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Original Article

War Injuries of External Male Genitalia: A Prospective Single-Center Study from the General Military Hospital, Sana'a, Yemen (2022–2024)

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ABSTRACT

Background: War-related external male genital injuries are uncommon but clinically significant, often coexisting with severe pelvic, vascular, and musculoskeletal trauma and causing potential long-term functional, cosmetic, and psychological effects.
Methods: This prospective, single-center study at the General Military Hospital, Sana'a, Yemen, included all consecutive male patients presenting with war-related external genital injuries from April 2022 to March 2024. Minor isolated injuries were managed in the emergency department, while severe or associated injuries required admission. Data collected included injury mechanism, management, complications, and short-term outcomes. Primary outcomes were injury patterns, management strategies, and one-month clinical outcomes. Secondary outcomes included complications, erectile function, cosmetic acceptability, and semen analysis at one month.
Results: Fifty-two patients (mean age 23.3 ± 4.9 years) were included. Penetrating trauma occurred in 44 (84.6%) and blunt trauma in 8 (15.4%). Penile injuries were seen in 16 (30.8%) and testicular injuries in 46 (88.4%). Isolated genital injuries occurred in 20 (38.4%), with 32 (61.5%) having associated injuries. All patients underwent surgery for penetrating wounds, large hematomas, or hematoceles. At one-month follow-up, early complications occurred in 12/52 patients, including wound infections (15.4%) and urinary tract infections (7.7%). Of 42 patients completing investigations, semen analysis was normal in 71.4%, and 28.6% had abnormal semen parameters. Late complications included testicular atrophy (33.3%), erectile dysfunction (4.8%), and post-operative penile curvature (4.8%).
Conclusion: Prompt assessment and timely surgical management are essential. While most patients had satisfactory short-term outcomes, a notable proportion experienced complications, highlighting the need for structured protocols and longer follow-up.

1. Introduction

Genital injuries are clinically significant due to their frequent association with major pelvic and vascular trauma from both blunt and penetrating mechanisms, as well as the potential for chronic impairment following penile and scrotal injuries [1]. While injuries to the external genitalia are rarely life-threatening on their own, they are often accompanied by other potentially fatal injuries to the abdomen, pelvis, or groin [2]. Traumatic injuries to the genitourinary (GU) tract occur in 2.2–10.3% of hospitalized trauma patients, with external genital injuries accounting for one-third to two-thirds of these cases [3]. Approximately 70% of GU injuries in combat settings involve the external genitalia, representing up to 5% of all military-related trauma [4, 5, 6]. GU trauma occurs across all age groups but is most common in males aged 15–40 years, with 5% of cases occurring in children under ten years of age [7].

The testes, scrotum, and penis are vulnerable to both blunt and penetrating trauma. Testicular injuries may range from contusions to ruptures, while scrotal trauma often involves deep lacerations, burns, or avulsions. Penile injuries include fractures (rupture of the corpus cavernosum), amputations, strangulation, or bite-related injuries, as well as missile injuries [8].

Because trauma predominantly affects young individuals, injuries to the external genitalia can profoundly impact health-related quality of life, compromising urinary function, sexual performance, fertility potential, cosmetic appearance, and psychological well-being [9].

In Yemen, the ongoing conflict over the past decade has led to a notable increase in war-related male genital injuries, primarily from gunshots, explosions, and blast injuries. However, there is a scarcity of data on the epidemiology, management, and short-term outcomes of these injuries in low-resource, conflict settings. Aim: This study aimed to evaluate the mechanisms, types, and anatomical distribution of war-related external genital injuries, associated injuries, management strategies, and short-term clinical outcomes,

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including complications, sexual and reproductive function, and cosmetic results.

2. Patients and Methods

This prospective, single-center study was conducted at the General Military Hospital, Sana'a, Yemen, from April 2022 to March 2024. The study included all consecutive male patients presenting to the emergency department with war-related external genital injuries.

Inclusion criteria were males of any age with war-related external genital trauma. Exclusion criteria included non-war-related injuries, previous genital surgery, or incomplete clinical data.

Data collected included patient demographics, injury mechanism (penetrating vs blunt), anatomical site, associated injuries, time from trauma to hospital presentation and surgery, management approach, intraoperative findings, hospital stay, and follow-up outcomes. Patients were examined systematically, including the penis, scrotum, and perineum, documenting penetrating injuries, scrotal swelling, or hematomas.

2.1. Management

Mild isolated injuries were treated conservatively in the emergency department with local wound care. Surgical intervention was performed for penetrating injuries, large hematomas, or urethral involvement. Urethral injuries were managed with urethral catheterization or suprapubic cystostomy following preoperative retrograde urethrogram. Scrotal ultrasound and Doppler were selectively performed to evaluate testicular integrity and perfusion. Standard laboratory investigations included CBC, kidney and liver function tests, urinalysis, and urine culture.

2.2. Follow-up

One month after injury, patients underwent semen analysis to assess post-traumatic reproductive function. Evaluation followed standard laboratory protocols and included assessment of semen volume, sperm concentration, motility, and morphology. This timing allowed stabilization of acute post-injury changes and provided an initial assessment of fertility-related outcomes following management of external genital trauma. Outcomes were classified as "excellent" (good wound healing, satisfactory cosmetic appearance, preserved sexual function) or "unfavorable" (significant complications such as testicular atrophy, abnormal semen parameters, erectile dysfunction, or penile deviation). All patient information, including injury details, course of treatment, and follow-up findings, was recorded on a specifically designed data collection sheet.

2.3. Statistical analysis

Only descriptive statistics were used, with percentages and means calculated for all variables. This study represents a consecutive series of eligible patients; no formal sample size calculation was performed.

3. Results

3.1. Epidemiology

During the study period, 52 patients with external genital injuries were admitted to the urology department **(Table 1)**. All patients were male, with a mean age of 23.3 ± 4.9 years (range: 10–32 years). Most patients were aged 20–29 years (38/52, 73.1%). Thirty patients (57.7%) were single, and 22 (42.3%) were married.

Table 1: Demographic characteristics and Mechanism of Injury

Category	Subcategory	Frequency	Percentage%
1. Age category	<20 years	10	19.2
	20-29 years	38	73.1
	30-39 years	4	7.7
2. Marital status	Single	30	57.7
	Married	22	42.3
Mechanism of Injury	Blunt: RTA, Fall astride	8	15.4
	Penetrating:	44	84.6
	Gunshot, Stabbed,	20	38.4
	Shells (explosive devices)	24	46.2

RTA, Road Traffic Accident; n, Number of participants.

Penetrating trauma was the predominant mechanism, occurring in 44 patients (84.6%). Injuries caused by explosive devices accounted for 24 cases (46.2%), while gunshot or stabbing injuries occurred in 20 cases (38.4%). Blunt trauma was observed in 8 patients (15.4%) **(Table 1)**.

3.2. Types and Distribution of Genital Injuries

Scrotal injuries were identified in 44 patients (84.6%), penile injuries in 16 patients (30.8%), and testicular injuries in 46 patients (88.5%). Testicular injuries involved the right testis in 12 patients (23.1%), the left testis in 20 (38.5%), and were bilateral in 14 patients (26.9%) **(Table 2)**.

3.3. AAST Injury Grading

According to the AAST classification, most scrotal injuries were Grade II (32/44, 72.7%). Testicular injuries were most commonly Grade I (16/46, 34.8%) and Grade V (14/46, 30.4%). Penile injuries were predominantly Grade II (12/16, 75.0%) **(Table 2)**.

3.4. Associated Injuries

Concomitant injuries were present in 32 patients (61.5%). Femoral–pelvic fractures were the most frequent associated injury (24/52, 46.2%), followed by vascular injuries (12/52, 23.1%), abdominal–pelvic organ injuries (4/52, 7.7%), and urethral injuries (2/52, 3.8%) **(Figure 1)**.

3.5. Surgical Repair Indications

Six patients (11.5%) had extensive hematomas, six patients (11.5%) had hematocoele, and the majority of patients (n=40, 76.9%) had indications for intervention because of penetrating injuries.

3.6. Surgical Management and Discharge Outcomes

All patients underwent surgical management. Fourteen patients (26.9%) required scrotal exploration and/or orchiectomy due to testicular destruction or avulsion. Blood transfusion was required in 14 patients (26.9%) because of associated vascular or orthopedic injuries. Thirty patients (57.7%) were discharged home, while 22 (42.3%) were transferred to other departments for continued care **(Table 3)**.

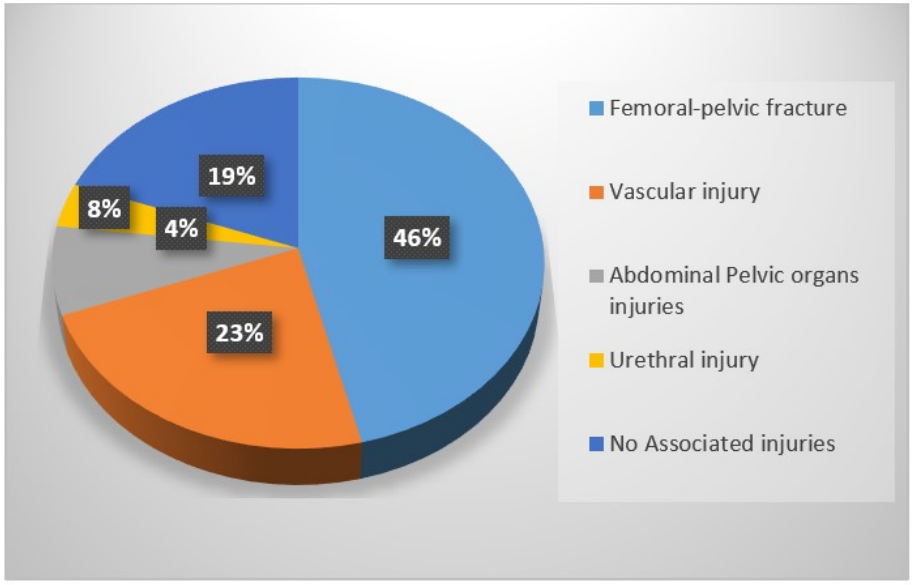


Figure 1: Distribution of associated injuries distribution.

Table 2: Types, Distribution, and Genital Lesions according to the AAST Injury Grading System

External Genitalia Examination	Type of Injury	Frequency	Percentage%
Penis	Laceration	16	30.8
Scrotum	Laceration	18	34.6
	Swelling	2	3.8
	Skin loss	16	30.8
Testes	Testicular dislocation	6	11.5
	Testicular rupture	12	23.1
	Hematocoele	10	19.2
Side of Testes injury	Right testis	12	23.1
	Left testis	20	38.5
	Bilateral	14	26.9
	AAST Grade		
	Penis (n = 16)	Scrotum (n = 44)	Testes (n = 46)
Grade I	2	6	16
Grade II	12	32	8
Grade III	2	0	4
Grade IV	0	4	4
Grade V	0	2	14

AAST, American Association for the Surgery of Trauma; n, Number of participants.

3.7. Complications and Follow-up

During the study, early complications were observed in 12 of the 52 patients, including wound infections in 8 patients (15.4%) and urinary tract infections in 4 patients (7.7%). At the one-month follow-up, 42 patients completed post-injury investigations. Urine analysis was normal in all 42 patients (100%). Semen analysis was normal in 30 patients (71.4%), while 12 patients (28.6%) demonstrated abnormal semen parameters at one month, including oligospermia and/or motility disorders in 8 patients (19.0%) and azoospermia in 4 patients (9.5%). Semen culture was negative in 40 patients (95.2%) and positive in 2 patients (4.8%). Late complications included testicular atrophy in 14 patients (33.3%), erectile dysfunction in 2 patients (4.8%), and post-operative penile curvature in 2 patients (4.8%). Abnormal semen parameters at one month were observed in 12 patients (28.6%). At one-month follow-up, 28 patients (66.7%) achieved a satisfactory outcome, characterized by good wound healing, preserved sexual function, and acceptable cosmetic appearance, while 14 patients (33.3%) experienced an unfavorable outcome, including complications such as testicular atrophy, abnormal semen parameters, erectile dysfunction, or post-operative penile deformity **(Table 3)**.

4. Discussion

Young men are frequently affected by injuries to the male external genitalia. Several studies have documented similar findings: Lee et al., in a 10-year review, reported a mean age of 27.8 years [10], while Ahmed et al. observed a mean age of 28±3.2 years [11]. In our study, the mean age was 23.3±4.9 years, which aligns with these reports. Diagnosis was primarily based on clinical assessment, followed by emergency surgery. Scrotal ultrasound was performed in 14 patients (53.8%) and was not systematically applied. This approach aligns with Djè and Coulibaly [12, 13], who suggest emergency surgical exploration except in cases of severe trauma. This therapy would decrease the likelihood of problems and aftereffects. The treatment attitude to scrotal injuries is diverse and depends above all on the existence or absence of a hematocele on clinical evaluation [14].

Mechanisms of injury were predominantly penetrating (84.6%), with blunt trauma representing 15.4%. RTA and gunshot injuries accounted for 68% and 16% of injuries, respectively, in the Ahmed et al. study [11], but penetrating injuries accounted for 79% of injuries in other reports [15]. This is comparable to the situation

Table 3: Type of Surgical Intervention, Management, Complications, and Follow-up Outcomes

Surgical category	Intervention details	Frequency	Percentage (%)
Penile injuries	Glans laceration, Buck's fascia laceration treated by Penile exploration and suturing	14	26.9
	Cutaneous avulsion/laceration involving the glans treated by Penile stump refashioning with primary suturing	2	3.8
Scrotal injuries	Superficial or deep laceration/contusion treated by debridement and primary/secondary suturing	40	76.9
	Scrotal hematoma evacuation	4	7.7
Testicular injuries	Scrotal exploration and/or orchiectomy for testicular destruction or avulsion	14	26.9
	Hematocele evacuation for contusion/hematoma/subclinical laceration	24	46.2
	Scrotal exploration with testicular repair	8	15.4
Supportive management	Blood transfusion for associated vascular or orthopedic bleeding	14	26.9
Discharge and Associated Injuries	Discharge to another department	22	42.3
	Discharge home	30	57.7
Early Complications (n = 52)			
	Wound infection	8	15.4
	Urinary tract infection	4	7.7
Follow-up investigations at 1 Month (n = 42)			
Urine analysis	Normal	42	100
Semen analysis	Normal	30	71.4
	Abnormal semen parameters at one month	12	28.6
	Oligospermia/motility disorder	8	19.0
	Azoospermia	4	9.5
Semen culture	Negative	40	95.2
	Positive	2	4.8
Late complications			
	Erectile dysfunction	2	4.8
	Testicular atrophy	14	33.3
	Penile abnormality: post-operative curvature formation	2	4.8
	Abnormal semen parameters at one month	12	28.6
Outcome			
	Satisfactory outcome	28	66.7
	Unfavorable outcome	14	33.3

n, Number of patients.

in other nations where penetrating wounds are more common [16]. Gunshot wounds accounted for 38.4%, while explosive devices caused 46.2% of injuries. Penile injuries were noted in 30.8% of patients, lower than the 60% reported in large cohort studies by Bertini and Corriere [17], likely due to differences in sample size and study period.

All patients underwent prompt assessment and management, including hemodynamic stabilization and urethral evaluation when indicated. Penetrating penile injuries were treated with debridement and exploration, preserving tissue for potential reconstruction, with corpora repaired using absorbable sutures [18]. Scrotal and testicular injuries were addressed immediately: hematomas were evacuated, necrotic tissue excised, and tunica albuginea closed, using tunica vaginalis flaps in selected cases (15.4% of testicular repairs; 46.2% of hematocele evacuations). Orchiectomy was required in 26.9% of patients with non-viable testes, mostly due to high-velocity gunshot injuries, consistent with previous reports [19, 20].

Penetrating scrotal wounds were generally managed with exploration; partial scrotal skin loss was repaired primarily. Large hematoceles were drained promptly to prevent infection and ischemia,

whereas stable hematomas were managed conservatively with rest, ice, and elevation [21, 22].

Associated injuries occurred in 32 patients (61.5%), primarily vascular and musculoskeletal, requiring multidisciplinary management. In Ahmed et al.'s study, related injuries were observed in 41% of cases [11]. Mean hospital stay was 5.2±5.1 days, comparable to Coulibaly [12] but shorter than reports from Burkina Faso [22].

At one-month follow-up, 28 patients (66.7%) achieved satisfactory cosmetic and functional outcomes, including good wound healing, acceptable genital appearance, and preserved sexual function. Exceptions included two patients requiring bilateral orchiectomy with subsequent testosterone therapy. Semen analysis, completed in 42 patients, showed normal results in 71.4%, oligoasthenozoospermia in 19.0%, and azoospermia in 9.5%. Early infection was uncommon and managed with local care. Cosmetic and functional outcomes of therapy of penetrating genital damage are usually favorable if adequate, on-time treatment and repair are undertaken [23]. In testicular injuries, sperm production and sustained hormonal function have been observed in men with adequately bilateral repaired testes after penetrating injuries [24].

4.1. Limitations

This study is limited by its single-center military setting, small sample size, and potential selection bias (only patients reaching this hospital were included). Follow-up was incomplete, and validated instruments for sexual function or quality of life (e.g., IIEF) were not used.

5. Conclusion

External male genital injuries during war are caused by a variety of mechanisms, ranging from minor penile lacerations to complete avulsion of the testes and scrotum. Timely evaluation, meticulous wound irrigation with saline and mild antiseptics, and prompt surgical intervention remain critical for minimizing infection and preserving function. In our cohort, while a majority of patients achieved satisfactory cosmetic and functional outcomes at one month, a substantial proportion experienced complications, including testicular atrophy, abnormal semen parameters, penile deformity, and erectile dysfunction. These findings highlight the need for standardized management protocols for war-related genital trauma and for future multi-center studies with longer follow-up to better assess fertility, sexual function, and quality of life outcomes.

Conflicts of Interest

The authors declare no conflict of interest.

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Institutional Review Board (IRB)

This study was approved by the Ethics Committee of the General Military Hospital, Sana'a, Yemen (Approval No. GMH-URO-2024-7).

Informed consent

Written informed consent was obtained from all participants.

Large Language Model

Artificial intelligence or large language model tools were used for language editing and formatting only. No AI tools were used for data analysis, interpretation, or scientific content generation.

Authors Contribution

WAKA, MANA, MSA, A were responsible for conceptualization. WA, AAS, AF, AS, NA conducted data collection. MS, AAS, AF, AS, NA performed data analysis. WAKA, MAMA, MS, AAS, AF, AS, NA carried out manuscript writing as well as manuscript review and editing.

Data Availability

Patient data related to this study are not publicly available but can be obtained upon request from the corresponding author.

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