



Original Article

Pak J Urology 2024

02-01 (3): 82-87

Split Glans & Advancement Flap To Repair Penile Hair Tourniquet Injury In Children: A Challenging Problem Of Unknown Etiology.

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Article History

Received: March-15,2024

Accepted: April-24,2024

Revised: June-30,2024

Available Online:-10-08-2024

Abstract

Background: Penile Hair tourniquet injury is a clinical phenomenon that involves hair or thread becoming so tightly wrapped around the coronary sulcus of penis, causing progressive penile strangulation and compromised blood flow resulting in clinical appearance which ranges from simple edema to necrosis of urethra, corpora and sometime partial or near total penile amputation. It is most commonly found in boys between 0-6 years of age and almost described in circumcised boys. The patients usually present with urethra-cutaneous fistula with most of urination from fistula site. With high index of suspicion and careful inspection of the affected area are key to diagnosis. Surgical repair is challenging due to ischemic necrosis, scarred tissue with compromised blood supply.

Objective: To find out the cause and outcome of repair by split glans & advancement flap for hair tourniquet penile injury

Study design: A retrospective study

Place and duration of study : Department of Pediatric Urology, The Children's Hospital and University of Child Health Sciences, Lahore. From Jan 2015 to December 2021

Methodology: This retrospective study was conducted from the medical record from Jan. 2015 to December 2021. All Children with classical tourniquet injury were included and iatrogenic urethral injury or UCF after hypospadias surgery were excluded. We repair urethra in transverse fashion & cover the repair with a full thickness dartos-cutaneous flap advanced and fixed in split glans. SPSS version 21 was used for statistical analysis of data. Variables like age, cause, injury type, outcome of surgical repair: measured single urinary stream from glans tip and cosmesis were noted

Results: Total 30 patients were retrieved. All patients were male of age range 2-12 years with mean age of 7 years. The most children have two ends of urethra separated apart with scarred tissue at distal penile area and tight band around penis. From 30 patients Children with grade II injury (presence of urethra-cutaneous fistula) are 20 and grade III injury (subtotal amputation of corpus spongiosum, hanging glans) are 10 and no patients presented with grade I (superficial skin lesion) and IV injury (loss of glans, complete section of corpus spongiosum). Success rate of fistula closure are 28 patients, two patients developed fistula and 26 patients satisfied about cosmesis.

Conclusion: Split glans & advancement flap is a good choice for repair of such ischemic injuries of penis which provides a healthy vascular cover to repair and blood supply to glans as well. Mothers and general population should be educated about this preventable trauma, which is caused by negligence and ignorance.

Key words: Penile Hair Tourniquet injury (PHTI), Urethrocutaneous fistula (UCF), Balanoprepucial sulcus (BPS), Penile Strangulation Injury (PSI).

Citations: Ghulam Mujtaba Zafar, Muhammad Nadeem Sajjad, Muhammad Zaheer, Muhammad Hanan Yousaf, Fawad, & Muhammad Naseem Javeed. Split Glans & Advancement Flap To Repair Penile Hair Tourniquet Injury In Children: A Challenging Problem Of Unknown Etiology: Original Article . Pakistan Journal of Urology (PJU), 2(01), 82-87. <https://doi.org/10.69885/pju.v2i01.58>

Introduction

Penile Hair Tourniquet Injury (PHTI) is a rare injury in which hair get entangled around the coronal sulcus of a circumcised penis, giving rise to a spectrum of clinical manifestations ranging from mild swelling and redness of glans to the more severe complications such as urethrocutaneous fistula , gangrenous of glans penis and even penile amputation [1]. Mostly children have this injury below 6 years of age and etiology is unknow most of the time [2]. The constricting hair ring typically becomes lodged at balanoprepucial sulcus (BPS), which is a deep anatomical groove that holds the hair or thread in place [3,4]. This condition is exceedingly rare in uncircumcised boys, as the prepuce covers the BPS. Most injuries are accidental but some cases of deliberate hair tying around the penis to manage urinary incontinence and few cases of abuse have also been reported [5, 6]. Management of PHTI requires awareness of this rare clinical entity, maintaining a high clinical index of suspicion, meticulous inspection of the affected area with magnification, examination under general anesthesia, and timely intervention to prevent the occurrence of severe complications [7]. Early removal of the hair coil is crucial to prevent urethral damage and glandular necrosis [8, 9]. The aim of this study is to share our insights and expertise regarding this uncommon condition in children and report the outcomes of our own surgical technique.

Methods & Materials

We conducted review of data involving 30 cases of Penile Hair Tourniquet Injury who received treatment at the Pediatric Urology Department, Children Hospital and University of Child Health Science, Lahore, starting at Jan. 2017 to Dec. 2023. This study is approved by the Institutional Review Board under the reference number No/730/CH-UCHS. The data was recorded on a predesigned proforma. The variables of our study were, clinical presentation, grade of injury, outcome of surgical intervention and complications. Data was analyzed by SSPS 21. All patients who presented with acute condition underwent removal of tourniquet at clinic or in the operating room under general anesthesia in those children who were non cooperative. The tourniquet removed, was mostly the bunch of hair or thread. Subsequently, the children underwent re-examination at 6 to 8 weeks later and graded on bases of grading system which was proposed by Harouchi and Bashir et al, as outlined in Table 1 [10, 11].



Condition at first presentation (Figure-1)

Table 1: Causes of Hair Tourniquet injury

Causes	Number (Percentage)
Unknown	19 (63.3%)
Nocturnal enuresis	06 (16.6%)
Post circumcision bleeding	01(3.3%)
Jealously/abuse	04 (13.3%)

Table 2: Classification of degree of the penile injury

Type	Features
Grade I	Superficial skin injury without a urethral injury.
Grade II	Partial transection of corpus spongiosum with urethrocutaneous fistula
Grade III	Complete transection of corpus spongiosum and constriction of the corpus cavernosum.
Grade IV	Gangrenous of the glans penis with or without amputation of glans.

Table 3: Causes of Hair Tourniquet injury

Causes	Number (Percentage)
Unknown	19 (63.3%)
Nocturnal enuresis	06 (16.6%)
Post circumcision bleeding	01(3.3%)
Jealously/abuse	04 (13.3%)

Table 4: Classification of the degree of penile injury

Type	Features
Grade I	Superficial skin injury without urethral injury.
Grade II	Partial transection corpus spongiosum with urethrocutaneous fistula.
Grade III	Complete transection of the corpus spongiosum and constriction of the corpus cavernosum.
Grade IV	Gangrenous glans with or without auto amputation.

Table 5. Clinical Presentation of Penile Hair tourniquet injury.

Grade of injury	Number	Percentage %
Grade 2 injury	20	66.6 %
Grade 3 injury	10	33.3%
Grade 1 & 4 injury	0	0

Table 6. Complications after surgical intervention.

Outcome	Grade II	Grade III	Total
Number of patients	20	10	30
Successful surgery	19	9	28 (93%)
Fistula	1	1	2 (7%)
Persistent constriction ring	0	0	0%
Stricture	0	0	0%

Children with those of superficial skin injury were treated conservatively after the removal of the hair tourniquet with care of local wound, utilizing antibiotics and anti-inflammatory medications. After the removal of the hair tourniquet, the decision to perform surgical intervention was delayed for at least 03 months [14]. The repair process followed general principles for these cases. In grade 2 injuries, a complete release of the constriction ring involved dorsal dissection, excision of whole fibrous/scared tissue , margin dissection of the fistula, edge trimming and transverse closure of the urethral defect using interrupted 6/0 PDS suture. The penis was degloved, the glans split on the ventral side, and a second layer of coverage with a skin and subcutaneous tissue flap to the urethral suture line was performed. The flap was advanced between the open wings of the split glans. For children with grade 3 injuries, dissection around proximal and distal ends of urethra and corpus spongiosum was conducted, followed by direct end-to-end anastomosis of both end of urethra by using interrupted 6/0 PDS suture, encompassing both the spongiosum and urethra. The glans was then reunited to the corpus cavernosum with PDS 5/0. Dressings were maintained for 1 week, and the urethral catheter was removed on the 10th postoperative day, followed by wound care using polymyxin B topical ointment .



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Patient followed in the outdoor clinic at 1 months, 3 months, 6 months, and then yearly. Parents were given instructions on wound care and were asked to observe the child's urinary stream. During each visit, a thorough evaluation of the wound was performed, and parents were requested to provide a video of the child's voiding to assess the urinary stream. The successful repair was determined by achieving a proper urinary flow from external urethral meatus at the tip of the glans and attaining an excellent cosmetic appearance with no evidence of a constriction ring.

Results

The data were statistically describe by using mean value \pm standard deviation for age, median (range) for the time between onset of symptoms and presentation and number (percent) for categorical variables. Statistical analysis was conducted using SPSS 21. The total number of patients were 30 in our study. The mean age of patients was 4.43 year with standard deviation value of \pm 2.5 years. The time interval between the onset of symptoms and presentation was roughly estimated to be 1-4 weeks, as the exact onset was usually unnoticed by the parents. The mean follow up period for the patients was 22.5 ± 8.65 months, ranging from 6 to 36 months.

Table 3. Clinical Presentation of Penile Hair tourniquet injury.

Grade of injury	Number	Percentage %
Grade 2 injury	20	66.6 %
Grade 3 injury	10	33.3%
Grade 1 & 4 injury	0	0

All children included in the study had undergone previous circumcision and had normal looking external urethral meatus at glans. Not a single boy had any neurological diseases, but 6 boys had a history of nocturnal enuresis. The parents of 4 children believed that someone had tied these hairs, raising suspicion of abuse in these cases. One child had a history of a tie to control bleeding after circumcision performed by a quack (Table.2). On the day of presentation, hair coils were removed in the outdoor clinic for 22 boys (73%), while 8 boys (27%) were too anxious and tuft of hair or thread were deeply buried, requiring removal under general anesthesia in the operating room as a day case. No urinary diversion catheter was placed at the time of presentation. Of the total, 20 boys (66%) had partial transection of the penile urethra, while ten boys (33%) had complete transection of the penile urethra (Table 3). Surgical repair was required for all boys and the procedure was delayed for atleast 3 months from the initial time of presentation. All patients underwent a single-stage repair, as described previously, over a silicone catheter/stent, which was kept for atleast mean period of 9 ± 1.5 days for grade II and grade III injuries.

Table 3. Post surgical intervention complications.

Outcome	Grade II	Grade III	Total
Number of patients	20	10	30
Successful surgery	19	9	28 (93%)
Fistula	1	1	2 (7%)
Persistent constriction ring	0	0	0%
Stricture	0	0	0%

Out of the 30 children, 28 (93%) had a satisfactory functional and cosmetic outcome, while 2 (7%) developed urethra-cutaneous fistulae that were repaired six months later. During the follow-up period of 6 to 36 months, all patients demonstrated good penile length with a wide urethral opening at the tip of the glans, which was highly satisfactory for the parents. None of the patient in our study developed anastomotic stricture. The success rate after the primary surgical intervention was 93% (Table 3). It is important to note that there were no patients with grade I and grade IV injuries in this study.

Discussion

PHTI is a clinical phenomenon involving the circumferential strangulation of the penis by the human hair or thread. The injury mechanism begins with the impairment of lymphatic flow, followed by obstruction to venous outflow, and then the impairment of arterial inflow [2]. Various terms, including constrictive band injury, hair-thread tourniquet syndrome, penile strangulation injury, and penile hair coil strangulation, have been used in the literature [1, 17, 21, 24]. PHTI is an uncommon condition and is often overlooked due to factors such as very thin hair, severe edema and swelling of glans penis, or a lack of awareness about this entity among primary health care providers, including pediatricians and emergency pediatric physicians [12, 22]. The acute condition of Penile Hair Tourniquet Injury (PHTI) should be treated as a surgical emergency, requiring immediate intervention. Early diagnosis of PHTI and rapid initial treatment are crucial in preventing serious complications. However, many children often present with urethrocutaneous fistula (grade 2), and a few cases involve complete transection of the corpus spongiosum (grade 3). Surgical repair is typically recommended for the more severe cases of penile injury, specifically grade 2 and above. The etiology of Penile Hair Tourniquet Injury (PHTI) is often unknown, but it is commonly accidental. In some cases, there may be voluntary tying for the treatment of conditions such as nocturnal enuresis or spiritual healing. [2,5,6]. Child abuse or obsessive behaviors could be potential causes, particularly in

young children or if there is evidence of a knot on the constrictive agent [20]. Differential diagnoses for PHTI include infection, dermatitis, insect bites, trauma, or congenital constriction bands (23). In this study, we suspected child abuse in four boys and nocturnal enuresis was reported in six children but could not find any reason in the remaining 19 boys. Patients with Grade II, III, and IV require surgical repair, and different approaches has been reported in the literature. Dikshit et al. described Urethral Advancement and Glanduloplasty Incorporated Procedure (URAGPI), in which the proximal urethra was mobilized up to three times the length of the distance between the neo-meatus and corona. The advantages of URAGPI include a lower incidence of fistula and diverticula formation, as well as good cosmetic results. (13) This is similar to Koff's technique of urethral mobilization in distal hypospadias [18, 19] The described technique by Dikshit et al., known as URAGPI has certain disadvantages including the potential development of chordee, glandular disruption, meatal retraction, or stenosis. We were not convinced to discard the normal distal glandular urethra as mention in above study and to do unnecessary dissection of the penile urethra in very young boys. We didn,t mobilize the urethra instead we did the transverse closure of the fistula or urethra and covered the suture line with the advancement of a full-thickness skin flap along with dartos which helps to prevent the formation of fistula and stricture. AbouZeid et al. deccribed a delayed single-stage repair involving three layers (urethra, dartos, and skin) in 16 children with 100 percent success rate [14]. The choice of surgical technique mostly depends on the severity of the injury and the surgeon's preference. In a multi-center study of 25 cases, Badawy et al. described single-stage repair by spatulation and end-to-end anastomosis of penile urethra, reinforced by a second layer vascularized dartos flap and closure of the overlying skin was done with the lower edge of the glans penis with 84% success rate and reported complications (16%) were stricture and fistula. An onlay dartos base local penile skin rotation flap was also used in children with grade III injuries [1]. Kirtane et al. described an approximation of both ends of the urethra, shaft, and glans over silastic stents without any suture with in good result but in a series of only seven patients [17]. Harouchi et al. reported the largest series of 38 patients and have suggested a two-stage repair for severe degrees of tourniquet injuries by reinforcing the nearly totally amputated glans with corpus cavernosum first followed by urethroplasty later on [10]. We did successful one stage repair in 10 children with grade III (partially amputated) injuries. Another study by J. Qamar et al. involved a simple fistula repair and advancement of the skin flap up to the glans in 12 patients with the development of a fistula in one patient [16]. In our study, we repaired grade II and grade III injuries with urethral approximation and advancement of the skin/dartos flap into split glans wings with 93% success rate and excellent cosmetic outcome. We found fistula formation in 2 (7%) children which were closed successfully later on. We believe that the advancement of normally innervated skin into the glans, not only to prevent fistula formation but also to potentially improve the vascular supply and sensations of the glans [16].

Conclusion

Split glans & advancement flap is a good choice for repair of such ischemic injuries of penis which provides a healthy vascular cover to repair and blood supply to glans as well. Mother and general pediatrician should be educated about this

preventable injury, which is usually missed by lack of awareness.

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Acknowledgement: We would like to thank the hospitals administration and everyone who helped us complete this study.

Disclaimer: Nil

Conflict of Interest: Nil

Funding Disclosure: Ni

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