

Factores socioeconómicos, clínicos y quirúrgicos relacionados al manejo de trauma abdominal penetrante en un hospital de alto nivel de complejidad del caribe colombiano: experiencia de 3 años

Socio-economic, clinical, and surgical factors related to the management of penetrating abdominal trauma in a high-complexity institution in the Colombian Caribbean: 3-year experience

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Abstract

Introduction: Trauma is an important cause of mortality worldwide and the fourth cause of death in Colombia. This condition generates morbidity and disability, having a substantial impact on the years of life potentially lost, especially in the younger ages where it is more prevalent.

Objective: To characterize epidemiologically and clinically patients with penetrating abdominal trauma managed surgically.

Materials and methods: Observational cross-sectional retrospective study of patients with penetrating abdominal trauma, surgically managed in a high complexity level hospital between 2016 and 2018, including sociodemographic and clinical variables related to trauma, type of surgical intervention and associated complications.

Results: A total of 115 patients were identified, 94.8% of them were male. The predominant mechanism of injury was by a short stabbing weapon (67.8%). Drug and intoxicant use were found in 43.7% of the cases. The main organs injured were the small intestine (39.1%), small vessels (20%) and liver (16.5%). The most frequent types of repairs performed were small bowel repair (22.6%) and small bowel anastomosis (20.9%). The Penetrating Abdominal Trauma Index >25 showed higher hyperlactatemia (80%) and sepsis (50%). Mortality was 3.4%, associated with reoperation and sepsis.

Conclusion: Mortality due to penetrating abdominal trauma in the Colombian Caribbean coast is low. Nine out of ten cases are men, almost half of the cases are related to the consumption of psychoactive substances and the main complications are hyperlactatemia and sepsis.

Key words: Wounds and Trauma, Caribbean Region, General Surgery, Mortality.

Resumen

Introducción: El trauma es una importante causa de mortalidad a nivel mundial y la cuarta causa de muerte en Colombia. Esta condición genera morbilidad y discapacidad, impactando sustancialmente sobre los años de vida potencialmente perdidos, sobre todo, en las edades más tempranas donde es más prevalente.

Objetivo: Caracterizar epidemiológica y clínicamente pacientes con trauma abdominal penetrante manejados quirúrgicamente.

Materiales y métodos: Estudio observacional de corte transversal y linealidad retrospectiva de pacientes con trauma abdominal penetrante, manejados quirúrgicamente en un hospital de alto nivel de complejidad entre 2016 y 2018, que incluye variables sociodemográficas y clínicas relacionadas con el trauma, el tipo de intervención quirúrgica y complicaciones asociadas.

Resultados: Se identificaron 115 pacientes, el 94,8% de sexo masculino. El mecanismo de lesión predominante fue por arma corto-punzante con 67,8%. Se encontró consumo de drogas y sustancias embriagantes relacionado en

el 43,7% de los casos. Los principales órganos lesionados fueron el intestino delgado 39.1%, pequeños vasos con 20% e hígado con 16.5%. Los tipos de reparo realizados más frecuentemente fueron la rafia de intestino delgado (22,6 %), y la anastomosis de intestino delgado (20,9%). El Penetrating Abdominal Trauma Index >25 mostró mayor hiperlactatemia (80%) y sepsis (50%). La mortalidad fue del 3.4%, asociado a reintervención y sepsis.

Conclusión: La mortalidad por trauma abdominal penetrante en la costa del caribe colombiano es baja. 9 de cada 10 casos son hombres, casi la mitad de los casos se relaciona a consumo de sustancias psicoactivas y las principales complicaciones son la hiperlactatemia y sepsis.

Palabras clave: Heridas y Traumatismos, Región del Caribe, Cirugía General, Mortalidad.

1. Introduction

Trauma is an important cause of mortality worldwide and the fourth cause of death in Colombia (1); among the different types of traumas, the abdominal area is one of the most frequently affected, and its treatment constitutes a diagnostic, therapeutic and surgical challenge, given the great confluence of organs within the abdominal cavity. Penetrating abdominal trauma is defined as the violation or transgression of the parietal peritoneum (2). The mechanisms of trauma are very varied, involving a diversity of objects and weapons, including sharp objects and firearms. As a consequence of the above, this type of pathology has a significant impact on the years of life potentially lost (1).

Before the age of surgery and the use of anesthetics, the management of abdominal trauma victims was exclusively conservative (3). It was not until the Great War in 1915 that the exploration of all abdominal wounds became mandatory, which finally led to a decrease in patient mortality during the Second World War (4). Nowadays, there are several clinical approaches and treatments for this type of patient, ranging from conservative management to mandatory surgery, thanks to advances in techniques and available technology. However, there are still complications that result in non-negligible morbidity and mortality in these patients (5).

In patients injured with penetrating abdominal trauma, there is variable involvement of the parietal peritoneum, with between 20% to 80% being affected depending on the type of weapon. The hollow viscera are mainly affected, with the small intestine being the most frequently injured organ (6), followed by other hollow viscera such as the stomach and colon, and to a lesser extent the solid viscera. Although trauma to the hollow viscera does not initially con-

tribute to the patient's instability, they are the focus of contamination that significantly increases the risk of postoperative infectious complications.

In general, blunt abdominal trauma is more frequent in developed countries, mainly due to traffic accidents, representing an important cause of death and disability (7). However, in countries and geographic locations where there are armed conflicts and civil violence, this relationship between penetrating and blunt abdominal trauma is inverted, with the former being one of the main causes of death due to trauma (8). Studies carried out in Latin America show significant complications associated with this type of trauma of 39.24% and non-negligible mortality of up to 3.9% (9), in addition, they report mortality rates of 19 deaths per 100 patients admitted with a diagnosis of abdominal trauma (10).

Colombia is a country with high rates of violence and accidents, so the presence of patients with physical trauma in emergency departments is frequent. This determines the need to have national, regional and local registries of the main traumatic injuries, in order to know the dynamics of this condition and to define safe and effective algorithms. In the hospital of Caldas, at the end of the 90's, a study was carried out with this approach, determining that the penetrating injury mechanism was the most frequent, with 96.7%, and the predominant complications were infectious, followed by bleeding (11). In Cartagena, in 2011, a study of 59 trauma patients was carried out, determining that the main abdominal involvement was due to penetrating trauma in 69.5%, with a distribution of injuries by sharp weapon and firearm of 40.7% and 30.5% respectively, and a mortality of 9.6% (12).

Since penetrating abdominal trauma is one of the entities that generates the greatest number of complications, morbidity, and mortality in the context of trauma, as well as its high incidence in our environment, it is of vital importance to describe the clinical, surgical and sociodemographic factors related to penetrating abdominal trauma. Based on the above, the present study aims to characterize the penetrating abdominal trauma surgically managed in a hospital of high level of complexity in the Colombian Caribbean, during a period of 3 years.

2. Materials y methods

Observational study of cross-sectional and retrospective linearity, which took as subject population of study all medical records with complete data of patients older than 18 years old with evidence of clinical or imaging diagnosis of penetrating abdominal trauma and who were taken to surgical manage-

ment in the E.S.E. University Hospital of the Caribbean (UHC), in the period between the years 2016 and 2018.

In all selected medical records, variables such as sex, age, relevant history of substance abuse, previous abdominal surgeries, comorbidities, injury characteristics such as time elapsed between injury and surgery, injured abdominal anatomical area, mechanism of injury, relevant physical examination findings, calculation of the traditional shock index (SI) and the unmodified index to estimate the risk of mortality were collected. In addition, relevant paraclinical findings, intraoperative aspects such as evidence of a penetrating abdominal wound with intraperitoneal injury, transfusion or autotransfusion and frequency of therapeutic laparotomy were studied. The risk of infection and death was estimated using the Penetrating Abdominal Trauma Index (PATI) score (13), intraoperative contamination between one to four quadrants, types of most frequently used repairs, most frequently injured organs, need for ICU, hospital stay, frequency and type of postoperative complication, and mortality.

The descriptive analysis of qualitative variables was performed by calculating absolute and relative frequencies; quantitative variables were expressed as median and interquartile range (IQR) given the nonparametric nature of these variables estimated by the Kolmogorov Smirnov test. Comparisons of proportions were performed with the X² or Fisher's exact test as necessary; comparisons of quantitative variables were performed with the Mann Whitney U test; a p value <0.05 was considered statistically significant. Finally, an exploratory analysis of the predictive capacity of traditional and modified SI for complications was performed, consisting of the calculation of the Receiver Operator Curves (ROC), estimating the cut-off point of the SI with the best values of sensitivity, specificity and Area Under the Curve (AUC) with their respective confidence intervals at 95%.

This research followed the rights and principles enshrined in the Declaration of Helsinki (14) and was classified as minimal risk according to resolution 8430 of 1993 of the Colombian Ministry of Health (15). Likewise, this study was endorsed by the Ethics Committee of the E.S.E. University Hospital of the Caribbean.

3. Results

During the study period, 115 patients who met the selection criteria were identified. The median age was 27 years (IQR: 23 - 33), of which 94.8% were male. The most important antecedent was substance use in 43.7% of cases, followed by abdominal surgery and arterial hypertension with 7% and 0.9% respectively. The median time elapsed between the time of injury and surgery was 60 minutes (IQR: 30 - 190). The area of injury was more frequent in the anterior abdominal wall in 73.9%, with the main mechanism of injury being a sharp-force injury (SFI) (67.8%). The remaining percentage was presented with firearm injury (FI). Physical examination revealed peritoneal irritation in 60% and epiplocele in 16.5%. Digital examination of the wound was performed in 20.9% of the patients, with intraperitoneal findings in 19.1%. The median modified SI was 1.10 with a mortality risk of 86.1%; on the other hand, the unmodified SI had a median of 0.80 with a 33% mortality risk. The clinical and sociodemographic characteristics are summarized in **Table 1**.



During the study period, 115 patients who met the selection criteria were identified.

The median age was 27 years»

Table 1. Clinical and sociodemographic characteristics of the study population.

	N (115)	%
Age M (IQR)	27 (23 - 33)	
Gender		
F	6	5,2
M	109	94,8
Background		
Psychoactive Substance Us	50	43,5
Abdominal Surgery	8	7,0
Arterial Hypertension	1	0,9
Diabetes Mellitus	0	0,0
Coronary Heart Disease	0	0,0
Time between injury and surgery	60 (30 - 190)	
Area of injury		
Anterior wall	85	73,9
Espalda	31	27,0
Flanco	29	25,2
Injury cause		
Short Stabbing	78	67,8
Firearm	37	32,2
Physical exam		
Peritoneal irritation	69	60,0
Epiplotele	19	16,5
Digital Wound Scan	24	20,9
Positive	22	19,1
SI Modified	1,10 (0,93 - 1,29)	
Mortality risk > 0,9	99	86,1
SI Unmodifie	0,80 (0,71 - 0,97)	
Mortality risk > 0,9	38	33,0

* The percentage is calculated over the total N.
SI: Shock Index

Among the paraclinical findings on admission, leukocytosis and hyperlactatemia were found in 54.8% and 27% respectively. Intraoperative findings showed penetrating abdominal injury in 93% of cases, need for therapeutic laparotomy in 77.4% and intraperitoneal injury in 70.4%. The PATI score had a median of 8 with an infection risk ratio of 8.7%; intraoperative contamination was observed in 45.2%, being more frequent in the first quadrant (37.4%). The most frequent types of repairs performed were small bowel repair (22.6%), followed by small bowel anastomosis (20.9%), solid organ repair (20%) and large bowel repair (17.4%). Prophylactic appendectomy was also performed in 28.7% of patients and damage control surgery in 5.2%. The need for intensive care unit (ICU) management was present in 16.5%, the

median hospital stay was 4 days (IQR: 2 - 6). Some complication was observed in 24.4% and 3.5% of patients died (Table 2).

Table 2. Paraclinical findings on admission, intraoperative and postoperative evolution

	N (115)	%
Leukocytosis	63	54,8
Excess point < -8	16	13,9
Hyperlactatemia	31	27,0
Intraoperative aspect		
Penetrating abdominal injury	107	93,0
Therapeutic laparotomy	89	77,4
Intra peritoneal lesion	81	70,4
Auto transfusion	5	4,4
Transfusion	7	6,1
PATI Score	8 (0 - 14)	
Risk of infection and death > 25	10	8,7
Intraoperative Contamination	52	45,2
One quadrant	43	37,4
Two quadrants	10	8,7
Three quadrants	2	1,7
Four quadrants	1	0,9
Type of Repair		
Small Intestine	26	22,6
Small bowel anastomosis	24	20,9
Solid	23	20,0
Large Intestine	20	17,4
Stomach	11	9,6
Other hollow viscera	8	7,0
Colostomy	7	6,1
Vascular repair	7	6,1
Large bowel anastomosis	3	2,6
Duodenum	2	1,7
Prophylactic appendectomy	33	28,7
Damage control surgery	6	5,2
Need for stay in intensive care	19	16,5
Total days of hospital stay	4 (2 - 6)	
Postoperative complication	28	24,4
Mortality	4	3,5

* The percentage is calculated over the total N.
PATI: Penetrating Abdominal Trauma Index

The main organs affected were the jejunum in 25.2%, small vessels 20%, liver 16.5%, diaphragmatic wound 15.7% and ileum in 13.9%. When comparing the organs affected by mechanism of injury, a higher frequency of involvement of the jejunum, ileum, bladder, intraperitoneal colon, and cecum was

found in patients with FI, while in patients with SFI, diaphragmatic injury was more frequently observed in the context of associated thoraco-abdominal trauma (20.9%) (**Table 3**). Postoperative complications were wound seroma in 12.2%, followed by abdominal sepsis and organ-space surgical site infection, requiring reoperation in 11.3%. The median time between injury and surgery in patients with the main complications ranged between 30 and 75 min, with no statistically significant differences between them.

Table 3. Main viscera injured overall and stratified by mechanism of injury

	All organs		FI N=37		SFI N=78		Value p
	N	%	N	%	N	%	
Jejunum	29	25,2	16	43,2	13	16,7	0,0021
Small vessels	23	20,0	8	21,6	15	19,2	0,7646
Liver	19	16,5	5	13,5	14	17,9	0,5496
Diaphragmatic wound	18	15,7	2	5,4	16	20,5	0,0372
Ileum	16	13,9	10	27,0	6	7,7	0,0085
Stomach	11	9,6	2	5,4	9	11,5	0,4987
Spleen	9	7,8	3	8,1	6	7,7	0,9384
Descending colon	7	6,1	4	10,8	3	3,8	0,2092
Transverse colon	6	5,2	2	5,4	4	5,1	0,9504
Bladder	5	4,4	4	10,8	1	1,3	0,0364
Ascending colon	4	3,5	1	2,7	3	3,8	0,7556
Intra Colon	4	3,48	4	10,8	0	0,0	0,0095
Pancreas	4	3,5	1	2,7	3	3,8	0,7556
Duodenum	3	2,6	0	0,0	3	3,8	0,5499
Cecum	3	2,6	3	8,1	0	0,0	0,0314
Gallbladder	3	2,6	1	2,7	2	2,6	0,9654
Kidneys	3	2,6	1	2,7	2	2,6	0,9654
Sigmoid colon	1	0,9	1	2,7	0	0,0	0,3217
Extra Colon	1	0,9	1	2,7	0	0,0	0,3217
Ureters	1	0,9	1	2,7	0	0,0	0,3217
Large vessels	1	0,9	1	2,7	0	0,0	0,3217
Biliary tract	0	0,0	0	0,0	0	0,0	-
Adrenal glands	0	0,0	0	0,0	0	0,0	-
Uterus	0	0,0	0	0,0	0	0,0	-
Ovary	0	0,0	0	0,0	0	0,0	-
Tube	0	0,0	0	0,0	0	0,0	-

*The percentage is calculated over the total N.

FI: firearm injury; SFI: sharp-force injury

The comparison of physical examination findings and mortality risk by calculating the modified and unmodified shock indices, stratifying the sample by whether therapeutic laparotomy was performed or not, showed a higher frequency of peritoneal irritation (65.2%) and mortality risk by modified SI

of 89.9%, ($p < 0.01$); the same analysis showed a higher frequency of digital exploration of the wound in the group without therapeutic laparotomy (**Table 4**).

Table 4. Comparison of physical examination aspects and risk of mortality by shock index, stratified by whether or not therapeutic laparotomy was performed

Therapeutic Laparotomy

	Yes N=89	No N=26	Value p
Physical examination			
Peritoneal irritation	58 (65,2)	11 (42,3)	0,0363
Epiplotele	19 (21,3)	0 (0,0)	0,3607
Digital Wound Scanning	14 (15,7)	10 (38,5)	0,0251
Positive	13 (14,6)	9 (34,6)	0,0434
SI Modified	1,15 (0,96 - 1,28)	1,01 (0,87 - 1,30)	0,1000
Mortality risk > 0,9	80 (89,9)	19 (73,1)	0,0128
SI Unmodified	0,84 (0,72 - 0,97)	0,77 (0,65 - 0,96)	0,0980
Mortality risk > 0,9	31 (34,8)	7 (26,9)	0,4507

*The percentage is calculated over the total N.
SI: Shock Index

The analysis of the paraclinical findings, complications, and evolution of the patients according to the PATI index, showed in the group with PATI >25, the presence of hyperlactatemia (80%), wound seroma (40%), need for re-intervention and sepsis with 50% each, fistulas, and hypocalcemia with 30% and 20%, respectively. In addition, greater need for ICU management, longer hospital stays and mortality (**Table 5**).



The comparison of physical examination findings and mortality risk by calculating the modified and unmodified shock indices, stratifying the sample by whether therapeutic laparotomy was performed or not, showed a higher frequency...»

Table 5. Comparison of paraclinical findings, complications, and patient outcome according to the Penetrating Abdominal Trauma Index infection risk score.

	PATI >25 N=10 (%)	PATI ≤ 25 N=105 (%)	Value
Leukocytosis	4 (40,0)	59 (56,2)	0,3441
Excess point < -8	3 (30,0)	13 (12,4)	0,1438
Hyperlactatemia	8 (80,0)	23 (21,9)	0,0003
Pneumothorax	2 (20,0)	22 (21,0)	0,9437
Complications			
Wound seroma	4 (40,0)	10 (9,5)	0,0193
Reintervention	5 (50,0)	8 (7,6)	0,0023
Sepsis	5 (50,0)	6 (5,7)	0,0005
OSI organ	4 (40,0)	4 (3,8)	0,0017
Inadvertent injury	1 (10,0)	4 (3,8)	0,3708
Fistulas	3 (30,0)	1 (1,0)	0,0018
Hypocalcemia	2 (20,0)	2 (1,9)	0,0373
Post-surgical ileus	1 (10,0)	3 (2,9)	0,3085
Deep OSI	0 (0,0)	3 (2,9)	0,5896
Eventration	1 (100)	2 (1,9)	0,2407
Superficial OSI	0 (0,0)	.2 (1,9)	0,6611
Wound dehiscence	0 (0,0)	1 (1,0)	0,7576
ICU stay	9 (90,0)	10 (9,5)	<0,0001
Hospital Stay Days	9 (6 - 22)	3 (2 - 5)	0,0003
Mortality	3 (30,0)	1 (1,0)	0,0018

* The percentage is calculated over the total N.
OSI: Operative Site Infection.

Comparison of the main complications among the deceased patients showed a higher frequency of reintervention and sepsis with 100% each, in addition to hypocalcemia and postoperative ileus in 25% of the deceased vs. the non-deceased. In the last ones, a greater presence of associated pneumothorax (21.6%) and wound seroma (12.6%) was observed ($p < 0.05$) (**Table 6**).

«In the last ones, a greater presence of associated pneumothorax (21.6%) and wound seroma (12.6%) was observed.»



Table 6. Comparison of major complications stratified by mortality
Mortality

	Yes N=4	No N=111	Value p
Wound seroma	0 (0,0)	14 (12,6)	<0,0001
Reintervention	4 (100,0)	9 (8,1)	0,0001
Sepsis	4 (100,0)	7 (6,3)	0,0025
OSI organ	4 (100,0)	4 (3,6)	0,0759
Inadvertent injury	2 (50,0)	3 (2,7)	0,0754
Fistulas	3 (75,0)	1 (0,9)	0,9077
Hypocalcemia	1 (25,0)	3 (2,7)	0,0356
Post-surgical ileus	1 (25,0)	3 (2,7)	0,0356
Deep OSI	0 (0,0)	3 (2,7)	0,0105
Eventration	0 (0,0)	3 (2,7)	0,0105
Superficial OSI	0 (0,0)	2 (1,8)	0,0495
Wound dehiscence	0 (0,0)	1 (0,9)	0,2260

*The percentage is calculated over the total N.

OSI: Operative Site Infection.

Finally, the ROC curve analysis of the modified and unmodified SI in the prediction of complications did not show statistically significant results (**Table 7**).

Table 7. ROC curve analysis of modified and unmodified shock indicators in the prediction of complications.

	Prediction complication	Sensitivity (SI 95%)	Specificity (SI 95%)	AUC	IC 95%	Valor p
Complications						
SI Modified	> 1,23	46,4 (27,5 - 66,1)	75,9 (65,5 - 84,4)	0,588	0,492 - 0,679	0,1685
SI Unmodified	> 0,89	53,6 (33,9 - 72,5)	73,3 (62,6 - 82,2)	0,620	0,525 - 0,710	0,0571

SI: Shock Index.

4. Discussion

Trauma is recognized by the WHO as a global health problem (16,17). In Colombia, violent deaths are one of the main causes of death according to reports from the Ministry of Health (1); the same behavior is observed in Cartagena, with abdominal trauma being a frequent presentation (18). This study shows that the main affected group corresponds to young male patients located in the third decade of life. The universal literature describes similar dynamics, as shown by Johnson et al (19), who carried out a retrospective study with the same objective as this study, observing an average age of presentation of trauma of 32 years and 91% involvement in men (19). In Latin America, a study carried out in Mexico (20) with a presentation of penetrating abdomi-

nal trauma of 67%, coincides that the male gender is the main group affected (91.4%). It is noteworthy that a similar study was carried out in Cartagena in previous years, which showed similar results (12), where 81.4% were male with a male to female ratio of 4:1, and an average age of 34.8 years. Nevertheless, this study updates the epidemiological data, describes other variables more extensively and finds a higher prevalence in men.

In 2013, Cordovilla et al (21) published a study of trauma associated with drug or alcohol use, determining a positivity of 39% and 50% respectively, similar to what was observed in this study, which can be explained by socioeconomic and psychosocial factors that very often affect this age group. In this report, the use of drugs and alcohol was additionally found to be related to an increase in the probability of trauma recurrence and to an earlier presentation of the first trauma by 15 years (21). Other studies from North America (22,23) and Latin American countries (24-26) confirm this close relationship between drugs of abuse and alcohol and trauma, which exposes an important social conflict of public order, addiction and violence.

In the literature reviewed there is no precise description of the time elapsed from the trauma to the surgical procedure. However, reference is made to the importance and impact on the prognosis of these patients when control of hemorrhage and contamination of the abdominal cavity is achieved within the first hour of life, as mentioned in the ATLS protocols (27). Similar to previous results in our institution (12), the times for surgical care in the present work continue to be predominantly during the first 60 minutes. In a cross-sectional study carried out in the United Kingdom (28), 938 patients with abdominal trauma by a short sharp weapon were identified, determining a hospital stay average of 3.04 days, data comparable to our statistics, however, much lower than those reported in other series that present averages of 6 to 10 days (20,29). However, it is worth clarifying that these data do not differentiate from closed trauma, whose involvement of a solid viscera could prolong hospital stay.

Gonzalez et al., (22) in their study of abdominal wounds, describe as the main mechanism of trauma the one produced by sharp weapons, with main affectation of the anterior abdominal wall. Such results are comparable to those of this study, where this anatomical region was affected in 2/3 of the patients. This contrasts with other studies, such as the one carried out prospectively in Mexico in 2010 (30), where SFI represent 40% of the injuries, below FI, corresponding to 55%; the same behavior in other regions such as

« *It is described in world literature that approximately 66% of the patients with suspected penetrating abdominal injuries are those who really need therapeutic intervention.* »

North America (22), whose results show a ratio of 8 to 1, with a predominance of FI. Mnguni et al (31) in their study conducted in Durban - Southern Africa, reported different factors influencing the outcomes of patients with abdominal trauma compared to those of the present study, such as severity of injury, delay in surgery, hemodynamic instability evidenced by hypovolemic shock, metabolic acidosis, the need for blood transfusion and low hemoglobin levels (31).

It is described in world literature that approximately 66% of the patients with suspected penetrating abdominal injuries are those who really need therapeutic intervention (7). Absolute indications for laparotomy in the context of penetrating abdominal trauma have been described over time (32); it has been documented that the physical examination evaluating the presence of signs of peritoneal irritation and transgression of the parietal peritoneum by digital exploration of the wound, allows to accurately determine the patients who benefit from surgical intervention without other diagnostic tools, as demonstrated in a study conducted in 2017 in the city of Medellin - Colombia with 559 patients (33), where a sensitivity and specificity of this tool was obtained of 98.46% and 96.08% respectively.

Along the same lines, the findings of this study show that peritoneal transgression can be accurately identified by means of an adequate physical examination. Kong et al (34) determined in their study of the spectrum of lesions in the context of omental evisceration that this observation correlates with positive laparotomies in 98% and therapeutic laparotomies in 96%. According to the indications evaluated in our study, patients with peritoneal irritation and epiplocele are candidates for laparotomy, with 93% of positive findings. However, there is a lower performance of therapeutic laparotomy compared to the study by Kong et al (34), probably due to the inclusion of signs of peritonism, which have lower specificity than the finding of epiplocele itself.

Other results with lower performance mention that up to 60% of patients requiring therapeutic laparotomy can be defined by physical examination (35). This is perhaps because patients with flank, thoracoabdominal and back

wounds are considered, which makes the clinical signs much more subtle in their presentation. Other series such as those performed by Mitchell et al (36) and Onofre et al (9), show rates of non-therapeutic laparotomy much higher than those of the present study, ranging from 21.57% in the anterior abdominal wall, to 37.5% for the dorsum and flanks. These results could not be faithfully comparable, since they include patients managed expectantly, which is not contemplated in the present study.

On the other hand, there is evidence documenting the usefulness of the traditional and modified shock indexes for the evaluation of patients in the context of trauma (37-40). Stevan et al (41) establish a specificity and sensitivity of 90% and 45%, respectively, for an index of ≥ 0.8 , defining that this association determines a better evaluation than the measurement of classic vital signs (41). Their applicability in trauma and general hemorrhage could be extrapolated specifically to abdominal trauma. There is no literature on the use of these physiological evaluation markers as predictors of surgical requirement. Despite the above, in the present study these results were significantly related to the presence of peritoneal irritation and mortality without affirming that they are indicators of it. These markers continue to be an easily replicable clinical measure in emergency services, with the advantage of a quick view of the condition and prognosis associated with trauma, so it would be relevant to conduct targeted studies to evaluate their diagnostic performance in patients in need of surgical management.

In the study by Santos et al., (42) where a total of 1795 patients were studied over a period of 7 years, they found 100% and 60% mortality for indices greater than 60 and in the 30-59 range respectively; in addition, 100% survival for scores below 30. This parameter is described in the literature as a metric of the risk of complications (43,44), also documented in the present study, thus defining it as a crucial measure for the subsequent management of patients.

In the present study, a lower mortality was evidenced with regard to the local study carried out in 2011 (9.3%) (12), and similar to that reported in the world literature (3.6%) (23),(45),(46),(47). No patient died during the trans-

«However, there is a lower performance of therapeutic laparotomy compared to the study by Kong et al (34), probably due to the inclusion of signs of peritonism ...



operative period, probably explained by the absence of major vascular lesions and the exclusion of patients with major extra-abdominal wounds that have been reported as the main causes of death due to exsanguination (48,49).

Conclusions

Mortality due to penetrating abdominal trauma in the Colombian Caribbean coast is low, and in comparison, to previous studies it has decreased considerably. Nine out of ten cases are men, almost half of the cases are related to the consumption of psychoactive substances and the main complications are hyperlactatemia and sepsis. The correcting interventions and management times show a favorable performance and are consistent with the results obtained. The main organs affected are the small and large intestine. Only 1 out of 5 patients required intensive care management and the average hospital stay was less than 5 days. Future studies are needed to constantly evaluate the behavior of penetrating abdominal trauma, and external factors associated with pre- and in-hospital management that may change this dynamic.

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« *The main organs affected are the small and large intestine. Only 1 out of 5 patients required intensive care management and the average hospital stay was less than 5 days.»*

References

1. Ministerio de Salud de Colombia. Análisis de Situación de Salud (ASIS) Colombia, 2016. [Consultado 11 Nov 2021]. Disponible en: <https://www.minsalud.gov.co/sites/rid/Lists/Biblioteca-Digital/RIDE/VS/ED/PSP/asis-colombia-2016.pdf>
2. Shah M, Galante JM, Scherer LA, Utter GH. The utility of laparoscopic evaluation of the parietal peritoneum in the management of anterior abdominal stab wounds. *Injury*. 2014; 45(1):128-33.
3. Loria FL. Historical aspects of penetrating wounds of the abdomen. *Surg Gynecol Obstet*. 1948; 87(6):521-549.
4. Bennet JDC. Abdominal surgery in the War: the early story. *JR Soc Med*. 1991; 84(9):554-557.
5. Rizzi M. Historia de las heridas penetrantes de abdomen. *Rev Médica del Uruguay*. 2009; 25(4):249-263.
6. Coleman JJ, Zarzaur BL. Surgical management of abdominal trauma: Hollow viscus injury. *Surg Clin*. 2017; 97(5):1107-1117.
7. Holmes JF. Trauma. 5th ed: Editors: Moore EE, Feliciano DV and Mattox KL. New York, NY: McGraw-Hill, 2004, 1,469 pages.
8. Søreide K. Epidemiology of major trauma. *Br J Surg*. 2009; 96(7):697-8.
9. Onofre JAP, Torres LG, Aguilar JMS. Trauma abdominal penetrante. *Cir Cir*. 2006; 74(6):431-442.
10. Mazariegos MG, López ME. Caracterización epidemiológica, clínica y terapéutica de pacientes mayores de 15 años con traumatismo abdominal, ingresados a los hospitales: General San Juan de Dios y Roosevelt [Internet] 2009 [Consultado el 20 de junio 2021]. Disponible en: http://biblioteca.usac.edu.gt/tesis/05/05_8555.pdf
11. Cabrales RA, Castaño J, García F. Trauma abdominal: factores predictivos de complicación y muerte. *Rev Colomb Cir*. 1994; 9(3):137-141.
12. Martínez Anaya JC, Herrera Sáenz FA, Ramos Clason EC. Aplicabilidad de los índices de trauma abdominal en el Hospital Universitario del Caribe desde enero del 2008 hasta febrero del 2011 [Internet] 2011 [Consultado el 20 de junio 2021]. Disponible en: <https://repositorio.unicartagena.edu.co/handle/11227/1174>
13. Moore EE, Dunn EL, Moore JB, Thompson JS. Penetrating abdominal trauma index. *J Trauma*. 1981; 21(6):439-45.
14. Millum J, Wendler D, Emanuel EJ. The 50th anniversary of the Declaration of Helsinki: progress but many remaining challenges. *JAMA*. 2013; 310(20):2143-4.
15. Ministerio de Salud de Colombia. Resolución 8430 de 1993 [Internet] 1993 [Consultado 11 Nov 2021]. Disponible en: <https://www.minsalud.gov.co/salud/Lists/Normatividad%20%20Salud/DispForm.aspx?ID=2110&ContentTypeId=0x0100A08A4A1DF8E9D448BEF600BFAC0E7622>
16. Organización Mundial de la Salud. Informe mundial sobre la violencia y la salud [Internet] 2002 [Consultado 11 Nov 2021]. Disponible en: http://apps.who.int/iris/bitstream/handle/10665/43431/9275324220_spa.pdf;jsessionid=543F4C9FA2351CC4273E69E7798EC86D?sequence=1
17. Haagsma JA, Graetz N, Bolliger I, Naghavi M, Higashi H, Mullany EC, et al. The global burden of injury: incidence, mortality, disability-adjusted life years and time trends from the Global Burden of Disease study 2013. *Inj Prev*. 2016; 22(1):3-18.
18. Departamento Administrativo Distrital de Salud (DADIS). Perfil epidemiológico de Cartagena de Indias, año 2011 [Internet] 2011 [Consultado 11 Nov 2021]. Disponible en: <https://www.minsalud.gov.co/plandecenal/mapa/Analisis-de-Situacion-Salud-Cartagena-2011.pdf>
19. Johnson JJ, Garwe T, Raines AR, Thurman JB, Carter S, Bender JS, et al. The use of laparoscopy in the diagnosis and treatment of blunt and penetrating abdominal injuries: 10-year experience at a level 1 trauma center. *Am J Surg*. 2013; 205(3):317-321.

20. Parra G, Contreras G, Orozco D, Domínguez A, Mercado J, Bravo L. Abdominal trauma: experience of 4961 cases in Western Mexico. *Cir Cir*. 2019; 87(2):183-189.
21. Cordovilla S, Rodríguez S, Guerrero F, Lara R, Pino F, Rayo A, et al. Alcohol and/or drug abuse favors trauma recurrence and reduces the trauma-free period. *Med Intensiva*. 2013; 37(1):6-11.
22. Gonzalez RP, Turk B, Falimirski ME, Holevar MR. Abdominal stab wounds: diagnostic peritoneal lavage criteria for emergency room discharge. *J Trauma Acute Care Surg*. 2001; 51(5):939-943.
23. Leppaniemi A, Salo J, Haapiainen R. Complications of negative laparotomy for truncal stab wounds. *J Trauma Acute Care Surg*. 1995; 38(1):54-58.
24. Barboza Paucar YJ. Factores de riesgo asociados a morbimortalidad en pacientes operados por trauma abdominal abierto [Internet] 2014 [Consultado 11 Nov 2021]. Disponible en: <https://repositorio.usmp.edu.pe/handle/20.500.12727/2208>
25. Sánchez Zapién C. Trauma abdominal, frecuencia, incidencia, morbimortalidad y factores de riesgo en el Hospital Central de San Luis Potosí: "Dr. Ignacio Morones Prieto" [Internet]. 2014 [Consultado 11 Nov 2021]. Disponible en: <https://repositorioinstitucional.uaslp.mx/xmlui/handle/i/2372>
26. Laffita Labañino W, Abilio Luciano CS, Fernández Expósito W, González López J, García Cordeiro JE. Caracterización de traumas abdominales en pacientes atendidos en Clínica Multiperfil. *Revista Cubana de Cirugía*. 2013; 52(2):194-204.
27. American College of Surgeons. Advanced Trauma Life Support [Internet] 2020 [Consultado 12 Nov 2021]. Disponible en: <https://www.facs.org/quality-programs/trauma/atls>
28. Pallett JR, Sutherland E, Glucksman E, Tunnicliff M, Keep JW. A cross-sectional study of knife injuries at a London major trauma centre. *Ann R Coll Surg Engl*. 2014; 96(1):23-26.
29. Naeem BK, Perveen S, Naeem N, Ahmed T, Khan I, Khan I, et al. Visceral Injuries in Patients with Blunt and Penetrating Abdominal Trauma Presenting to a Tertiary Care Facility in Karachi, Pakistan. *Cureus*. 2018; 10(11):e3604.
30. de Dios Díaz-Rosales J, Arriaga-Carrera JM, Lenin Enríquez-Domínguez D, José R, Castillo-Moreno D, Montes-Castañeda JG. Trauma penetrante abdominal: Comparativa de morbimortalidad en heridas por arma de fuego y arma punzocortante. *Cir Gen*. 2010; 32(1-2010):24-28.
31. Mnguni M, Muckart D, Madiba T. Abdominal trauma in Durban, South Africa: Factors influencing outcome. *Int Surg*. 2012; 97(2):161-168.
32. Ivatury RR. *The Textbook of Penetrating Trauma*. Williams & Wilkins; 1996.
33. Gómez-Botero J, Restrepo-Jaramillo M, Morales-Urbe CH. Utilidad del examen físico para el diagnóstico de lesión intraabdominal en heridas por arma cortopunzante. *Rev Colomb Cirugía*. 2018; 33(1):52-61.
34. Kong V, Weale R, Blodgett J, Buitendag J, Oosthuizen G, Bruce J, et al. The spectrum of injuries resulting from abdominal stab wounds with isolated omental evisceration: A South African experience. *Am J Surg*. 2019; 217(4):653-657.
35. Todd SR. Critical concepts in abdominal injury. *Crit Care Clin*. 2004; 20(1):119-134.
36. Mitchell TA, Hutchison T, Becker TE, Aden JK, Blackburne L, White CE. Nontherapeutic laparotomy in American combat casualties: A 10-year review. *J Trauma Acute Care Surg*. 2014; 77(3):S171-S175.
37. Cannon CM, Braxton CC, Kling-Smith M, Mahnken JD, Carlton E, Moncure M. Utility of the shock index in predicting mortality in traumatically injured patients. *J Trauma Acute Care Surg*. 2009; 67(6):1426-1430.
38. Terceros-Almanza LJ, García-Fuentes C, Bermejo-Aznárez S, Prieto-del Portillo C, Mudarra-Reche I, Sáez-de la Fuente M, et al. Predicción de hemorragia masiva. Índice de shock e índice de shock modificado. *Med Intensiva*. 2017; 41(9):532-538.
39. Keller AS, Kirkland LL, Rajasekaran SY, Cha S, Rady MY, Huddleston JM. Unplanned transfers to the intensive care unit: the role of the shock index. *J Hosp Med*. 2010; 5(8):460-465.

40. Bruijns SR, Guly HR, Bouamra O, Lecky F, Lee WA. The value of traditional vital signs, shock index, and age-based markers in predicting trauma mortality. *J Trauma Acute Care Surg.* 2013; 74(6):1432-1437.
41. Charry JD, Bermeo JM, Montoya KF, Calle-Toro JS, Ramiro Núñez L, Poveda G. Índice de shock como factor predictor de mortalidad en el paciente con trauma penetrante de tórax. *Rev Colomb Cirugía.* 2015; 30(1):24-28.
42. Santos G, Camacho EA. Cirugía de control de daños: Índice de trauma abdominal como factor predictivo de mortalidad. *Rev Colomb Cir.* 2004; 19(2):85-91.
43. Moore EE, Dunn EL, Moore JB, Thompson JS. Penetrating abdominal trauma index. *J Trauma.* 1981; 21(6):439-445.
44. Croce MA, Fabian TC, Stewart RM, Pritchard FE, Minard G, Kudsk KA. Correlation of abdominal trauma index and injury severity score with abdominal septic complications in penetrating and blunt trauma. *J Trauma.* 1992; 32(3):380-387.
45. Velmahos GC, Demetriades D, Toutouzas KG, Sarkisyan G, Chan LS, Ishak R, et al. Selective nonoperative management in 1,856 patients with abdominal gunshot wounds: should routine laparotomy still be the standard of care? *Ann Surg.* 2000; 234(3):395-402.
46. Tyburski JG, Wilson RF, Warsow KM, McCreadie S. A trial of ciprofloxacin and metronidazole vs gentamicin and metronidazole for penetrating abdominal trauma. *Arch Surg.* 1998; 133(12):1289-1296.
47. Haan J, Kole K, Brunetti A, Kramer M, Scalea TM. Nontherapeutic laparotomies revisited. *Am Surg.* 2003; 69(7):562.
48. Kauvar DS, Sarfati MR, Kraiss LW. National trauma databank analysis of mortality and limb loss in isolated lower extremity vascular trauma. *J Vasc Surg.* 2011; 53(6):1598-603.
49. Perkins ZB, De'Ath HD, Aylwin C, Brohi K, Walsh M, Tai NR. Epidemiology and outcome of vascular trauma at a British Major Trauma Centre. *Eur J Vasc Endovasc Surg.* 2012; 44(2):203-9.