to understand the process by which keloid scars form. It has been suggested that keloid scars form as a result of collagen build-up, from the effect of hostile or hypoxic environment on tissue, or the hyperactivity of mast cells and the release of histamine. It has also been suggested that tension at scar edges create abnormal healing and might aid in the production of keloids [43].

Some topical therapies and therapeutic options have been described in the treatment of keloid scars. Treatments such as pressure on the keloid scar, silicone gel sheets, intralesional steroid injections, and massaging the scar with topical steroids have been suggested. A meta-analysis on the different treatment options for keloid scars has shown no statistical significance between the use of different treatment options separately or in combination [46]. Thus, no recognized guidelines have been established for the treatment of keloids. Surgical excision combined with intralesional steroid injections was and remained, the traditional treatment for keloids [47]. Creating a regulated treatment guideline has been challenging due to the lack of randomized controlled trials. The use of ablative laser technology, such as the CO<sub>2</sub> laser, has lately produced hopeful outcomes.

### **6.4 Trauma**

Although rare, traumatic complications of circumcisions have troubling consequences. Injury to the skin of the shaft [11, 48], injury to the glans or urethra [49–52], or total amputation of the whole length of the phallus are reported [53, 54]. These events, although very rare, are seen in rural regions where ritual mass circumcisions are performed by untrained individuals using primitive devices. They require referral to specialized centers with experience in reconstruction.

Circumcision, although it's considered to be a simple procedure, may cause serious problems such as penile skin necrosis or skin loss. Extensive skin removal is noticed at the end of the operation when the suture lines are under tension. Early postoperatively, the patients usually present with wound dehiscence after the first erection due to insufficient skin and stress on the suture line. Unfortunately, primary closure of such wound dehiscence is almost always unsuccessful. The skin is deficient, and skin stretch cannot accommodate the length of the erect penis; hence, another dehiscence is inevitable. If the penis is left to heal with secondary intention the scarring might entrap the penis, creating a buried penis. The scar of secondary intention might cause tethering or a mechanical pull on the erect penis. The bend of the penis might be painful; it might not permit a full erection to form and might hinder penetration and successful intercourse. The patient is left with frustration and grave disappointment, and the situation is left in the hands of the reconstructive urologists or plastic surgeons. Penile reconstructive surgery, in these

cases, represents a significant challenge. The patient needs skin flaps or grafts from non-hair-bearing areas to cover the area of skin loss. The success of these procedures depends on the size of the area of skin loss, the use of flap vs. graft with its vascularity, and graft or flap take. Infection and excessive tension are the enemies in such cases and are to be prevented with all measures. A proper reconstruction procedure leaves the patient with excess skin that allows room for erection, has excellent visual appeal, is free of hair and contractions, and provides decent sensation. The use of scrotal-dartos-fascio-myo-cutaneous flap has been reported to cover up a defect of skin after circumcision procedure [48].

The penis is the organ which gives males their sexual confidence. Some of the devastating complications of circumcision are loss of part or the whole length of the penis. Trauma to the glans penis or even part of the penile shaft leaves behind a patient with low self-esteem and quality of life. Seleim and ElBarbany [22], after reviewing the literature, they did not find a grading system to define post-circumcision trauma to the penis. It was found that the term complete penile amputation, although obviously meant total penile loss, was used by authors to describe solitary glans amputation [55]. Therefore, they proposed a grading system to help better understand the extent of the injury, and to ease in finding the appropriate management options for each grade. Grade I was defined as skin complications, minor or major, ranging from simple skin infection or stitch sinus to major skin loss necessitating reconstruction. Grade II was for isolated urethral injury and the creation of an iatrogenic urethra-cutaneous fistula. Grade III was used to describe glans amputation and isolated glans injury. Grade IV was extended to include an insult to the corpora cavernosa. Grade V was defined as a total phallic loss either by amputation or gangrene [22]. All the patients in the study above had a history of circumcision being performed by inexperienced surgeons at primary care hospitals using electrocautery for hemostasis. This grading system helped in creating a standardized platform to help in understanding the extent of these injuries [20].

## **7. Conclusion**

Circumcision is reported as one of the most common surgical procedures performed throughout the world. It is performed for religious reasons in Muslim and Jewish countries, for medical reasons such as phimosis or recurrent balanitis and are done electively for esthetic and cosmetic reasons. Unfortunately, it is still one of the most common rituals performed for religious reasons by inexperienced individuals. The incidence of complications of circumcision is quite low. It is believed to be a technically simple and safe surgical procedure. Having said that critical complications such as necrotizing fasciitis or total penile amputation may arise. Although circumcision is considered to be a technically simple and safe procedure with significantly low risk, it may occasionally lead to gravely devastating complications. It might place the patient in a state of mutilation, with low self-esteem. These complications present a reconstructive predicament, needing an expert in their repair. Even so, after the patch up work, the patient may still have psychological trauma and diminished sexual confidence.

## **Acknowledgements**

Reem Aldamanhori is an associate professor in Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

## **Conflict of interest**

The author declares no conflict of interest.

IntechOpen

IntechOpen

## **Author details**

Reem Aldamihori  
Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia

\*Address all correspondence to: [rdamihori@iau.edu.sa](mailto:rdamihori@iau.edu.sa)

## **IntechOpen**

---

© 2019 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

## References

- [1] Introcaso CE, Xu F, Kilmarx PH, Zaidi A, Markowitz LE. Prevalence of circumcision among men and boys aged 14 to 59 years in the United States, National Health and nutrition examination surveys 2005-2010. *Sexually Transmitted Diseases*. 2013;**40**(7):521-525
- [2] Morris BJ, Kennedy SE, Wodak AD, Mindel A, Golovsky D, Schrieber L, et al. Early infant male circumcision: Systematic review, risk-benefit analysis, and progress in policy. *World Journal of Clinical Pediatrics*. 2017;**6**(1):89-102
- [3] El Bcheraoui C, Zhang X, Cooper CS, Rose CE, Kilmarx PH, Chen RT. Rates of adverse events associated with male circumcision in U.S. medical settings, 2001 to 2010. *JAMA Pediatrics*. 2014;**168**(7):625-634
- [4] Razzaq S, Mehmood MS, Tahir TH, Masood T, Ghaffar S. Safety of the plastibell circumcision in neonates, infants, and older children. *International Journal of Health Sciences*. 2018;**12**(5):10-13
- [5] Horowitz M, Gershbein AB. Gomco circumcision: When is it safe? *Journal of Pediatric Surgery*. 2001;**36**(7):1047-1049
- [6] Gerber JA, Borden AN, Broda J, Koelewyn S, Balasubramanian A, Tu D, et al. Evaluating clinical outcomes of an advanced practice provider-led newborn circumcision clinic. *Urology*. 2019;**127**:97-101
- [7] Srinivasan M, Hamvas C, Coplen D. Rates of complications after newborn circumcision in a well-baby nursery, special care nursery, and neonatal intensive care unit. *Clinical Pediatrics (Phila)*. 2015;**54**(12):1185-1191
- [8] Kim JK, Koyle MA, Chua ME, Ming JM, Lee MJ, Kesavan A, et al. Assessment of risk factors for surgical complications in neonatal circumcision clinic. *Canadian Urological Association Journal*. 2019;**13**(4):E108-EE12
- [9] Storm DW, Baxter C, Koff SA, Alpert S. The relationship between obesity and complications after neonatal circumcision. *The Journal of Urology*. 2011;**186**(Suppl 4):1638-1641
- [10] Demaria J, Abdulla A, Pemberton J, Raees A, Braga LH. Are physicians performing neonatal circumcisions well-trained? *Canadian Urological Association Journal*. 2013;**7**(7-8):260-264
- [11] İnce B, Dadacı M, Altuntaş Z, Bilgen F. Rarely seen complications of circumcision, and their management. *Turkish Journal of Urology*. 2016;**42**(1):12-15
- [12] Peters JW, Schouw R, Anand KJ, van Dijk M, Duivenvoorden HJ, Tibboel D. Does neonatal surgery lead to increased pain sensitivity in later childhood? *Pain*. 2005;**114**(3):444-454
- [13] Wang J, Zhao S, Luo L, Liu Y, Zhu Z, Li E, et al. Dorsal penile nerve block versus eutectic mixture of local anesthetics cream for pain relief in infants during circumcision: A meta-analysis. *PLoS One*. 2018;**13**(9):e0203439
- [14] Kumar M, Chawla R, Goyal M. Topical anesthesia. *Journal of Anaesthesiology Clinical Pharmacology*. 2015;**31**(4):450-456
- [15] Talini C, Antunes LA, Carvalho BCN, Schultz KL, Del Valle MHCP, Aranha Junior AA, et al. Circumcision: Postoperative complications that required reoperation. *Einstein*. 2018;**16**(3):eAO4241
- [16] Bowa K, Li MS, Mugisa B, Waters E, Linyama DM, Chi BH, et al. A controlled trial of three methods

for neonatal circumcision in Lusaka, Zambia. *Journal of Acquired Immune Deficiency Syndromes*. 2013;**62**(1):e1-e6

[17] Raut A. Sutureless versus sutured circumcision: A comparative study. *Urology Annals*. 2019;**11**(1):87-90

[18] Voznesensky M, Mutter C, Hayn M, Kinkead T, Jumper B. Pediatric sutureless circumcision: An effective and cost efficient alternative. *The Canadian Journal of Urology*. 2015;**22**(5):7995-7999

[19] Akyüz O, Bodakçı MN, Tefekli AH. Thermal cautery-assisted circumcision and principles of its use to decrease complication rates. *Journal of Pediatric Urology*. 2019;**15**(2):186.e1-186.e8

[20] Al-Hazmi H, Traby M, Al-Yami F, Kattan AE, Al-Qattan MM. Penile reconstruction in a newborn following complicated circumcision: A case report. *International Journal of Surgery Case Reports*. 2018;**51**:74-77

[21] Fang DB, Shen YH, Zhu XW, Fang JJ, Mao QQ, Chao-jun W, et al. Penile necrosis resulting from post-circumcision microwave diathermy: A report of 9 cases. *Zhonghua Nan Ke Xue*. 2015;**21**(5):428-431

[22] Seleim HM, Elbarbary MM. Major penile injuries as a result of cautery during newborn circumcision. *Journal of Pediatric Surgery*. 2016;**51**(9):1532-1537

[23] Weiss HA, Larke N, Halperin D, Schenker I. Complications of circumcision in male neonates, infants and children: A systematic review. *BMC Urology*. 2010;**10**:2

[24] Heras A, Vallejo V, Pineda MI, Jacobs AJ, Cohen L. Immediate complications of elective newborn circumcision. *Hospital Pediatrics*. 2018;**8**(10):615-619

[25] Bastos Netto JM, de Araújo JG, de Almeida Noronha MF, Passos BR, de Bessa J, Figueiredo AA. Prospective randomized trial comparing dissection with Plastibell® circumcision. *Journal of Pediatric Urology*. 2010;**6**(6):572-577

[26] Baskin LS, Canning DA, Snyder HM, Duckett JW. Treating complications of circumcision. *Pediatric Emergency Care*. 1996;**12**(1):62-68

[27] Lebina L, Laher F, Mukudu H, Essien T, Otworld K, Gray G, et al. Does routine prophylactic oral flucloxacillin reduce the incidence of post-circumcision infections? *American Journal of Infection Control*. 2013;**41**(10):897-900

[28] Galukande M, Sekavuga DB, Muganzi A, Coutinho A. Fournier's gangrene after adult male circumcision. *International Journal of Emergency Medicine*. 2014;**7**:37

[29] Scurlock JM, Pemberton PJ. Neonatal meningitis and circumcision. *The Medical Journal of Australia*. 1977;**1**(10):332-334

[30] Brook I. Infectious complications of circumcision and their prevention. *European Urology Focus*. 2016;**2**(4):453-459

[31] Frisch M, Simonsen J. Cultural background, non-therapeutic circumcision and the risk of meatal stenosis and other urethral stricture disease: Two nationwide register-based cohort studies in Denmark 1977-2013. *The Surgeon*. 2018;**16**(2):107-118

[32] Van Howe RS. Incidence of meatal stenosis following neonatal circumcision in a primary care setting. *Clinical Pediatrics*. 2006;**45**(1):49-54

[33] Morris BJ, Moreton S, Krieger JN. Meatal stenosis: Getting the diagnosis right. *Research and Reports in Urology*. 2018;**10**:237-239

- [34] Karami H, Abedinzadeh M, Moslemi MK. Assessment of meatal stenosis in neonates undergoing circumcision using Plastibell device with two different techniques. *Research and Reports in Urology*. 2018;**10**:113-115
- [35] Varda BK, Logvinenko T, Bauer S, Cilento B, Yu RN, Nelson CP. Minor procedure, major impact: Patient-reported outcomes following urethral meatotomy. *Journal of Pediatric Urology*. 2018;**14**(2):165.e1-165.e5
- [36] Neheman A, Rappaport YH, Darawsha AE, Leibovitch I, Sternberg IA. Uroflowmetry before and after meatotomy in boys with symptomatic meatal stenosis following neonatal circumcision - a long-term prospective study. *Urology*. 2019;**125**:191-195
- [37] Snodgrass W. Extensive skin bridging with glans epithelium replacement by penile shaft skin following newborn circumcision. *Journal of Pediatric Urology*. 2006;**2**(6):555-558
- [38] Kampouroglou G, Nikas K. Penile skin bridges after circumcision. *APSP Journal of Case Reports*. 2015;**6**(3):33
- [39] Kamal BA. Penile skin bridges: Causes and prevention. *International Surgery*. 2009;**94**(1):35-37
- [40] Williams CP, Richardson BG, Bukowski TP. Importance of identifying the inconspicuous penis: Prevention of circumcision complications. *Urology*. 2000;**56**(1):140-142
- [41] Xie LH, Li SK, Li Q. Combined treatment of penile keloid: A troublesome complication after circumcision. *Asian Journal of Andrology*. 2013;**15**(4):575-576
- [42] Demirdover C, Sahin B, Vayvada H, Oztan HY. Keloid formation after circumcision and its treatment. *Journal of Pediatric Urology*. 2013;**9**(1):e54-e56
- [43] Alyami F, Fernandez N, Koyle MA, Salle JP. Keloid formation after pediatric male genital surgeries: An uncommon and difficult problem to manage. *Journal of Pediatric Urology*. 2019;**15**(1):48.e1-48.e8
- [44] Ozakpinar HR, Sari E, Horoz U, Durgun M, Tellioglu AT, Acikgoz B. Keloid of the circumcision scar: A rare complication. *International Wound Journal*. 2015;**12**(5):611-612
- [45] Park TH, Chang CH. Letter regarding "Keloid formation after circumcision and its treatment". *Journal of Pediatric Urology*. 2013;**9**(1):e56-e57
- [46] Wong TS, Li JZ, Chen S, Chan JY, Gao W. The efficacy of triamcinolone acetonide in keloid treatment: A systematic review and meta-analysis. *Frontiers in Medicine*. 2016;**3**:71
- [47] Heppt MV, Breuninger H, Reinholz M, Feller-Heppt G, Ruzicka T, Gauglitz GG. Current strategies in the treatment of scars and keloids. *Facial Plastic Surgery*. 2015;**31**(4):386-395
- [48] Innocenti A, Tanini S, Mori F, Melita D, Innocenti M. Scrotal dartos-fascio-myo-cutaneous flaps for penis elongation after catastrophic iatrogenic skin shaft sub-amputation: A case of recovery using an extremely adaptable flap. *International Journal of Surgery Case Reports*. 2016;**28**:300-302
- [49] Gluckman GR, Stoller ML, Jacobs MM, Kogan BA. Newborn penile glans amputation during circumcision and successful reattachment. *The Journal of Urology*. 1995;**153**(3 Pt 1):778-779
- [50] Giovanni A, Wahyudi I, Rodjani A. Neo-glans reconstruction after glans amputation during circumcision using autologous buccal

mucosal graft. *Urology Case Reports*.  
2018;**18**:11-13

[51] Khaireddine B, Adnen H, Khaled BM, Adel S. Surgical reimplantation of penile glans amputation in children during circumcision. *Urology Annals*. 2014;**6**(1):85-87

[52] Baskin LS, Canning DA, Snyder HM, Duckett JW. Surgical repair of urethral circumcision injuries. *The Journal of Urology*. 1997;**158**(6):2269-2271

[53] van der Merwe A, Graewe F, Zühlke A, Barsdorf NW, Zarrabi AD, Viljoen JT, et al. Penile allotransplantation for penis amputation following ritual circumcision: A case report with 24 months of follow-up. *Lancet*. 2017;**390**(10099):1038-1047

[54] Kim JH, Park JY, Song YS. Traumatic penile injury: From circumcision injury to penile amputation. *BioMed Research International*. 2014;**2014**:375285

[55] Hashem FK, Ahmed S, al-Malaq AA, AbuDaia JM. Successful replantation of penile amputation (post-circumcision) complicated by prolonged ischaemia. *British Journal of Plastic Surgery*. 1999;**52**(4):308-310