ORIGINAL ARTICLE

Bull horn injuries, analysis of 138 cases

Heridas por asta, análisis de 138 casos

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Abstract

Objective: *Bull-horn injuries (BHI) are unique and there is reduced published literature about it. We present an analysis of a 11-year BHI case series.* **Method:** *Retrospective and analytical study of 138 cases developed during a 11-year period with hospitalization admission greater than 24 hours with diagnosis of BHI/contusion. We classified patients in two groups: group A, patients undergoing procedures under general anaesthesia and group B undergoing procedures under local anaesthesia. Variables: age, sex, date, hospitalization length, main region affected, Comprehensive complication index (CCI, Injury Severity Score ISS, intensive care unit (ICU) admission, stay and mortality.* **Statistical analysis:** *t-Student test, ANOVA, χ^2 and linear or logistic regression.* **Results and conclusions:** *ISS was related to hospital stay, CCI, ICU admission and type of treatment applied. The comparative statistical analysis of variables between both groups determined a significant difference in age, ISS and hospitalization length, being greater in those belonging to group A. There is a more risk of undergoing surgery by increasing age, ISS and presenting the wounds in thorax-abdomen-pelvis area. CCI may be a good method of quantifying postoperatory morbidity in polytraumatized patients or in other areas besides the abdomen.*

Keywords: *Cattle. Injuries. Penetrating wounds. Trauma. Wounds.*

Resumen

Objetivo: *Las lesiones por cuerno de toro (BHI) son únicas y existe poca literatura publicada al respecto. Presentamos un análisis de una serie de casos de BHI de 11 años.* **Método:** *Estudio de 138 casos desarrollados durante un período de 11 años con ingreso hospitalario mayor a 24 horas con diagnóstico de BHI/contusión. Clasificamos a los pacientes en dos grupos: grupo A, pacientes sometidos a procedimientos bajo anestesia general y grupo B sometidos a procedimientos bajo anestesia local. Variables: edad, sexo, fecha, tiempo de hospitalización, principal región afectada, Índice integral de complicaciones (ICC, ISS, ingreso, estancia en unidad de cuidados intensivos (UCI), estancia y mortalidad.* **Análisis estadístico:** *prueba t-Student, ANOVA, χ^2 y lineal o logística regresión.* **Resultados y conclusiones:** *El ISS se relacionó con la estancia hospitalaria, ICC, ingreso en UCI y tipo de tratamiento aplicado.El análisis estadístico comparativo de variables entre ambos grupos determinó una diferencia significativa en la edad, ISS y tiempo de hospitalización, siendo mayor en los pertenecientes a grupo A. Existe más riesgo de ser operado por el aumento de la edad, el ISS y la presentación de las heridas en la zona tórax-abdomen-pelvis.La ICC puede ser un buen método para cuantificar la morbilidad postoperatoria en pacientes politraumatizados o en otras zonas además del abdomen.*

Palabras clave: *Ganado. Lesiones. Heridas penetrantes. Trauma. Heridas.*

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Introduction

Bull horn injuries (BHI) occur frequently in areas where bullfighting is a common practice, especially in Latin America[1-3]. *Bullfighting,* from τα û ρος, *taurus* (bull), and μ ά χομαι, *machomai* (to fight), is defined as the spectacle in which the bull and the fighter (on foot or on horseback) face each other[3]. BHI usually cause such severe damage so anyone who suffers from them should be considered a polytraumatized patient. Advances in surgery in these patients have allowed mortality in BHI to be reduced by up to 5%, which in other times were fatal[2].

The province of Guadalajara, in Spain, with an approximate population of 253,000 inhabitants in 2017, celebrates between 500 and 600 bullfighting events a year[4,5]. BHI have their own characteristics in polytraumatized patients, such as extensive tissue tears, multiple paths of injury, presence of foreign bodies and massive inoculation of germs, which can compromise life[1]. Mortality, usually secondary to hypovolemic *shock* and sepsis, usually is less than 5%[1,3]. Currently there is little and heterogeneous literature, being the subject of research in areas of high incidence. As the objective of this study, we present a statistical analysis based on the morbidity of 138 cases of BHI in the last 11 years in our hospital.

Method

Retrospective, analytical and observational case series study, developed at the Hospital General Universitario de Guadalajara (second level hospital) during the period from January 2006 to December 2016. The electronic medical records (Mambrino XXI®) of that period of patients treated by the emergency department were reviewed, according to ATLS management *(Advanced Trauma Life Support)* and admitted for more than 24 hours with the diagnosis of "wound/trauma caused by a bull horn." Availability of care by the emergency department was 24 hours a day, 7 days a week, with the possibility of resources for resuscitation, surgery, and intensive care for the majority of polytraumatized patients (level III trauma according to the American classification). In addition to specific treatment based on the affected organ, surgical treatment under general anesthesia consisted of washing the wound with antiseptic solution, Friedrich, and skin suture over non-suction drains. In most cases, non-absorbable suture material was used to close the wound, using absorbable sutures on occasions for sites deeper into the skin. In surgical procedures under local anesthesia, 1% mepivacaine was used, with subsequent cleaning of the wound with antiseptic solution and suturing of the skin with placement of non-aspiration drains. Antimicrobial therapy was broad-spectrum, with an empirical regimen of amoxicillin-clavulanic acid or gentamicin plus metronidazole in the case of allergy to beta-lactams, modified depending on the specific antibiotic therapy in cases of wound infection. The type of trauma treated in this area was variable, from a simple contusion or laceration by a bull horn to extensive muscle tears, with penetration into the abdominal/thoracic cavity, which could be accompanied by visceral or vascular injuries.

We classified the patients into two groups according to the type of treatment used: group A included those who underwent procedures under general anesthesia and group B those with procedures under local anesthesia. Patients who did not undergo surgery (10 patients) were excluded from the group analysis. The variables studied in both groups were age, sex, month of the event, days of hospitalization, main region affected, *Comprehensive Complication Index* (CCI) (group A only), complication and number of complications (group B only), *Injury Severity Score* (ISS), admission and stay in the intensive care unit (ICU), and mortality.

Statistical analysis was performed using the *software* SPPS v.20. For the description of the categorical and quantitative variables, the frequencies and medians and the interquartile range (IR) were used, respectively. To compare the means of the variables between both groups, the student t test or ANOVA was used for the quantitative variables, and the test of χ^2 for the qualitative ones. For the multivariate analysis, linear or logistic regression was performed depending on whether the dependent variable was linear or binary. All contrasts were two-tailed and a value of $p < 0.05$ was considered statistical significance.

Results

138 cases were analyzed, with a median age of 34.7 years, of which 10 were women (7%) and 128 were men (93%). The months with the highest incidence were August and September (35% and 38%, respectively). The median hospitalization was 5 days (IR: 4-9). The main region affected was the lower limbs, with 83 cases (60%), followed by the trunk (thorax, abdomen, and pelvis) with 45 cases (33%), the upper limbs with 6 cases (4%), and the head and neck with

4 cases (3%) (Fig. 1). The ISS had a median of 1 point (IR: 1-9). Admission to the ICU was necessary in 12 patients (9%), with a median stay of 8.5 days (IR: 2-21). There were no deaths in our series (Table 1). The descriptive analysis by groups resulted as reflected in table 2.

The most frequent surgical intervention was Friedrich (50%), followed by exploratory laparotomy (10%); the rest of the interventions are detailed in table 3.

The comparative statistical analysis of variables between both groups determined a significant difference with respect to age, ISS and days of hospitalization, being greater in those belonging to group A. On the other hand, in this group there was a predominance of BHI locations in the thorax, abdomen, and pelvis (50.7%), unlike group B (15.4%), in which they predominated in the lower or upper limbs (*odds ratio* [OR]: 5.66; 95% confidence interval [95%CI]: 2.5-12.9; $p < 0.001$). The rest of the variables did not show significant differences (Table 4).

Multivariate statistical analysis (adjusted for age and sex) in the total population showed that ISS is related to hospital stay, postoperative morbidity (CCI), ICU admission, and the type of treatment applied (group A or group B). If the ISS is increased by one unit, the mean hospital stay is prolonged by 0.39 days (95% CI: 0.19-5.59; $p < 0.001$). For each increase in one unit of ISS, the CCI increases by 1.04 points (CI95%: 0.50-1.59; $p < 0.001$). In addition, patients with higher ISS increase their probability of admission to the ICU (OR: 1.23; 95%CI: 1.11-1.37; $p < 0.001$). Similarly, for every 1 unit increase in ISS, the probability of presenting a group A treatment increases by 14% (OR: 1.14; 95%CI: 1.07-1.22; $p < 0.001$). Finally, in turn, for each 1-unit increase in the ISS, the frequency of BHI in regions exposed to visceral trauma (thorax, abdomen, and pelvis) increases by 20% (OR: 1.20; 95%CI: 1.12-1.29; $p < 0.001$) (Table 5).

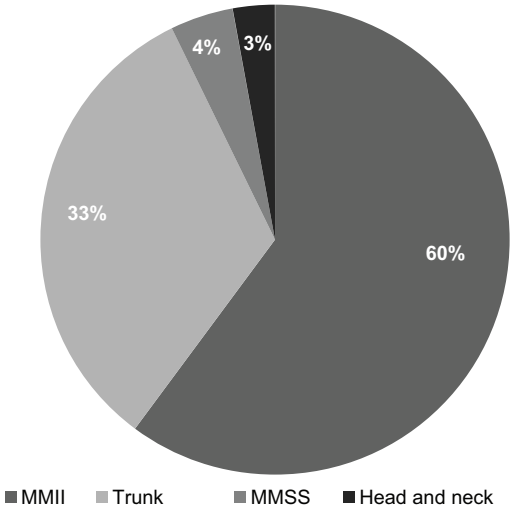

Figure 1. *Distribution of bull horn injuries, main region affected. MMII: lower limbs; MMSS: upper limbs.*

Table 1. Main characteristics of patients with bull horn injuries

Age, median (RI)	**34 (26-50)**
Man Woman	128 (93%) 10 (7%)
Event month	August (35%) and September (38%)
Hospitalization time, median (IR)	5 (4-9) days
Group A, cases	72 (52%)
Group B, cases	66 (48%)
ISS, median (IR)	1 (1-9) points
ICU admission	12 cases (9%)
ICU stay, median (IR)	9 days (2-21)
Deaths	0%

ISS: Injury Severity Score; IR: interquartile range; ICU: intensive care unit.

Discussion

The BHI are injuries with a high incidence in countries where the recreational practice of bullfighting is frequent[1]. Our series coincides demographically with the main ones published in the literature, with males being more frequently affected and with a mean age between the second and third decades of life[1,2,6-8]. Shukla et al.[8] have described another subgroup of patients in rural India in which the female sex predominates. This could be explained because the interaction with these animals is for work and not recreational purposes, and there may be a predominance of the female sex in this area.

The most frequent annual period are the months of August and September, summer in Spain, dates in which local festivals are more frequent. To reduce morbidity and mortality, it is necessary to have a permanent or temporary medical-surgical service close to the facilities where bullfighting is held[2]. The provision of more health personnel to the reference hospitals in the months in which the festivities prevail, especially in provinces with the greatest number of bullfighting

Table 2. Description by groups of patients with bull horn injuries

Variables	Group A	Group B
Cases	72 (52%)	66 (48%)
Age in years, median (RI)	39 (29-52)	31 (23-42)
Men Women	67 (93%) 5 (7%)	61 (92%) 5 (8%)
Hospitalization time, median (IR)	6 (4-9) days	4 (4-7) days
ISS, median (IR)	7 (1-16) points	1 (1-1) points
ICU admission	9 (13%) cases	3 (5%) cases
ICU stay, median (IR)	15 (5-26) days	2 (1-2) days

ISS: Injury Severity Score; IR: interquartile range; ICU: intensive care unit.

Table 3. Surgical procedures in patients with bull horn injuries

Type	Frequency	Percentage
Friedrich	58	50
Exploratory laparotomy	11	10
Diaphragmatic suture	4	4
Femoropopliteal bypass	4	4
Intestinal suture	3	3
Thoracostomy: Argyll chest tube	3	3
Reduction and osteosynthesis	3	3
Abdominal parietal repair	3	3
Arthrodesis	2	2
Intramedullary nail	2	2
Hepatectomy	2	2
Bowel resection	2	2
Abdominal packing	2	2
Colostomy	2	2
Atrial reconstruction	1	1
Endovascular procedure	1	1
Skin flap	1	1
Sphincteroplasty	1	1
Penile reconstruction	1	1
Lung suture	1	1
Reconstruction of anal mucosa	1	1
Cystostomy	1	1
Nephrectomy	1	1
Colectomy	1	1
Eyelid suture	1	1
Clavicular resection (partial)	1	1
Stentendovascular	1	1
Popliteal venous anastomosis	1	1
Total	115	100

festivities per year, considering our province as belonging to this group, could also be considered.

The median hospital stay in our center was almost 50% less than in most series (5 days), with an average of 10-15 days[1,3,7,9].

The BHI characteristics depend on the mechanism of injury, linked to the context of coexistence with the animal (festivity, upbringing). The gorings are not conditioned only by the shape of the horn, but mainly by the class of bull and its direction or disposition during the goring. Due to ballistics and stabbing laws, in these there is a direct relationship between the position of the victim and the weapon, but in BHI this principle is not fully complied with, being able to find routes and serious injuries at a distance from the door of goring entrance. However, what is related is the disposition of the victim, since it differs if he is sitting or lying down. When encountering tense muscles during movement or standing, the muscle tear can be deeper and therefore more serious[10].

Our most frequent lesion site in both groups was the lower limbs, similar to what was found in the literature[1-3,11]. However, this frequency changes in the analysis by groups, since in those who underwent surgery the most frequently affected region was the thorax-abdomen-pelvis, probably secondary to a greater severity of polytrauma, as they are prone to visceral injuries in these regions., which in turn coincided with a higher ISS score in this group. On the other hand, in a series of 101 cases related to the workplace, perineal and thoracoabdominal injuries predominated[7,9]. Possibly it is due to the fact that the patients at that moment were not in a state of alert, or in dispositions in the work area other than those of flight, as they are usually found in bullfighting festivities. In most of the series, as in ours, the predominant treatment was surgical[1-3,7-9,11].

The CCI is a quantitative tool (0-100) to calculate postoperative morbidity, encompassing all the data collected through the Clavien-Dindo classification in patients undergoing surgery, avoiding pointing out only the major complication, which may be biased[12,13]. It should be noted that the latter is designed for

Table 4. Comparative analysis of variables between both groups

Variables	Group A	Group B	p	Mean differences	95%CI
Age. Years	41.3	35.1	0.024	6.2	0.84-11.52
ISS	8.8	3.1	< 0.001	5.69	3.25-8.12
Hospitalization days, median	9.3	5.5	0.01	3.8	0.95-6.66

95%CI: confidence interval of 95%; ISS: Injury Severity Score.

Table 5. Multivariate analysis adjusted for age and sex

Variables	Coefficient/ OR*	p	95%CI Coefficient/OR*
Days of hospitalization	0.39	< 0.001	0.19-5.59
CCI (score)	1.04	< 0.001	0.50-1.59
ICU admission*	1.23	< 0.001	1.11-1.33
Type of treatment (group A)*	1.14	< 0.001	1.07-1.22
Visceral injuries vs. upper and lower limbs*	1.2	< 0.001	1.12-1.29

*Analysis by OR.
CCI: Comprehensive Complication Index; 95% CI: 95% confidence interval; OR: odds ratio; ICU: intensive care unit.

procedures in the field of general surgery, not including surgery on extremities[12]. The most frequently affected region in our study was the lower limbs, performing mostly soft tissue procedures as surgical treatment (e.g., Friedrich), being able to extrapolate to general surgery procedures (e.g., hernioplasties, lymphadenectomies). Studies in the area of orthopedic surgery are beginning to apply the CCI in limb surgery[14]. Due to this, we have decided to use it as a morbidity collection tool, being the first study in the BHI literature that uses it, encompassing complications that could go unnoticed in other series.

The most frequent complications published in other series were wound infection/abscess and skin necrosis[1-3,7,11]. In our series, in patients who did not initially undergo procedures in the operating room, the most frequent complication was hematoma, followed by wound infection/abscess that required drainage, highlighting the importance of adequate surgical exploration, Friedrich, and healing of the wound.

Being considered as polytraumatized patients, we quantified the degree of involvement using the ISS, previously performed only by García-Marín et al.[3]; however, these authors use a measure of central tendency (mean) that is not adequate for its analysis. In our study, by correlating the ISS with postoperative morbidity (CCI), the type of treatment, hospital stay and the need for ICU, we achieved a direct relationship between the magnitude/severity of the trauma and the patient's prognosis, the first being analytical study of the BHI literature.

Conclusions

There is a greater risk of undergoing surgery as age, ISS and risk areas for visceral injury (thorax, abdomen and pelvis) increase. The ISS is directly related to hospital stay, postoperative morbidity (CCI) and ICU admission, as well as the type of treatment to receive, pointing more towards surgery the older the ISS and the age of the patients with BHI. We believe that the CCI may be a good method for quantifying postoperative morbidity in polytraumatized patients or with injuries in areas other than the abdomen. Regarding the descriptive parameters, the rest of the results were similar to those of other series: the majority of patients with BHI are male, the lower limbs predominate as the main lesion site, and they occur at the time of year when bullfights are more frequent.

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Conflicts of interest

The authors declare that they have no conflicts of interest in conducting this study.

Ethical disclosures

Protection of people and animals. The authors declare that no experiments were carried out on humans or animals for this research.

Data confidentiality. The authors declare that they have followed the protocols of their work center regarding the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appears in this article.

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