Gunshot wound injuries to the male external genitalia

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ABSTRACT

الأهداف: التعرف على نمط إصابات الطلقات النارية المدنية التي تتعرض لها الأعضاء التناسلية الذكرية الخارجية واستعراض خبرتنا في معالجة هذه الإصابات.

الطريقة: تمت هذه الدراسة الوصفية في قسم الجهاز البولي والكلى بمستشفى الثورة النموذجي التعليمي، صنعاء، اليمن وذلك خلال الفترة من يونيو 2005م إلى إبريل 2008م، وشملت 20 مصاباً. تم إجراء جراحة ترميمية عاجلة لكل المرضى الذين تأكد أو اُشتبه إصابتهم بجروح عميقة في الأعضاء التناسلية والبولية وذلك بعد عمل الفحوصات السريرية والتصوير الإشعاعي للإحليل بالطريق الراجع.

النتائج: بلغ متوسط أعمار المرضى 33.2 عاماً. وأُصيب منهم 15 مريضاً (75%) بأسلحة نارية عالية السرعة و5 مرضى أصيبوا بمسدسات ذات سرعة منخفضة. فيما عانى 18 مريضاً (90%) من إصابات مُصاحبة لإصابات الأعضاء التناسلية. أُصيب القضيب وحده في 10 مرضى (50%)، وكيس الصفن في 4 مرضى (20%)، والقضيب وكيس الصفن مجتمعان في 6 مرضى (30%)، وكانت إصابات 5 منهم سطحية. تم اكتشاف إصابات القضيب في 13 مريضاً وتمزق الإحليل في 6 مرضى. لاحظ 5 مرضى انحناء بسيط في القضيب أثناء الانتصاب بعد عملية الترميم، فيما عانى مريض واحد من تقوس حاد، ومريضان من بعض المشاكل الجنسية. واجهتنا 9 حالات مُصابة بتمزق الخصية وبلغت نسبة إنقاذ الخصية 45.5%.

خاتمة: كانت الأسلحة السائدة في دراستنا هي الأسلحة الأوتوماتيكية عالية السرعة، غير أن حدة الإصابات و نتائجها كانت مماثلة تقريباً لإصابات الأسلحة منخفضة السرعة. وقد يرجع ذلك إلى إصابة عضلات كبيرة مجاورة للأعضاء التناسلية في 90% من المرضى والتي من شأنها تقليل الأثر السلبي للأسلحة على الأعضاء التناسلية.

Objectives: To identify the patterns of civilian gunshot wound (GSW) injuries to the male external genitalia, and to present our experience in the management of such injuries.

Methods: This descriptive study was carried out in the Urology and Nephrology Center, Al-Thawra Modern General and Teaching Hospital, Sana'a, Yemen from June 2005 to April 2008, and included 20 men that presented with GSW injuries to the external genitalia. After clinical and radiological evaluation with retrograde urethrography when indicated, early surgical repair was undertaken for all patients with evident, or suspected deep genito-urinary wounds.

Results: The mean age of the patients was 33.2 years. In 15 (75%) patients, injuries were inflicted by high-velocity weapons, and in 5 by low-velocity pistols, and 18 (90%) patients had other associated injuries. The penis was involved alone in 10 (50%), scrotum in 4 (20%), and the penis and scrotum in combination in 6 (30%) patients. In 5 patients, the lesions were superficial. Corporeal injuries were detected in 13 patients, and urethral injuries were detected in 6 patients. In post-repair, mild curvature during erection was experienced by 5 patients, severe angulation by one, and sexual dysfunction by 2 patients. We encountered 9 testicular ruptures, and our testicular salvage rate was 45.5%.

Conclusion: Although the dominant inflicting weapons were high-velocity automatic rifles, the severity of injuries and their related outcomes were almost comparable to other low-velocity series. This is possibly due to the primary involvement of nearby bulky muscles in 90% of cases, which may absorb the blasts' effect of the projectiles on the genitalia.

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Penetrating trauma to the male external genitalia is relatively uncommon compared to other parts of the body.[1-3] Although these injuries are by themselves not life-threatening, they may be associated with other potentially life threatening injuries, and can have substantial effect on the ensuing quality of life for trauma victims.[4-7] Furthermore, the management of these injuries often present complex problems for urologists when the preservation or restoration of potency, fertility, normal micturation, and cosmesis are being considered as major treatment goals.[1,2,6,8,9] Gunshot wounds (GSWs) to the male external genitalia are infrequently described in the literature.[1,10] The largest reported series of such injuries are obtained from military experiences.[4,9,10] The management of civilian injuries, which are usually caused by low-velocity projectiles (<1,000 feet/second) differ significantly from that of the military, and experiences with these injuries in civilian setting has been minimally reported.[8,11] The genito-urinary tract is involved in approximately 10% of all traumas,[1,6,11] and injury to the urogenital organs occurs in 0.5-4.2% of all war injuries.[5,7,12,13] Additionally, the external genitalia are involved in approximately 29.4-68% of all urogenital injuries during wartime.[5,7,12] However, sparse data are available on the incidence of external genito-urinary injuries in civilian life.[1] With increasing civilian violence and easy availability of handguns, more GSWs injuries to the penis and scrotum have been documented, and consequently, several small studies in the non-military setting have been published in the last few years.[3,8,9,10] Likewise, in our community, easy accessibility of different types of weapons, and lack of strict rules that control possession of such weapons, especially in rural areas make these firearms available in the hands of many people to be used in resolving some social conflicts. This situation leads to a noticeable increase in the number of GSW trauma, and documentation of more injuries to the male external genital organs in our locality. We conducted this study to identify the pattern of GSW injuries to the male external genitalia in our community, and to highlight the magnitude of the problem, and therefore, derive some recommendations to help in better management of these injuries, and in the limitation of their incidence. We present our experience in the management of civilian non-combat GSW injuries to the male external genitalia patients treated at our institution.

Methods. This descriptive study was conducted from June 2005 to April 2008 in the Urology and Nephrology Center, Al-Thawra Modern General and Teaching Hospital, Sana'a, Yemen, the main referral hospital in the country. It included 20 patients with GSW injuries to the male external genitalia managed at our hospital during this period. The Academic Committee of our institution approved the conduction of this study. All patients with GSW injuries to the penis, scrotum, testes, and/or anterior perineum (that might injure the bulbar urethra) were included in the study. Patients with injuries to the surrounding regions not involving the aforementioned genito-urinary organs were excluded. Patients were initially evaluated in the emergency department by the Trauma Team. Thereafter, careful history and thorough physical examination were carried out, and inquiry on the type of weapon, mechanism of injury, number of bullets, and the time elapsed since trauma was obtained. The anatomical location of injury and its extent, missile trajectories, as well as associated extra-genitourinary injuries were all evaluated. Patients presented with suspected urethral injury, such as blood at the external urethral meatus, frank hematuria, and patient's inability or difficulty to void, and patients with gunshot injuries to the penis or perineum were submitted for retrograde urethrography (RUG) with the exception of those with hemodynamic instability, or with penile wounds that were clearly superficial on initial clinical examination. Routine roentgenograms of the abdomen were obtained in all patients, as well as roentgenograms of the thigh in patients with bullets involving the thighs. The definitive surgical treatments of genital injuries were carried out in the operating room. Penile and scrotal wounds that were clearly superficial were managed by local wound debridement and primary closure. Formal exploration was performed in patients with penile wounds deep to the Buck's fascia, expanding penile hematoma, palpable corporal defect, scrotal hematoma, scrotal wounds that penetrated the dartos fascia, and in those patients with evident, or suspected urethral injury. When the depth of injury was unclear, surgical exploration was undertaken. Penile wounds were explored via circumferential subcoronal degloving incision, unilateral scrotal injuries were explored via transverse mid-scrotal incision, while a longitudinal median raphe incision was utilized for bilateral exploration. Corporal tears and extruded seminiferous tubules were minimally and conservatively debrided of non-viable tissues, and corporal and tunical defects were closed primarily with interrupted 3/0 synthetic absorbable sutures (polyglycolic acid). When the testis has completely shattered and devastated, orchidectomy was performed. Concomitant urethral injuries were managed by conservative debridement and primary repair by 4/0 polyglycolic acid sutures over a silicon Foley catheter, which was left in-dwelling for 2-3 weeks. The skin was closed loosely after debridement of nonviable tissues, and broad spectrum systemic antibiotics were administered for 4-5 days postoperatively. The management of associated injuries

was undertaken during the same session of repair of genital wounds. Skeletal fractures were managed by the Orthopedic Trauma Team, and fixation of these fractures took priority over the repair of urogenital injuries. Explored patients were kept under our inpatient follow-up for 4-6 days following the repair. Patients with penile injuries were instructed to withhold sexual activities for 4-6 weeks, and those with urethral injury were discharged with their urethral catheter in place, to come back after 2-3 weeks for catheter removal and evaluation of the integrity of urethral repair by RUG. At discharge, all patients were requested to return for evaluation after 2-3 months or earlier if they experienced manifestations of infection, for example, unusual pain, fever, or wound discharge.

The data were collected then recorded and analyzed using the spreadsheet Microsoft® Excel® 2007 (Microsoft Corporation, Redmond, WA, USA). Continuous data were expressed as means and categorical variables were reported as a percentage and the results were illustrated in tables when the rows exceeded 2.

Results. The patients age ranged from 19-56 years (mean: 33.2 years), and 9 (45%) patients were under the age of 30 years. The time elapsed from trauma to admission ranged from 2-24 hours (mean: 6 hours). In 15 (75%) patients, the injuries were inflicted by high-velocity bullets from automatic rifles (Kalashnikov-Russian AK-47, or its modifications), which have a muzzle velocity of 2,300 feet/second, while 5 patients were injured by low-velocity handguns or pistols. Eighteen patients (15 of high-velocity and 3 of the 5 injured by low-velocity genital GSWs) had associated injuries to nearby structures (**Table 1**), and 2 patients had isolated external genito-urinary wounds. Thirteen (65%) patients were shot by more than one bullet (12 from the high-velocity group, and one from low-velocity group). By analyzing bullets trajectories, it was found that in all 18 patients with associated injuries to the proximal lower extremity, the genital organs were secondarily injured after the bullets initially hit either the thighs, or buttocks. With the exception of the 2 patients with associated femoral fracture who presented in a shocked state, all other patients were hemodynamically stable. No concomitant major vascular injuries in the thigh were encountered. The anatomical locations of the external genital wounds are shown in **Table 2**. Superficial skin lacerations of the penis or scrotum were treated by local wound debridement, and primary suturing. Corporal tears were rather extensive in 3 patients, and all corporal tears were treated by primary repair. The RUG was performed in 11 (69%) of the 16 patients with penile injuries, and was omitted in 3 patients with clearly superficial wounds, and in 2 patients who were hemodynamically unstable. Anterior urethral injuries were found in 6 (37.5%) of the 16 patients with penile wounds (5 identified by RUG, and one identified during exploration). Three patients had partial transaction of the anterior urethra, 2 patients had urethral defects of approximately 2 cm, and one patient had approximately one cm defect. All patients underwent conservative debridement, and primary repair over silicon Foley catheter. Exploration of scrotal wounds was undertaken in 8 patients, and showed 9 testicular ruptures (bilateral in one patient). Conservative debridement saved 4 injured testes, while orchiectomy was required for shattered, or devastated 5 testes (4 in unilateral, and one in bilateral injuries) yielding a salvage rate of 44.5%. There were no significant perioperative complications during hospitalization. After discharge, all patients were seen at least once for clinical follow-up examination. The overall mean follow-up duration was 11 months (ranging from 3 months-2 years) either by direct out-patient visit (13 patients), or by telephone (7 patients). Four patients disappeared after the first office visit. Follow-up evaluation focused on penile curvature or angulation, presence of voiding difficulties, as well as patients' subjective assessment and impression of the cosmetic results, and self-report of erectile capability and sexual satisfaction. Eight

Table 1 - Injuries associated with genital gunshot wounds (n=20).

Associated injury	n	(%)
Thigh*	18	(90)
Buttocks	2	(10)
Fracture femur	2	(10)
Fracture right forearm	1	(5)

*Each patient had thigh and other associated injury

Table 2 - Anatomical locations of genital gunshot wound injuries.

Anatomical location	n*	(%)
Penis	16	(80)
Superficial skin laceration	2	
Superficial injury to glans	1	
Corporeal injuries	13	
Right	2	
Left	5	
Bilateral	6	
Urethra†	6	(30)
Scrotum and testes	10	(50)
Superficial skin laceration	2	
Testicular rupture	8	
Right	3	
Left	4	
Bilateral	1	

*some patients have more than one injury,
†injured in association with corporal injury

of the 16 patients with penile injury (50%) reported full erection with straight and cosmetically accepted penis, while 5 patients observed mild curvature or deviation during erection, which did not impede sexual intercourse. Severe angulation during erection was reported by one patient, and erectile dysfunction by 2 patients; all had extensive penile injuries. Due to the relatively short-term follow-up duration, no precise information was available regarding fertility in patients who sustained testicular injury. All patients with urethral injury returned 2-3 weeks after discharge for catheter removal, and performance of control RUG. Of those 6 patients, RUG demonstrated a fistula at the site of the urethral repair in 2 patients (33%). The urethral catheter was reinserted, and that helped in spontaneous healing of the fistula in both patients after a further 4 weeks. However, 6 months later, one of the 2 patients developed symptomatic urethral stricture requiring 2 sessions of internal urethrotomies. The other patient disappeared from follow-up after healing of his urethral fistula. The remaining 4 patients with urethral injury did not report any voiding difficulties.

Discussion. The male external genitalia are protected against injury from GSWs and other forms of trauma by several defense mechanisms, the size and position and mobility of the penis and scrotum afford a relatively assured defense against severe traumatic injuries.[2,4,9] However, the increasing violence in today's societies has made these organs more susceptible to such injuries, and consequently, external genital GSW injuries have received increasing attention from urologists, and resulted in an increasing experience with the management of this type of trauma.[9,10] This epidemic increase of social violence has expanded to involve our locality, and subsequently, male genital GSWs became an increasingly reported genito-urinary injuries. Trauma in general affects young productive citizens, and may profoundly affect healthy related quality of life, and contributes much to the burden of costs related to death, disability, and loss of productivity, in addition to the burden of treatment costs. The present study showed that 45% of patients were under the age of 30 years, reflecting the magnitude of loss of productivity in such age group.

The GSW injuries to the external genitalia are commonly associated with injuries to the surrounding structures or other remote sites; either from the same bullet, or from multiple gunshots. In this study, 90% sustained associated non-genitourinary injuries with the proximal lower extremity being the most common involved site. Previous studies reported up to 80% of associated non-genitourinary wounds, frequently involving the thighs and buttocks.[1,8] Similarly, Kunkle et al[4] documented 84% incidence of associated injuries, and Cerwinka and Block[11] reported 90% incidence of such injuries among patients with penile GSWs, but these studies included the scrotum among those associated injuries. A lower rate (54%) of associated injuries has been noted by Mohr et al.[10] The high incidence of such associated injuries necessitates complete evaluation and a multidisciplinary approach to patient care.[2,6,10,14] Treatment of genito-urinary injuries can be safely delayed to accomplish appropriate management of potentially life, and/or limb threatening injuries.[1,7,8,10] The major treatment goals are maintenance or preservation of function (erection, fertility, testicular hormone secretion, and micturation), and achievement of satisfactory cosmetic results.[6,9,15] In our study, we adhered to the policy of early surgery, and we performed formal surgical exploration of all wounds with evident or suspected corporal, urethral, or testicular injuries. Patients with clearly superficial wounds were managed by local wound debridement and primary skin suturing. Corporeal injuries were identified and repaired in 81% of our patients with penile wounds. Other studies recognized and repaired corportomies in 62% of patients with penile GSWs.[4]

Many researchers stressed on early surgical exploration to accurately assess the extent of genital damage, and achieve judicious conservative debridement of wounded structures and primary repair of the lesions.[3,6,8,11,15,16] In addition, some authors indicated conservative treatment by local wound care and closure in a subgroup of patients with trivial, or minor wounds clearly superficial to penile Buck's fascia and scrotal dartos fascia.[1,2,4,10] We successfully treated 25% of our patients with this conservative approach. In other studies,[4,11] approximately 30% of patients were successfully treated in this manner. Urethral injury occurred in 37.5% of our 16 patients with penile wounds, and all of them were managed by primary tension-free repair over a catheter. The incidence of urethral involvement that was reported in the literature varies from 17-33% of patients with GSWs of the penis.[4,10,11,16] Most authors pointed to the importance of performing RUG in almost all patients with gunshot injuries to the penis to ensure the integrity of the anterior urethra, and to allow localization of injury.[4,9,10,14,17,18] We performed RUG in 11 of our patients with penile wounds, while it was omitted in 3 patients with clearly superficial injuries of the penis, and 2 hemodynamically unstable patients due to extensive injuries, requiring immediate surgical exploration. These reasons of omission of RUG were advocated and supported by many authors.[1,4,10,11,18] Moreover, others suggested the use of RUG on a case-by-case basis as the reported urethral involvement in approximately 25% of cases.[11]

The management of anterior urethral injuries in the setting of penile GSWs has been controversial.[4,17] Typically, complete disruptions treated by suprapubic diversion eventually result in a urethral stricture that will necessitate urethroplasty, and consequently, several institutions have attempted to treat these injuries by primary realignment with the hope that the rate of urethral stricture will decrease.[19] In cases where there is extensive urethral loss, such as with high-velocity bullets, staged treatment by temporary suprapubic diversion followed by definitive repair is considered to be the choice.[14,17,19] However, the disparity of opinions among authors is more obvious in the management of less destructive low-velocity gunshot injuries, in which the treatment options fluctuates between either primary repair or urinary diversion alone, in which delayed repair can be performed electively if stricture develops. A review of 9 contemporary civilian series by Kunkle et al[4] revealed the occurrence of 59 (23%) of associated urethral injuries in a total of 252 patients with penile GSWs, primary repair was described in 73% of patients, while 27% of patients underwent urinary diversion alone with possible delayed reconstruction. The preference of most investigators is to manage low-velocity GSW injuries of the anterior urethra with primary sutured repair.[8,11,14,16,18] Generally, defects less than 2 cm in the bulbar urethra and less that 1.5 cm in the penile urethra can be repaired primarily, while larger defects should be reconstructed at a later date, and in these patients a suprapubic catheter is placed while waiting for definitive treatment.[16,19]

In this study, we performed 8 scrotal explorations and by adhering to conservative debridement, we saved 44.5% of injured testicles. A study from civilian low-velocity projectile injuries reported wide range of testicular salvage from 39-75%.[1,2,10] In military experience, salvage rates varied form 10-52% with orchidectomy rate up to 90% following high-velocity injuries.[1,9] However, a higher salvage rate of 74.4% was reported recently during the last Iraq war.[5] Orchidectomy becomes necessary when the testis is completely shattered or avulsed.[2,6,10,20]

Following repair of penile injuries, 50% of our patients were satisfied both functionally and cosmetically, and reported full erection with straight penis. However, mild curvature was observed by 31% of patients, while sever angulation and erectile dysfunction were experienced by the remaining 19% patients in whom corporeal tears were rather extensive. Some authors reported that 3 in 14 of their patients with penile GSWs complained initially of partial erection, but with pharmacological therapy all achieved full erection.[21] Others documented 5 of their patients who noted some degree of erectile dysfunction, and 2 patients described slight penile curvature after penile GSWs.[4] Phonsombat et al[1] have not encountered any patients who have complained, or sought treatment for penile curvature following penetrating penile injury.

The present study has the inherent and potential limitations of trauma cases, such as, relatively small sample size, subjective nature of outcome measures, and poor long-term follow rates. All of these preclude clear conclusions regarding final assessment of management outcomes and benefits. These limitations and weaknesses were shared by many other series, and they were a reflection of the infrequency of these injuries, variable degree of injury severity, and multiple associated wounds in such patient population, the criminal nature of some injuries, and lack of response by many patients.[1,2,4,10,11] Contrary to other prior civilian studies which reported low-velocity GSW injuries,[1,4,10,11,16] our study differed in fact that 75% of our patients were inflicted by high-velocity weapons. Low-velocity bullets travel at less than 1,000 feet/second.[1,11] In contrast, high velocity rifles (for example, Russian AK47) fires at a velocity of approximately 2300 feet/second.[22] The kinetic energy of the bullet, and the degree of tissue damage are proportional to its mass and the square of its velocity, this kinetic energy is transferred to the tissues, and the blast effect of high-velocity projectiles causes a much larger area of tissue damage.[14,22] Although we expected that injuries to the genitalia from such bullets would be more extensive and devastating, needs more debridement, and have worse testicular salvage rates; the pattern of findings, and accordingly our management policies and their outcome were almost similar to those of prior civilian reports. These findings can be explained by the fact that 90% of our patients had associated injuries to near-by bulky muscular regions (thighs and buttocks), and the genitalia were secondarily inflicted by the bullets after they initially hit and traveled through those muscle groups. The primary involvement of such bulky muscular areas probably absorbed and buffered the highly destructive energy of high-velocity missiles, and therefore, the resulting injuries to the genitals were almost comparable to those of low-velocity missile injuries. It also appeared from the injury patterns of this series that the genitalia were not the prime target of assailants, unlike those of some Western civilian reports, in which most patients were shot with a single bullet aiming at the genitalia.[3,21] In those situations of single bullet wounds, the associated injuries are usually minor, but when the patient has been shot with multiple bullets, the associated injuries are often major.[11,21]

In conclusion, although the dominant inflicting weapons in our study were the high-velocity automatic rifles, the severity of injuries and their related outcome were almost comparable to those of other series discussing

low-velocity injuries to the genitalia. Our study disclosed the magnitude of morbidity and the resulting defective functional and cosmetic outcomes of this type of trauma on inflicted patients in our community, these may in turn leave significant imprint on the victim's quality of life. It also showed that nearly half of the inflicted persons were in their productive age period. Considering these, we should urge the government to legislate effective laws that control possession and limit distribution of different types of weapons. The media should participate effectively in public education to increase public awareness on the risks and hazards of careless and unlicensed use of firearms. In order to achieve satisfactory function and cosmetic results any evident or suspected corporal, urethral or testicular injury mandates prompt evaluation, early exploration, and primary repair.

Future studies discussing similar issues are recommended to exert some effort in eliminating all, or part of the potential weakness of previous studies, particularly the subjective nature of result measures, and the relatively limited and poor long-term follow-up periods, which preclude final assessment of management outcomes.

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