

Management of Transpelvic Gunshot Wounds in Civilian Trauma

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ABSTRACT

Background: Transpelvic gunshot wounds (TGWs) require special attention due to the high density of organs that can be injured within the pelvis, causing associated injuries and a high morbidity and mortality rate. The multiple systems that can be affected make their clinical evaluation difficult and require multiple diagnostic studies. This study aims to describe the demographic, diagnostic, and therapeutic characteristics of patients admitted with TGWs.

Patients and methods: Retrospective, cross-sectional, and descriptive study, which included patients older than 15 years of age with a diagnosis of TGW admitted to two hospitals with a high rate of penetrating trauma in a period of 3 years.

Results: The cohort was composed of 94 patients with TGWs. 68% of the population arrived with hypovolemic shock [shock index (SI) >0.7]. Trauma evolution time was <12 hours in 91%. Focused assessment with sonography for trauma (FAST) was negative in 91 cases (97%). Among the diagnostic studies, the following predominated: Tomography (65.2%), X-rays (11%), recto-sigmoidoscopy (5%), and urethrocytography (4%). A total of 56 therapeutic laparotomies (73.6%) and nine nontherapeutic (11.8%) were performed. The most frequently injured organs were—the small bowel (36%), colon (21.2%), rectum (13.8%), and bladder (13.8%). Damage control surgery (DCS) was performed in 25 patients (26.5%), and 28 (29.7%) required massive transfusion. The mean hospitalization was 6.7 days, the most frequent complications being surgical wound infection (8.5%), ileum (3.1%), anastomosis leak (2.1%), and wound hematoma (2.1%). Mortality was 8.2%.

Conclusions: Transpelvic gunshot wounds (TGWs) must be managed differently from penetrating abdominal trauma. Most of these patients have multiple injuries requiring early surgical treatment, even when admitted stable. Its protocolization is necessary according to the resources of each center for an adequate initial diagnostic evaluation since the physical examination can be uncertain.

Keywords: Damage control surgery, Gunshot wound, Pelvic Trauma, Penetrating trauma.

RESUMEN

Introducción: Las heridas por armas de fuego transpélvicas requieren especial atención debido a la gran cantidad de órganos que pueden ser lesionados dentro de la pelvis, causando alta morbilidad y mortalidad. Los múltiples sistemas que pueden ser afectados hacen que la evaluación clínica sea difícil y requieren de múltiples estudios diagnósticos. El objetivo de este trabajo es describir las características demográficas, diagnósticas y terapéuticas de pacientes hospitalizados por heridas por arma de fuego transpélvica.

Pacientes y métodos: estudio retrospectivo, descriptivo en donde se incluyen pacientes mayores de 15 años con el diagnóstico herida por arma de fuego transpélvica hospitalizados en dos centros con alto volumen de trauma penetrante en un periodo de 3 años.

Resultados: La cohorte fue compuesta por 94 pacientes con heridas por arma de fuego transpélvica. 68% de los pacientes ingresan con shock hipovolémico (SI >0.7). El tiempo de evolución desde el evento traumático fue menor a 12 horas en el 91% de los pacientes. FAST fue negativo en 91 casos (97%). Dentro de los estudios diagnósticos predominaron, tomografía (65.2%), rayos-X (11%), recto-sigmoidoscopia (5%) y uretrociatografía (4%). Se realizaron 56 laparotomías terapéuticas (73%) y 9 no terapéuticas (11.8%). Los órganos más frecuentemente lesionados fueron, intestino delgado (36%), colon (21.2%), recto (13.8%) y vejiga (13.8%). Cirugía de control de daños se requirió en 25 pacientes (26.5%) y 28 pacientes requirieron transfusión masiva (29.7%). El promedio de días de hospitalización fue 6.7 días y la complicación más frecuente fue la infección de herida quirúrgica (8.5%), íleo (3.1%), filtración de anastomosis (2.1%) y hematoma de herida (2.1%). La mortalidad fue 8.2%.

Conclusion: Las heridas por arma de fuego transpélvica deben ser manejadas de diferente forma al trauma abdominal. La mayoría de estos pacientes tienen múltiples lesiones requiriendo tratamiento quirúrgico precoz, incluso si el paciente es admitido estable. Para la evaluación diagnóstica inicial, es necesaria una protocolización de acuerdo a los recursos de cada centro, pues el examen físico puede ser equivoco.

Palabras claves: Trauma penetrante, Trauma pélvico, Herida por arma de fuego, Control de daños.

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INTRODUCTION

Although penetrating abdominal trauma has been extensively studied and described, it is not the case for the pelvis when studied as an isolated anatomical entity.¹⁻³ There is little bibliography that describes the characteristics and management of patients who suffer a TGW. The same can be said about its results in terms of morbidity and mortality.

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Among the challenges of this type of trauma is the high incidence of injuries associated due to the density of structures contained in an area of difficult access, such as the pelvic bone ring, which includes part of the small bowel, colon, rectum, bladder, nervous, and genital structures; and the possibility of vascular lesions that rapidly affect hemodynamics. All of the above make damage control strategies highly necessary. In stable patients, the difficulty of the few symptoms caused by extraperitoneal lesions, such as those in the bladder, ureter, and rectum, is added. In addition, multiple diagnostic options are available, such as tomography, urethrocytography, rectosigmoidoscopy, and ultrasonography, among others. However, the most optimal method for the diagnosis of lesions in this region is not so well defined.⁴

This article aims to describe the demographic and clinical characteristics, diagnostic studies, management, and complications of patients admitted with a diagnosis of TPGW in two centers with a high volume of penetrating trauma.

PATIENTS AND METHODS

Study Design and Population

A retrospective observational study that includes all patients older than 15 years old admitted to Dr Sótero del Río Hospital in Santiago, Chile, and Dr Domingo Luciani Hospital in Caracas, Venezuela, diagnosed with penetrating pelvic trauma between the years 2019 and 2021.

The pelvic area is defined as the zone between iliac crests as the upper limit and the perineal region as the inferior limit (Fig. 1). The study only included patients with transpelvic bullet trajectory, which is deduced clinically by connecting the entry and exit site of the projectile or in the computed tomography (CT) if the projectile crosses the middle line and stays between the peritoneum and bone edge in the contralateral side (Fig. 2).

The study excluded all patients with concomitant penetrating abdominal trauma, death in the trauma bay, transferred from other centers, and all patients whose penetrating trauma was not from a firearm.

Study Variables

The analysis included variables such as time since the traumatic event, age, sex, number of wounds in the pelvis, concomitant injury in other zones, SI, FAST, digital rectal exam (DRE), presence of blood in urine, presence of abdominal pain, type of diagnostic studies, type of treatment, associated injuries, need for DCS, need for massive transfusion, days of hospitalization, mobility,

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and mortality. A descriptive analysis was performed, presenting categorical variables such as proportions and continuous variables as means.

RESULTS

Within the analyzed period, 94 patients met the inclusion criteria. In this group, there are 85 male (90%) and nine female (10%) patients with a mean age of 26.9 years [standard deviation (SD) \pm 9.6]. The time between the traumatic event and admission was <12 hours in 86 patients (91%). In this cohort, wound by a single firearm projectile was predominant in 64 patients (68%) (Table 1).

Patients on admission presented a mean SI of 0.8 (SD \pm 0.47), among whom 64 (68%) presented an SI equal to or higher than 0.7 on admission to the emergency room. FAST was negative in 91 cases (97%). The DRE was positive for blood in eight patients (9%). Hematuria was obtained in 13 patients (14%). A total of 36 patients presented signs of peritoneal irritation (38%) (Table 1). Lower extremities were the area outside the pelvis more frequently injured in 27 patients (28.7%). In this cohort, CT was predominant as a diagnostic study (65%), followed by X-ray (11%), ultrasound (7%), rectosigmoidoscopy (5%), and cystography (4%). In the findings of those who underwent CT, pelvis fracture was present in eight patients (10%), followed by colon injuries in two patients (2%), and lumbar spine injury in two patients (2%).

A total of 17 patients (18%) were managed with nonoperative treatment. On the other hand, 77 patients (81%) were treated with surgery, out of whom only one with diagnostic laparoscopy, which was negative. The other 76 patients were treated with open surgery—nine laparotomies were nontherapeutic, and 56 were therapeutic. The injured organs in order of frequency were—the small intestine (36.1%), colon (21.2%), rectum (13.8%), bladder (13.8%), and genitals (7.4%) (Table 2). A total of 25 patients (26.5%) required DCS, and 28 (29.7%) needed a massive transfusion, defined as the transfusion of >6 red blood units in 1 hour. The mean of admission days was 6.7 (1–38 days). The most frequent complication was an infection of the surgical wound (8.5%), ileum (3.1%), anastomosis leak (2.2%), and surgical wound hematoma (2.1%). The mortality in this cohort was 8.2%.

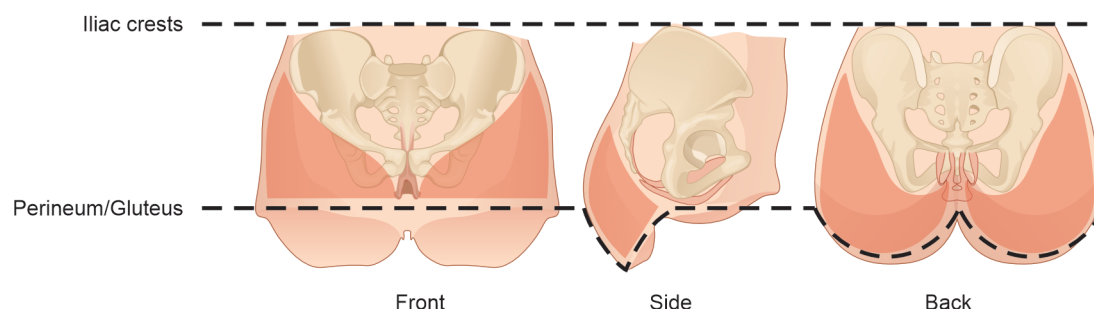


Fig. 1: Anatomical diagram of the pelvic area considered for the inclusion criteria of the study. The zone between iliac crests is the upper limit, and the perineal region is the inferior limit, including the gluteus

DISCUSSION

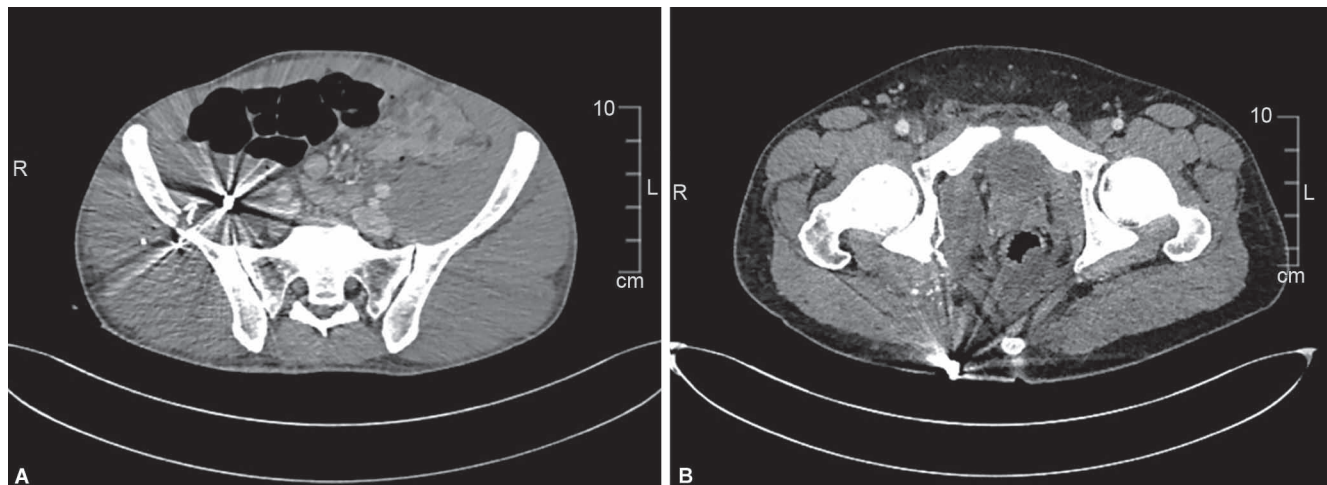
Frequently, TGW presents in the context of hypovolemic shock, where the most common is to find multiple and associated injuries, both intraperitoneal and extraperitoneal. This brings two problems: It makes clinical and imaging diagnosis difficult, and it creates a great surgical challenge, given that it requires fast and secure skills to have vascular control, in addition to the need to perform damage control techniques or repair different organs and systems.

When we analyzed the clinical presentation of patients, we found that only 38% of them who suffered an intraabdominal injury presented peritoneal irritation signs on admission, less than those found in other reports, where it varies from 48 to 62.3%.⁵ This can be determined because the injury of extraperitoneal organs does not manifest with peritoneal symptoms. In addition, given the complexity of these patients, more than one physical exam on admission is required, being necessary to perform it serially and by the same examiner to evidence subtle alterations in the clinic that determine a change in the treatment. Although DRE accompanies the secondary evaluation of the polytraumatized patient, in this cohort, we observed that only 61.5% of patients with rectal injury had a positive DRE, which is similar to other

studies that report a sensibility of 33–52%.⁶ Therefore, in case of suspicion of a rectal injury, other diagnostic studies that objectify the injury must be

Currently, FAST is considered an extension of the physical examination. However, in our study, 97% of the patients had negative FAST on admission, even though most of them had surgery. This can be explained because, in these patients, a significant number of lesions were extraperitoneal. Besides, FAST diagnostic precision is higher in unstable patients with blunt trauma⁷ while presenting a high incidence of false negative results in stable patients.⁸ Therefore, in a patient with negative FAST on admission and TGW, an injury cannot be ruled out; hence we recommend performing serial FAST in addition to other diagnostic studies.

The only clinical finding that correlated well with the imaging and surgical findings was the presence of hematuria in all patients with bladder injury. Hsieh et al.⁹ found similar results in which 94% of patients with bladder injury presented hematuria, as well as Guttman and Kerr,¹⁰ in whose report the bladder injury is associated with macroscopic hematuria in 95% of cases and 5% with microscopic hematuria.



Figs 2A and B: Tomography of a patient with penetrating transpelvic trauma with admission imaging criteria. The projectile crosses the middle line and stays between the peritoneum and bone edge on the contralateral side

Table 1: Patient demographics, clinical and injury data

	Total (n = 94)	SRH (n = 40)	DLH (n = 54)
Age	26.9 ± 9.6	30.1 ± 11.2	24.5 ± 7.3
Male	90% (85)	100% (40)	83% (45)
Trauma evolution time under 12 hours	91 % (86)	85% (34)	96% (52)
Gunshot trauma mechanism.	68% (64) 24.4% (23) 7.4% (7)	67% (40) 20% (8) 12.5% (5)	68.5% (37) 27.7% (15) 3.7% (2)
Single projectile			
Multiple single-shot projectiles			
Shotgun (multiple projectiles)			
SI on admission	0.85 ± 0.47	0.9 ± 0.68	0.8 ± 0.22
SI > 0.7 average	68% (64)	55% (22)	77% (24)
Negative FAST on admission	97% (91)	85% (34)	96.8% (91)
Positive DRE	9% (8)	5% (2)	11.1% (6)
Presence of hematuria	14% (13)	17.5% (7)	11.1% (6)
Signs of peritoneal irritation	38% (36)	22.5% (9)	50% (27)

FAST, focused assessment sonography for trauma; DRE, digital rectal exam; SRH, Sotero del Rio hospital; DLH, Domingo Lucianni hospital

Currently, the gold standard diagnostic test for penetrating pelvic trauma is the CT with elimination, arterial, and venous phases. If there is any doubt about urinary tract injury, a retrograde

Table 2: Injured structures in patients admitted with penetrating transpelvic trauma

	N (%)
Small bowel	34 (36.1)
Colon	20 (21.2)
Rectum	13 (13.8)
Bladder	13 (13.8)
Pelvic bone	8 (10.0)
Genitals	7 (7.4)
Cava Vein	3 (3.1)
Femoral vessels	3 (3.1)
Iliac vessels	2 (2.1)
Aorta	1 (1.0)

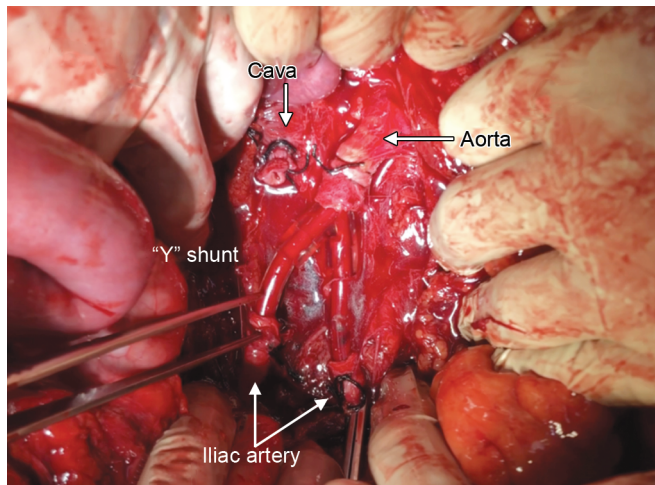


Fig. 3: Damage control surgery (DCS) in a patient with aortic injury in the iliac bifurcation, where Y shunt is used, in addition to the cava lesion to which ligation is performed

cystography can also be done; and if any rectal injury is suspected, a rectoscopy can also be performed (Fig. 3).⁴

However, other diagnostic studies can be done when CT is unavailable or used to complement it, such as angiography, cystoscopy, and speculoscopy. The choice and sequence of these studies depend on suspicion of the injury. According to the availability of each center, these studies are valid to guide the surgeon's conduct.

When we analyze the hemodynamic state of the cohort, 68% of the patients were admitted in hypovolemic shock (SI greater than 0.7). This is lower than the 82% found by Theodorakis and Baffes.¹¹ In our cohort, most unstable patients had injuries in multiple organs rather than specific isolated lesions. In these cases, bleeding control is problematic because it implies control of multiple sources of bleeding simultaneously (Fig. 3).

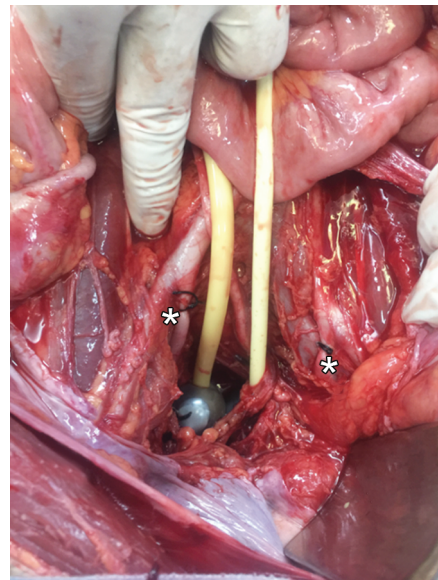
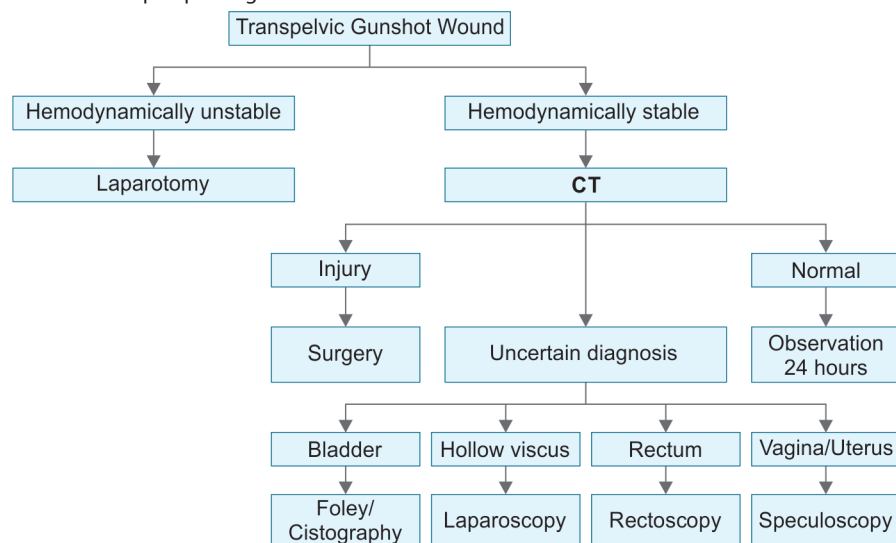


Fig. 4: Patient with a TGW. Abdominal examination revealed an expansive pelvic hematoma with active arterial and venous bleeding. The hematoma was opened with ligation of the hypogastric arteries (*), and installation of a hemostatic balloon (Foley) to control venous bleeding from the sacral plexus

Flowchart 1: Algorithm for the work-up of pelvic gunshot wounds



Although in stable patients with penetrating abdominal trauma, nonoperative management is accepted when it is protocolized; this management is controversial in patients with TGW.¹² In our cohort, 81.9% of the patients were managed surgically, although an injury was found in only 72.7% of the cases. These are more than reported by Duncan et al., wherein in 53.7% of the cases, an injury was found in the laparotomy.¹³

A total of 18% of patients were managed nonoperatively with good evolution. However, we need more studies to safely conduct nonoperative management in this type of patient. On the other hand, 26.5% of patients required DCS, with procedures such as vascular shunt, hypogastric artery and intestinal ligation, pelvic packing, and hemostatic balloons (Fig. 4).

In this study, 8.2% mortality was reported, lower than in other series that reported up to 12%¹³ and 12.4%.⁴ Mortality in these studies was due to a significant vascular injury, which is reported with an incidence of 34.5% and 30.9%, respectively. In our study, only 6% of patients presented a significant vascular injury, which may explain the low mortality.

This study has some limitations, starting with its retrospective methodology. The population was taken from centers with a high volume of penetrating trauma but with significant differences in resources and different countries. There are considerable differences between centers regarding access to massive transfusion, acute beds, and CT, among others. This can determine differences in diagnostic studies and morbidity and mortality. Another limitation is that the follow-up of patients was carried out until hospital discharge. Therefore, long-term complications can not be determined in this group of patients.

CONCLUSION

The TPGW is a challenge for trauma surgeons. In the unstable patient, with frequency, we found associated injuries that require applying damage control techniques. While in stable patients, CT is recommended, subsequent additional diagnostic studies will be needed accordingly (Flowchart 1). This type of trauma requires management different from penetrating abdominal trauma and established protocols, according to the resources of each center, to direct their study and treatment.

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