Eur J Trauma Emerg Surg (2014) 40:687–691
DOI 10.1007/s00068-014-0381-z

ORIGINAL ARTICLE

Bullhorn and bullfighting injuries

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Received: 14 September 2013 / Accepted: 20 January 2014 / Published online: 12 February 2014

Abstract
Purpose Our purpose was to present our hospital experience with bullhorn injuries.
Methods A retrospective analysis of patients in our Trauma Registry (1993–2012).
Results Fifteen patients were included. All were hemodynamically stable on presentation, with a mean Glasgow Coma Scale (GCS) score and a Revised Trauma Score (RTS) of 15 and 11.9, respectively. The Injury Severity Score (ISS) and New Injury Severity Score were 13.6 ± 6 and 15.9 ± 9, respectively. Seven had an ISS > 15. Injuries resulted from an isolated blunt trauma (BT) in four, penetrating trauma (PT) in seven, with extensive soft tissue injuries (STI) in three, and a combined BT + PT mechanism in four patients, with extensive STI in all. Three patients had injuries to vessels in the groin, two with prehospital vein ligation. Five patients had abdominal visceral injuries, and another had a sheathed goring, with a traumatic abdominal wall hernia and retroperitoneal hematoma. Four patients had thoracic injuries, and one of them had a traumatic thoracoplasty with a large open thoracic wound, a flail chest, and extensive STI. Two patients had traumatic brain injury, and six had bone fractures. Two-thirds of patients required a surgical procedure under general anesthesia. Morbidity included three surgical site infections, one leg compartment syndrome, and one persistent lymph drainage. There was no mortality, and the mean length of hospital stay was 16 days.
Conclusions Bullhorn and bullfighting injuries frequently have a multimechanistic origin which goes beyond a pure penetrating trauma. Associated blunt and STI were common in our series, and the overall prognosis of patients admitted to hospital was good.

Keywords Bullfighting · Bullhorn · Penetrating trauma · Blunt trauma · Soft tissue injuries

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Introduction

Bullfighting, also known as *tauromaquia* from the Greek words "ταύρος" (bull) and "μάχομαι" (fight), refers to a classic spectacle in which bulls and fighters on foot/horseback confront each other. Its origin dates from the Bronze Age, and it was born as a spectacle in Spain during the 12th century to celebrate war victories or religious festivities. Lance bullfighting was born during the 16th century as a royal event, and pawns took part in it to distract the bull. From the 17th century onwards, riding noblemen were progressively replaced by commoners on foot and, because of this, it was considered as vulgar by the royalty. Typical bullfighting is divided into three stages, which end when the bullfighter sticks their sword between the shoulder blades of the animal, aiming at the aortic arch;

this is the most dangerous part when most goring injuries occur. Other events are races ("*encierros*"), in which several bulls are released from the corral into fenced streets leading to the bullring while people run in front of them. These are dangerous when one bull is separated from the herd and surrounded by people [1], and this danger is compounded by the occasional association of alcohol intake by the runners. Bullfighting events, almost unique to Ibero-American countries because of cultural traditions, cause, on average, four deaths and 20–25 severely injured people every year in Spain [2]. Nevertheless, the mortality rate, usually from hypovolemic shock or sepsis, is less than 5 %, despite the occasional severity of these injuries [3–5]. Penetrating trauma is the most feared mechanism of injury inflicted by bulls and during bullfighting, and exsanguination is almost always caused by goring through large vessels in groin or torso wounds. However, associated blunt and extensive soft tissue injuries (STI) are so common that these patients should often be considered as multiple trauma patients.

Patients and methods

A retrospective analysis of patients with bullhorn injuries included in our hospital Trauma Registry between 1993 and 2012 was carried out. This is a selected series, since many cases in our area with minor-to-moderate injuries are treated locally and/or transported to small clinics. Our hospital serves as a center of reference for more severe injuries. The demographics, location, mechanism, type of injuries, trauma scores, treatment, morbidity, mortality, and length of hospital stay (LOS) were assessed. The definitions used were as follows: (a) penetrating trauma (PT): injuries caused by goring; (b) blunt trauma (BT): injuries not by goring, with the exception of the so-called "sheathed goring", which was also considered as BT; (c) sheathed goring: injury where the integrity of the skin is preserved due to its elasticity, but there is a traumatic hernia and potentially serious abdominal visceral injuries; (d) extensive STI: those requiring a surgical procedure under general anesthesia, irrespective of the need for other surgical procedures.

We have discussed our results in the context of some of the largest published series, which have been gathered by searching through the following databases: PubMed, IME (Spanish Medical Index), and LILACS (Latin American and Caribbean Health Sciences Literature).

Results

Fifteen patients were included during the study period, 12 male and 3 female, with a mean age of 30 years (range 16–58). All of them had some form of initial assessment and stabilization by emergency medical services (EMS) on site. Except for a minority of patients, a detailed description of the management at the scene and transport times to our center is lacking. All patients were hemodynamically stable on presentation, with a mean Glasgow Coma Scale (GCS) score and Revised Trauma Score (RTS) of 15 and 11.9, respectively (Table 1). The mean Injury Severity Score (ISS) and New Injury Severity Score (NISS) were 13.6 ± 6 and 15.9 ± 9, respectively. Seven patients had an ISS > 15. Injuries resulted from an isolated PT mechanism in seven patients, with extensive STI in three of them. An isolated BT trauma mechanism was seen in four patients. Injuries resulting from combined BT + PT mechanisms were seen in the remaining four patients, with extensive STI in all of them. Three patients had injuries to vessels in the groin, and two of them had a prehospital ligation of a major vein to stop the bleeding. Five patients had abdominal visceral injuries (Fig. 1), and another patient had a sheathed goring, with a traumatic abdominal wall hernia and retroperitoneal hematoma. Four patients had thoracic injuries, and one of them had a traumatic thoracoplasty with a large open thoracic wound, a flail chest, and extensive soft tissue injuries (Figs. 2 and 3). Two patients had a traumatic brain injury (TBI), and six had bone fractures. Two-thirds of patients required a surgical procedure under general anesthesia. All interventions were performed shortly after arrival, with the exception of a delayed colostomy on day 4 (patient no. 3). Plastic surgical procedures consisted of extensive debridement and lavage, with primary suture in all cases except for patient no. 9, who needed a skin graft on day 25. Morbidity included three patients with surgical site infections, one with a leg compartment syndrome and one with persistent lymph drainage. There was no mortality, and the mean LOS was 16 days.

Discussion

The pattern of bullhorn and bullfighting injuries varies depending on the way the bullfighter confronts the animal. If he faces the bull, the most frequently injured areas are the lower abdominal quadrants and upper internal thigh (Scarpa's triangle), whereas if he runs away from it, the involved areas are the thigh, gluteus, and perineum. The most common areas according to the largest series are the lower extremities, especially the thigh and perineum [4, 5]. Injuries are located more frequently on the right side because most people are right handed, and so they expose this side during different actions, such as when feeding the animals, placing ropes, bullfighting, or in self-defense during an attack. When the goring is deep enough, the bull

Table 1 Mechanism, injuries, severity, and surgical procedures

Case	TM	Injuries	ST injuries	ISS/ NISS	Surgical procedure	LOS (days)
1	B + P	Lung contusion	Inguinoscrotal, gluteus	19/19	Plastic procedure	7
2	P	Rib Fx, pneumothorax	None	9/13	Chest tube	5
3	B + P	TBI, Fx orbit, rectum, anal sphincter, penetrating abdominal wound	Perineal	24/24	Nontherapeutic laparotomy, delayed colostomy	19
4	B	Fx D10, D12, L2, multiple rib Fx, hemopneumothorax, liver grade II, kidney grade III	None	22/27	Chest tube	14
5	P	Right femoral vessels	None	17/17	Iliofemoral bypass, fasciotomy	14
6	P	Saphenous vein, branch of femoral vein	Scrotum	10/10	Vein ligation, suture albuginea of the testicle	9
7	B	RPH, hernia of abdominal wall	None	9/9	None	4
8	P	Left femoral vessels	Left thigh	10/10	Ligature of LFV, vein patch in LFA	22
9	P	Open Fx tibia–fibula	Limb tissue loss	10/10	OREF, plastic procedure	78
10	B	Kidney contusion, liver grade II	None	4/8	None	5
11	P	Muscles disruption in left thigh	None	4/4	Suture under local anesthesia	17
12	B + P	Nasal bones Fx, small bowel perforation	Right thigh	20/20	Small bowel resection, plastic surgical procedure	8
13	B	SDH, mastoid Fx, left shoulder luxation, large gluteal hematoma	None	17/17	ORIF	20
14	P	Extraperitoneal bladder perforation	None	10/10	Suture	6
15	B + P	Left humeral Fx, flail chest, multiple rib Fx, lung and diaphragm, thoracic wall	Thoracic wall	20/41	Lung and diaphragmatic suture, ribs fixation	15

TM trauma mechanism, *ST* soft tissue, *ISS* Injury Severity Score, *NISS* New Injury Severity Score, *LOS* length of hospital stay, *B* blunt, *P* penetrating, *TBI* traumatic brain injury, *Fx* fracture, *D* dorsal vertebra, *L* lumbar vertebra, *RPH* retroperitoneal hematoma, *LFV* left femoral vein, *LFA* left femoral artery, *OREF* orthopedic reduction and external fixation, *SDH* subdural hematoma, *ORIF* orthopedic reduction and internal fixation

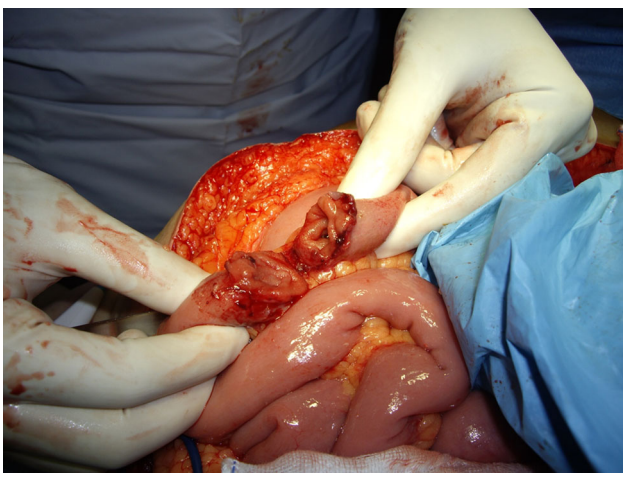

Fig. 1 Complete small bowel transection from a bullhorn entering via the thigh and psoas muscle into the abdomen

Fig. 2 Right torso wound of case 15 with a traumatic thoracoplasty, multiple rib fractures, flail chest, lung and diaphragmatic lacerations, and extensive soft tissue injuries with large muscle disruption

lifts the bullfighter in the air by flexing and extending its neck, and by rotational head movements, making the horn work like an axis, while the animal turns around itself trying to equilibrate his center of gravity. This makes the appearance of entry openings occasionally so small that they may not correlate with deep tissue destruction, with one or more trajectories, foreign bodies, and massive

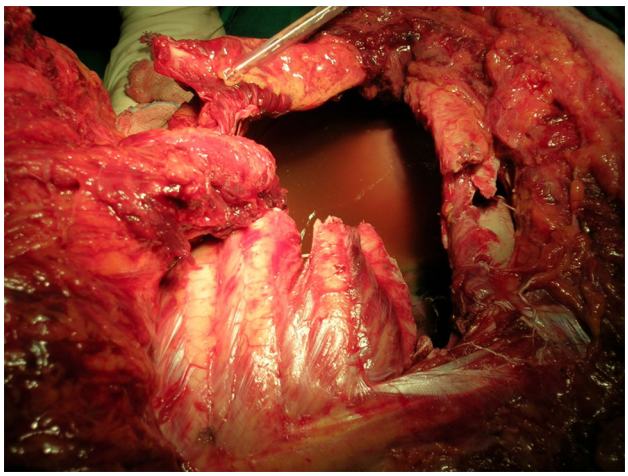

Fig. 3 Close-up view of the thoracic wall damage in case 15

inoculation of microorganisms. We have not seen these small entry openings in our small series but, rather, the opposite, with extensive STI in 40 % of patients. Other injuries are related to charges, falls, stomping, and even those incurred while the injured is being carried away by people without medical training or undertaking spine precautions, while trying to avoid new attacks. The epidemiology and variety of bullhorn injuries is well described in a report of 317 wounded in 3,936 events (8 %), mainly in Spain but also in southern France [6]. The most frequent injuries in surgical reports were: goring (39.5 %), mainly in the lower limbs (75 %), and bone fractures (12.6 %), half of them in the upper limbs. Goring was also the most frequent mechanism of injury in our series, although 53 % of our patients had injuries caused by blunt trauma, and 40 % had bone fractures.

A professional bullfighter's emergency assistance is first performed in the bullring's operating room by a local medical team, whereas amateurs are usually assessed by public EMS and, if necessary, taken to small clinics or referral hospitals, depending on the severity of their condition [7]. Injuries inflicted to farmers are frequent, with 24 % of them reporting livestock-related injuries, and 1.7 % of large-livestock farmers reporting injuries each year. Most of them are treated by general practitioners; however, serious injuries are frequently seen in regional hospitals [8].

Tetanus prophylaxis and antibiotic therapy are of paramount importance, since these injuries are regarded as contaminated wounds. Many antibiotic regimes are used that cover both aerobes and anaerobes, such as ampicillin plus aminoglycosides and metronidazole, ceftriaxone plus metronidazole, or amoxicillin. Infection rates range from 10 to 60 %, and it is the most frequent complication of these wounds. This complication was so feared by professional bullfighters that a memorial to Sir Alexander Fleming, the discoverer of penicillin, has stood at the main entrance to *Las Ventas* bullring in Madrid since 1964 [2, 3].

The cervicofacial area is not frequently involved according to most series, including ours, with one exception [7], but injuries here are severe and more likely to result in death than others [9]. The most frequent facial injuries are fractures, vascular (facial and lingual vessels), and intraoral, whereas dental avulsions, facial nerve, and parotid duct injuries have a low incidence. The most frequent cervical injuries are vascular (carotid artery and internal jugular vein) and laryngotracheal, which are usually due to section of the intercartilaginous membranes, since the horn slides on the cartilage and does not usually damage it. Superficial parotidectomy preserving the parotid duct seems to be the best approach for parotid gland injuries [1, 7, 10]. The most frequent causes of death in cervicofacial injuries are vascular, airway obstruction, and esophageal injuries, in decreasing order [11].

Chest trauma is the first cause of death, mainly due to heart and great vessels injuries. Thoracotomy is recommended in penetrating trauma, and the urgency and approach will be dictated by the hemodynamic status and the injury [12]. Our last case illustrates well the extensive damage to the thorax that goring can cause, and the patient was lucky to have survived (Table 1). Back torso goring injuries have a high risk of visceral lesions, and a liberal policy of laparotomy should be followed when in doubt. In selected cases with limited colon injury, minimal peritoneal contamination, good condition of the patient, and absence of delay in treatment, a primary repair can be used [4, 9, 13].

Abdominal wall hernias are rare and related to either penetrating or blunt trauma/lower ribs fracture, which cause muscle and fascial disruption without skin injury. A peculiar type of injury is the so-called "sheathed goring", in which deep layers may be injured with no or minimal skin wounds due to its elastic quality, carrying a high risk of missed and severe injuries [9, 14–16]. One of our cases had this type of injury, with a traumatic hernia of the abdominal wall and a retroperitoneal hematoma. The repair of these traumatic hernias can be delayed, depending on the defect and patient status. Hernioplasty is preferred to herniorrhaphy unless hollow viscus perforation and/or peritonitis are diagnosed, due to contamination and infection risk [10, 11].

The perineum, genital, and gluteal areas are the second most frequently injured by goring. Bullfighters attempt to prevent these with smooth trousers on which the horns slide away. If the sphincters are involved, a primary repair should be the best approach, regardless of whether the section is total or partial, since a delayed repair is more difficult and fecal continence recovery is lower; the need for a diverting colostomy must be considered, as was the

case in one of our patients. Scrotal avulsion often requires plastic surgical reconstruction [4, 5].

Despite popular belief, the frequency of vascular injuries is low, ranging from 1 to 15 % (20 % in our series), but they increase the probability of severe complications and death [4, 12, 16–19]. In one series of 56 vascular injuries, mostly in limbs ($n = 32$) and the abdomen ($n = 16$), the most frequently involved vessels were the femoral (common and superficial) and iliac arteries, followed by the superficial femoral, tibial, and saphenous veins [18]. Prosthetic grafts should be avoided due to the high risk of infection. Endovascular treatment with stents has been described to treat arterial thrombosis [18]. In venous injuries, primary repair, interposition graft, or ligation can be performed [9, 17]. Sometimes, a damage control approach and femoral vessel ligation is used by practitioners in the local infirmary, as seen in two of our three patients with these vascular injuries.

In conclusion, our selected case series shows that the combination of life-threatening goring injuries, BT, and extensive STI is common in these patients, requiring the involvement of multidisciplinary teams of trauma surgeons and orthopedics, as well as vascular and plastic surgeons. The overall prognosis of patients admitted to hospital is good.

Conflict of interest A. García-Marín, F. Turégano-Fuentes, A. Sánchez-Arteaga, R. Franco-Herrera, C. Simón-Adiego and M. Sanz-Sánchez declare that this manuscript has not been previously neither published nor submitted elsewhere for publication, it will not be sent to another journal, and there are no financial interests.

Compliance with Ethics Guidelines This article does not contain any studies with human or animal subjects performed by any of the authors.

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