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PENILE INCARCERATION WITH METALLIC RINGS: OUR EXPERIENCE IN TERTIARY CARE CENTRE OVER 6 YEARS

Urology

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ABSTRACT

INTRODUCTION: Penile incarceration injury is an uncommon surgical emergency. The aim is to analyze the management of cases of penile incarceration injuries in relation to grade of trauma, duration of onset of incarceration, technique of removal and outcome of each case.

MATERIALS AND METHODS: This is a retrospective study of 8 patients of penile incarceration injury by encircling metallic objects. Proper history, duration of injury, type and dimension of metallic object, injury grading, and techniques of removal and postoperative complication of each case were analysed.

RESULTS: We used string technique and its variants, manual cutting of ring, aspiration of blood from corporal bodies and surgical techniques to remove the offending objects.

CONCLUSION: Grades 1–3 can be treated with the string technique, aspiration and cutting techniques. Cutting devices have been used for all grades of injuries. The presence of devitalized tissue, in grade 5 and possibly grade 4 trauma, requires degloving and skin grafting if necessary.

KEYWORDS

Penile incarceration injury, Metallic rings.

INTRODUCTION

Penile incarceration injury is an uncommon emergency which occurs due to strangulation by a metallic or non metallic encircling object. Incarceration injury of penis from metallic or non metallic object was first reported in 1775 [1].

Different strangulating objects like wedding ring, metal plumbing cuff, bull ring, hammer- head, spare parts of vehicle and plastic bottle neck have been described [2] .

The motives reported for placing an incarcerating object in adult population are attempt at enhancement of sexual performance, psychiatric disorders and attempts to treat erectile dysfunction [3].

Penile incarceration injuries are surgical emergencies that require urgent decompression to avoid potential complications including ischemic necrosis, sexual dysfunction, impotency and even amputation [4][5] .

The method of removal from penis depends on the type and size of the object, time of onset of incarceration, grade of trauma, and equipments that are available in the operation theatre [4]. No single surgical manoeuvre can be considered appropriate for all cases. Reports of removal of these objects using different saws, cutter, string technique and other motorized equipments have been reported [2][6][7].

The aim of this study is to analyze the management of cases of penile incarceration injuries in relation to grade of trauma, duration of onset of incarceration, technique of removal and outcome of each case and review with the related available literature.

MATERIALS AND METHODS :

We performed a retrospective study of 8 patients of penile incarceration injury by encircling metallic objects, which had been treated in the Dept of Urology, Gauhati Medical College Hospital, a tertiary care institute, from January 2011 to September 2017. A thorough history to ascertain the cause, any pre-existing psychiatric illness, predisposing factors leading to such an event and duration of injury had been noted.

We examined these patients, noted their age, marital status, duration of incarceration, graded the trauma according to the grading scale by Bhat et al [8] , and reviewed the technique of removal of ring, duration of surgery, time of recovery and complications. Local examination to assess the viability of the skin and tissue distal to the constricting ring, temperature, colour of the skin, sensation of skin, ability to void, viability of skin underneath the constricting ring, were promptly assessed and injuries were graded according to grading by Bhat et al (Table 1). Penile Doppler was done to assess the vascularity of the penis distal to constriction. After giving analgesics and tetanus prophylaxis, Foley's catheter was given. Various techniques of removal were used and all patients had been operated under spinal anaesthesia. We evaluated results of surgery, complications and outcomes.

Table 1 : Grading of penile incarceration injury

Grading scales for penile incarceration injury		
	Penile Injury Grading System (Bhat et al)[8]	**Revised Grading System (Silberstein et al)[9]**
Grade	Injuries	
1	Oedema of distal penis. No evidence of skin ulceration or urethral injury	Low grade Injuries
2	Distal oedema, skin and urethral trauma, compression of corpus spongiosum and decreased penile sensation	

3	Trauma to skin and urethra, no distal sensation.	
4	Corpus spongiosum separation, presence of urethral fistula, corpus cavernosum compression, no distal sensation.	**High Grade Injuries**
5	Gangrene, necrosis, or complete amputation of distal penis	

RESULTS

The age of patients presented varied from 18 years to 44 years with average age of presentation 30 years. Duration of presentation varied from 12 hours to 240 hours (10 days). Average time of presentation was 45.2 hours (Table 2).

Seventy five percent of patients had sexual gratification and 25% had treatment of erectile dysfunction as motive behind placement of ring. 50% of patients had psychiatric illness (Table 2).

Internal diameter of the metallic objects varied from 2 cm to 3.8 cm. Average internal diameter was 2.7cm (Table 3).

Out of 8 patients 1 had grade 4 injury, 2 patients had grade 3 injury, 4 patients had grade 2 and 1 patient had grade 1 injury (Table 3).

Table 2 - Patient profile and history

Sl No (patient)	Age (Yrs)	Motive	Applied by	Marital Life	Mental Life
1	24	SG	Self	UM	NORMAL
2	18	SG	Self	UM	PSY
3	35	ED	Self	M	PSY
4	36	SG	Self	UM	PSY
5	28	SG	Self	M	NORMAL
6	44	ED	Self	UM	NORMAL
7	26	SG	Self	UM	NORMAL
8	29	SG	Self	UM	PSY
SG –self gratification ; ED – erectile dysfunction ; UM – unmarried ; M- married ; PSY – ongoing psychiatric treatment or h/o psychiatric illness					

Table 3 - Object used; Dimension; time of presentation; grade of injury; technique of removal; procedure time; complications

Sl no (patient)	OBJECT	DIMENSION (ID –internal diameter)	TIME OF PRESENTATION (HRS)	GRADE OF INJURY	TECHNIQUE OF REMOVAL	PROCEDURE TIME	COMPLICATIONS
1	Metal Ring	ID 3.8 cm	12	1	Degloving, Aspiration, Warm Compression	30 min	Nil
2	Metallic Nut	ID 2.2cm	36	3	Manual Cutting, Aspiration	25 min	Hyperesthesia
3	Metallic Nut	ID 2.7cm	24	2	Degloving, Aspiration, Warm Compression, String Technique	40 min	Nil
4	Finger Ring	ID 2 cm	144	4	Manual Cutting, Excision Of Necrotic Skin, Suprapubic Catheterisation	60 min	Skin necrosis, urethrocutaneous fistula Erectile Dysfunction
5	Metal Ring	ID 3 cm	24	2	Degloving, Aspiration, Warm Compression, String Technique	44 min	Parasthesia
6	Metal Ring	ID 2.7cm	14	2	Degloving, Aspiration, Warm Compression, String Technique	45 min	Nil
7	Metal Ring	ID 2.8cm	36	2	Degloving, Aspiration, Warm Compression, String Technique	50 min	Parasthesia
8	Metallic Nut	ID 2.5cm	72	3	Manual Cutting, Aspiration	30 min	Skin necrosis Erectile Dysfunction

All the patients were operated under spinal anaesthesia. The technique applied depended on grade of penile incarceration, its duration of presentation and type of object used. We performed the following procedures in the below mentioned grades of injury.

Grade 1 injury: A 36-year-old healthy male presented with swelling over penis after application of a metallic ring over base of his shaft at 12 hours. On examination a metallic ring of 0.5cm thick and 3.7 cm internal diameter was placed over the base of penis. The penis distal to ring was grossly oedematous with hyperesthesia, with cyanotic discoloration with subnormal temperature. Skin was intact and patient was able to void but with difficulty. No attempts were done to manually remove the ring over the skin as it could lacerate the skin or urethra. A circumferential incision was made over the coronal sulcus and penis was degloved. The oedematous skin was decompressed by squeezing out the tissue fluid. As oedema subsided, the ring was slipped off slowly. After removal of the object, warm moist saline packs were applied. Temperature and colour of skin became normal. The coronal incision was closed and catheter was placed. Patient could void next day after removal of catheter. Patient was discharged on 2nd day. On follow up at 1 month and 3 months, he had normal voiding and with normal erection.

Grade 2 injuries: Four patients presented with grade 2 injuries. Two of them presented at 24 hrs, one at 14 hrs and another at 36 hrs. On examination there was distal oedema, skin and urethral trauma at the site of application of ring with corpus spongiosum compression and decreased penile sensation. However there was no breach in the urethra. As there were no instruments to cut the ring at operation theatre during late night we tried the above mentioned technique using circumcoronal degloving incision. However it failed due to excessive oedema. String technique was then tried by using drip set tubing in one case and umbilical tape with glans aspiration in three cases. This technique was successful with all the four patients with grade 2 injuries. Post operatively wound healing was good and patient voided well however there was slight pain in 2 patients in penile urethra during voiding. On follow up at 1 month and 3 months, the patients who presented earlier at 14hrs and 24hrs had normal voiding and with normal erection. However there was erectile dysfunction in the patient who presented late.

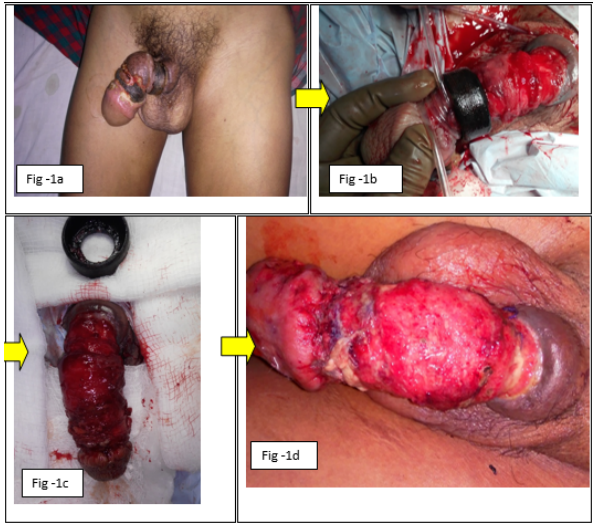

Figure 1 : *1a - Ten days old Grade 3 penile incarceration injury ; 1b - Excision of necrotic skin; then using string technique (IV drip set) to remove the ring; 1c - Penis after removal of ring by string method; 1d - Postoperative 5th day; Split skin graft was done after 2 weeks*

Figure 2 : *2a - Grade 3 penile incarceration injury; 2b - Using Bard Parker knife handle as shield to avoid tissue injury; 2c - Opening the ring using heavy forceps without cutting on the opposite side (this can be done only when the ring thickness is less); 2d - Ring removed after cutting with hack saw. Loss of epidermis of penis can be seen*

Figure 3 : Grade 4 penile incarceration injury (however urethra was intact)

Grade 3 and Grade 4 injuries : Two patients presented with grade 3 injury (Fig-1) with skin and urethral trauma but no distal sensation and one patient presented with grade 4 injury (Fig-3) with separation of corpus spongiosum , urethral fistula, corpus cavernosum compression but no distal sensation. The grade 3 injuries presented at 36hrs and 72hrs and the grade 4 injury presented at 244 hours (10 days). Due to increased thickness and less internal diameter of the rings the attempts at removal by corporal aspiration and string methods failed desperately. The rings were cut opened by using steel hack saw blade. In two cases urethrocutaneous fistula were present with necrosis of distal penile skin. Suprapubic catheterisation was done and the fistula was allowed to heal. Regular debridement was done in the necrosed area. Split skin graft was then placed. End to end urethroplasty was done after 8 months. The patient had decreased erectile function with no morning erections.

DISCUSSION

Penile incarceration injuries by constricting devices are rare with only a few cases reported in literature [10]. Autoerotism is the most common cause of such application of penile rings [11].

The placement of metallic rings over the flaccid penis results in venous congestion that augments penile length and girth. However, prolonged application of such devices leads to development of penile compartment syndrome. Initially there is venous and lymphatic obstruction to outflow distal to the ring and later there is arterial inflow obstruction which results in tissue ischemia and necrosis [10].

There is wide variation in time of presentation various literature ranging from three hours to 1 month [12][6] .

Bhat et al. categorised penile incarceration injury into grade 1 to grade 5 as mentioned in table 1 [8]. Silberstein et al. presented a revised and simpler grading system for penile incarceration injuries in which injuries were classified into low and high grade injuries which corresponded to grade 1-3 and grade 4,5 respectively as mentioned in table 1 [9] . Low grade injuries requires no further intervention most of time after removal of constricting device, while high grade injuries often required surgical intervention.

Non-metallic objects, although can easily be removed by cutting the constricting device caused the most severe injuries [77.7 % of high-grade injuries]. On the other hand, it is difficult to remove metallic objects even if caused less of high grade injuries [22.22% of high grade injuries] [9][11]. In children the constricting band may be a thread or hair which may be buried in oedema. Therefore one should look for a constricting band in if there is penile oedema [13].

When patient presents with grades 1–3, the challenge is to remove the device without damaging the oedematous tissue, before the onset of gangrene [6] .

Urinary retention has to be attended first. A Foley catheter is recommended for grades 1 and 2, while suprapubic catheterization is recommended for grades 3–5 trauma [14][8] .

Follow-up imaging is necessary to rule out urethral strictures after removal of the constricting device and also after urethroplasty [14].

Techniques of removal of the constricting device are divided into four categories. They are string techniques with or without aspiration of blood from glans and corpora, cutting techniques, aspiration techniques, and surgical techniques [6][11].

Table 4 : String techniques and its variants

Author	Object	Size	Grade	Incarceration time (hrs)	Technique
Bucy et al [1968][15]	Ball Bearing	2cm ID	2	8	Cord, glans aspiration
Browning and Reed [1969][16]	Metal Ring	UKN	3	3	Umbilical tape, glans drainage
Rana and Sharma [1994][17]	3 Washer	UKN	1	14	String, glans drainage
Detweiler et al (2001)[6]	Steel bushing	UKN	1	18	Wrapping technique
Shukla et al [2014][11]	Metal nut Metal ring	ID 2cm ID 2.5cm	3 2	168 20	Tape gauze Desloughing, glans apiration
Present study	Metal ring Metal ring Metal ring Metal ring	ID 2.7 cm ID 3 cm ID 2.7 cm ID 2.8 cm	2 2 2 2	24 24 14 36	Umbilical tape Drip set Drip set Drip set
UKN – unknown ; ID – internal diameter					

String techniques and its variants (Table 4): In 1968, Bucy was the first to utilize the string technique to remove metal ball bearing device from an incarcerated penis [6].

A string is passed proximally beneath the ring and the string is wrapped tightly over the shaft upto glans. The proximal part of the string is released so that the ring is lifted and pushed forward over the tightly wrapped penis repeatedly till the ring is out of penis. [18] [17] [11]. Such techniques are feasible for grade 1-3 category injuries [6][19][17]. Different material have been used so far as string such as thread, suture [18], umbilical tape[16] and intravenous drip [20].

In present case series, string technique was used in four cases, 3 with intravenous drip set and 1 with umbilical tape soaked in Vaseline. In our experience string technique is an effective and safe for removing metallic devices from incarcerated penis in low grade injuries.

Table 5 - Manual cutting devices					
Author	Object	Size	Grade	Incarceration Time	Cutting Tool
Bhat et al. (1991)[8]	Metal ring	0.3 cm thick	2	4 days	Saw
	Metal nut	0.5 cm thick	3	8 days	Hammer, chisel
	Metal nut	0.5 cm thick	3	5 days	Saw
Meadoff et al (1995)[21]	Steel band	UKN	UKN	UKN	Hacksaw
Chakarbarty & Das (1976)[22]	Steel pipe	UKN	2	8 h	Steel cutting saw
Tiwari et al. (1977)[23]	Iron nut	0.7 X 1.0 cm	2	15 days	Saw
Present series	Metallic nut	2.2cm	3	36h	Hack saw*
	Finger ring	2 cm	4	24h	Hack saw*
	Metallic nut	2.5cm	3	72h	Hack saw*
ID - internal diameter ; * with other techniques					

Cutting devices : There are broadly two types of cutting devices used, they are electric and non electric (table 5). The type of equipment used depends on the equipment available, size/ thickness of metallic object, and grade of penile injury.

Various authors have used hammer and chisel [8] ; hand saw [24] [8]; Dremel Moto-tool [5] [25], circular orthopedic saw with diamond teeth [26]; heavy drills [8]; and hack saw [27].

Shielding device should be used between the cutting device and shaft to avoid inadvertent injury to tissue. Various shielding device used are selected laryngoscope blade [9], tongue depressor [28] and wooden tongue [21].

Mechanical stresses of sawing and drilling can cause superficial thermal burns that are obviated by cool water irrigation [25] [8] [26], water sprays [5] or atomizer water mist [29].

The metal is either cut with two divisions around 180° apart [25] [26] or with one cut and scoring of the opposite side, followed by bending the ring by an expander tool and releasing it sprays [5].

Low grade injuries can be treated by this technique, provided suitable cutting tools are available. In the present series, we used steel cutting hack saw manually in three cases as drilling devices were not available in the casualty department. We cut the rings at 12' clock and scored at 6'clock then bended the ring using heavy forceps. We used Bard Parker's knife handle as shielding device. We used manual cutting in grade 3 and 4 injuries.

Table 6 – Aspiration techniques					
Author (date)	Object	Size	Grade	Time of incarceration	Removal technique
Sinha et al (1988)[30]	Iron nut	1.5 x 2.0 cm	2	8 h	Aspiration 66 ml blood
Punekar et al. (1978)[27]	Hammer head	1.5 cm thick	3	14 h	Needle punctures with expression of lymph
Shukla et al (2014)[11]	Metal Bearing	3.5 cm ID	1	6h	Aspiration
Present study	metal ring	ID 3.8 cm	1	12	Aspiration*
	metallic nut	ID 2.2cm	3	36	Aspiration*
	metallic nut	ID 2.7cm	2	24	Aspiration*
	finger ring	ID 2 cm	4	240	Aspiration*
	metal ring	ID 3 cm	2	24	Aspiration*
	metal ring	ID 2.7cm	2	14	Aspiration*
	metal ring	ID 2.8cm	2	36	Aspiration*
	metallic nut	ID 2.5cm	3	72	Aspiration*
* with other techniques; ID – internal diameter					

Aspiration of blood and lymph from swollen penis can be done by either single puncture by wide bore needle 16G or multiple punctures [6] [27]. It can be used either alone in low grade injuries who have presented early or can be combined with other techniques. Sinha et al aspirated a total of 66ml of blood from the shaft and glans bilaterally to achieve detumescence by using a wide bore 18-gauge needle with a 20 ml syringe [30]. In this series we did aspiration by multiple puncture in corporal bodies at base and at glans in all the cases, as the initial manoeuvre to attempt removal of ring.

Table 7 – Surgical techniques;					
Author	Object	Size	Grade	Time of incarceration	Removal technique
Wasadikar et al (1997)[12]	Metal ring	1.4 cm ID	2	30 days	Excision to corpus cavernosum
Klein & Smith (1987)[14]	Ball bearing	UKN	5	7 days	Excision to Buck's fascia
Shukla et al (2014)[11]	Metal Bearing	2.5 cm ID	2	18hrs	Wide excision of affected skin and reapproximation
Present study	metal ring	ID 3.8 cm		12	Degloving, Aspiration, Warm Compression
	metallic nut	ID 2.7cm		24	Degloving, Aspiration, Warm Compression, String Technique
	metal ring	ID 3 cm		24	Degloving, Aspiration, Warm Compression, String Technique
	metal ring	ID 2.7cm		14	Degloving, Aspiration, Warm Compression, String Technique
	metal ring	ID 2.8cm		36	Degloving, Aspiration, Warm Compression, String Technique
ID – internal diameter					

Surgery : The technique of doing dorsal slit, removal of oedematous preputial skin or then incision over coronal sulcus and degloving, retrieval of ring and subsequent approximation of the coronal incision can be used in grade 2-3 injuries. Split skin grafting can be done if defect is large due to skin excision simultaneously or later [31][32]. In case of delayed presentation with necrosis, extensive debridement is necessary with or without skin grafting at a later date. Partial or total amputation may be necessary in case of gangrene of the penis [31].

Baruah et al. described an innovative technique using circumcoronal incision, degloving the penis and removing a heavy metallic ring in higher grade penile incarceration injury cases [33]. In this series dorsal slit, circumcoronal incision, degloving and retrieval of ring had been done in 5 cases with grade 1-2 injuries.

Penile incarceration injuries may present with early or late complications. Urinary retention, urethral fistula , urethral stricture , skin ulcerations ; decreased or loss of penile sensation, gangrene of penile skin and subcutaneous tissue , gangrene of penis and priapism [8] [5][9].

In our series, skin necrosis was found in one patient with grade 3 injury and a urethrocutaneous fistula in grade 4 injury patient.

Follow up is necessary in cases of penile incarceration injury in form of physical examination, penile Doppler, micturating cystourethrogram, uroflowmetry and psychiatric evaluation.

Conclusion

Penile strangulation is an unusual clinical condition. Early recognition of the injury and urgent decompression of involved tissue by removing encircling object are required to prevent potential complication. In this study, we have treated the patients by using various techniques for removal of the offending metallic rings. We noticed that longer the time of presentation the higher the grade of trauma and the greater the risk of devitalized tissue. We have found that grades 1–3 can be treated with the string technique, aspiration and cutting techniques. Cutting devices have been used for all grades of injuries. The presence of devitalized tissue, in grade 5 and possibly grade 4 trauma, requires degloving and skin grafting if necessary. Although such penile incarceration injuries are rare in literature and presentation is usually late, prompt identification of grade of injury, early removal of the offending device and appropriate postoperative care and follow up care salvage the penis.

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