

Prognosis of mortality and evolution in pancreaticoduodenal trauma in patients with wound by projectile of firearm

Pronóstico de mortalidad y evolución en trauma pancreatoduodenal en pacientes con herida por proyectil de arma de fuego

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Abstract

Background: The wounds caused by the firearm projectile are published to date in a public health problem in the world. As an example, we mentioned that the injuries caused by firearms are the first cause of death in the age group between 1 and 19 years in the United States, as in Mexico. **Objective:** The objective of the study was to analysis of the prognostic factors of mortality and evaluation of the evolution in patients with TPD due to abdominal HPPAF. **Methods:** This was a retrospective, observational, and descriptive study. Helped by 49 clinical files of patients who were admitted to the department of surgery of the University Hospital José Eleuterio González, between 2011 and 2015 and whose diagnosis was due to pancreatic trauma (TP), duodenal trauma (TD), or pancreaticoduodenal trauma (TPD) by wounds caused by the firearm projectile. **Results:** During a collection period of 5 years, a total of 49 clinical records applicable to the study were obtained according to the inclusion criteria, of which 36 (73%) suffered only from TD, 37 (75%) from TP, and 24 (49%) about TPD. Significant differences were obtained for mortality associated with TD and TPD, but not for TP. The most affected organ as a lesion associated with a TPD was the liver, followed by thoracic structures and the stomach. The most significant risk factor for mortality was a prolonged stay in the intensive care unit. **Conclusions:** Data obtained are consistent with those consulted, providing new reproducible statistics for future studies regarding the increasing violence in our country and around the world.

Key words: Firearm projectile injuries. Mortality. Pancreaticoduodenal trauma.

Resumen

Antecedentes: Las heridas por proyectil de arma de fuego constituyen un problema de salud pública en el mundo. Como ejemplo mencionamos que este tipo de lesiones son la primera causa de muerte en el grupo de edad de 1 a 19 años en los EE.UU., al igual que en México. **Objetivo:** Análisis de los factores pronósticos de mortalidad y evaluación de la evolución en pacientes con TPD por HPPAF abdominal. **Método:** Estudio retrospectivo, observacional y descriptivo, realizado con 49 expedientes clínicos de pacientes que fueron admitidos en el departamento de cirugía del Hospital Universitario José Eleuterio González entre los años 2011 y 2015, cuyo diagnóstico fue herida por proyectil de arma de fuego con

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trauma pancreático (TP), duodenal (TD) o pancreatoduodenal (TPD). **Resultados:** Durante un periodo de recolección de 5 años se obtuvieron 49 expedientes clínicos aplicables al estudio según los criterios de inclusión, de los cuales 36 pacientes (73%) sufrieron únicamente TD, 37 (75%) TP y 24 (49%) TPD. Se obtuvieron diferencias significativas para la mortalidad asociada a TD y TPD, pero no para TP. El órgano más afectado como lesión asociada a un TPD fue el hígado, seguido de las estructuras torácicas y el estómago. El factor de riesgo para mortalidad más significativo fue una estancia prolongada en la unidad de cuidados intensivos. **Conclusiones:** Los datos conseguidos concuerdan con los consultados, otorgando nueva estadística reproducible para futuros estudios respecto a la violencia creciente en nuestro país y alrededor del mundo.

Palabras clave: Heridas por proyectil de arma de fuego. Mortalidad. Trauma pancreatoduodenal.

Introduction

Gunshot wounds are currently a global public health problem. In the USA, around 50,000 people die from this cause every year, and it is the leading cause of death in the 1 to 19 years age group. In Mexico, 20,000 deaths have been reached, although the epidemiology of this type of wounds is still largely unknown here^{1,2}.

Specialists in this field attribute the increase in its incidence to different factors, such as domestic violence, unemployment, low income, integration to gangs at early ages, use of drugs, and uncontrolled distribution of firearms³.

At José Eleuterio González University Hospital, located in Monterrey, in the State of Nuevo León, Mexico, the attendance of 309 patients with gunshot wounds originating from the same municipality was reported in 2016, accounting for 51% of the cases received between 2005 and 2015. In 2011, this municipality was ranked among the most dangerous cities in the world, and although violence has been decreasing over time, thorough investigation into this issue is required^{1,4}.

In the abdominal trauma series, the prevalence of pancreatic trauma (PT) has been between 3 and 12%, with two thirds of injuries resulting from penetrating trauma and one-third from blunt trauma⁵. The incidence of this type of injury, even when rare, is gradually increasing with the passing of years; it is attributed to the use of firearms and mostly to accidents⁶⁻¹⁰. Similarly, duodenal trauma (DT) is considered rare, with less than 5% of all abdominal trauma involved, with those caused by any penetrating weapon predominating¹¹⁻¹³. Pancreaticoduodenal trauma (PDT) is uncommon; however, requiring pancreatoduodenectomy as a surgical procedure is not, although the use of this technique for gunshot wounds has not been thoroughly analyzed. Given

that these serious wounds are rare, there are few series of reports of exclusive experiences with this procedure for trauma, and not a single one has been published since 1984^{13,14}.

The purpose of the present study is to carry out an analysis of the prognostic factors of mortality, to assess evolution in patients with PDT by firearm projectile to the abdomen and to make a comparison with the number of DT and PT with regard to that of PDT, in addition to establishing the correlation of the number of injured organs with mortality.

Methods

The study is retrospective, observational, and descriptive. It was carried out based on 49 medical records of patients who were admitted to the surgery department of the José Eleuterio González University Hospital between 2011 and 2015, with main complication being DT, PT, or PDT caused by intra-abdominal gunshot wounds. Pancreatic and duodenal injuries were classified according to the Organ Injury Scaling Committee of the American Association for the Surgery of Trauma (AAST)¹⁵.

This study was carried out with approval of the José Eleuterio González University Hospital research committee. The information obtained was collected within a database for later use for statistical analysis. Patient private information was only reviewed by the authors and coauthors, and as a privacy protocol, the digital files will be removed in a period of 5 years.

Inclusion criteria

The inclusion criteria were:

- Operations carried out at José Eleuterio González University Hospital
- Patients with PT, DT, or PDT caused by a firearm projectile.

Exclusion criteria

The exclusion criteria were:

- Medical records without the information relevant to this study
- Clinical records with irregularities in their content or preparation.

The number of injured organs, shock grade, gender, age, number of hospitalization days, number of days at intensive care unit, existence of associated fractures, body temperature, oxygen saturation, heart rate, blood pressure, respiratory rate, injury severity score (ISS), peritoneal irritation, chest, trachea, diaphragm, esophagus, duodenum, pancreas, small intestine, large intestine, liver and kidney injuries, and their respective therapeutic management, such as primary repairs, intestinal resection, hemostasis and vascular grafts, in addition to pyloric exclusion, associated injuries, number of packed red blood cell units used, admission to the intensive care unit, prolonged stay, and follow-up were considered as variables.

Some of the analyzed variables were not thoroughly reviewed due to their lack of statistical significance.

Data were analyzed using the Numbers® software, v3.6.1 (Apple Inc.). Statistical analysis was carried out using the IBM SPSS Statistics program, v20.0 (SPSS, Inc., Armonk, NY, USA). The risk analysis was performed taking the 95% confidence interval into account.

Results

During a 5-year record collection period, 49 patient records were obtained that were applicable to the study according to the inclusion criteria, out of which 36 patients (73%) suffered only DT, 37 (75%) PD, and 24 (49%) PDT.

Demographic and clinical values are, including associated organ injuries, which constituted 71% of the sample and where the liver and stomach were the injured organs that were most commonly linked to PDT and, in addition, 92% of PT, DT, and PDT had more than two associated organ injuries.

Male predominance for gunshot wounds was shown. Most of them had organ damage in more than two organs simultaneously due to this cause, but shock grade was only > 1 in 26% of the sample.

The factors that, thanks to the statistical analysis, we were able to define as being “of risk” or “protective” and that reached significant levels (except in the vital

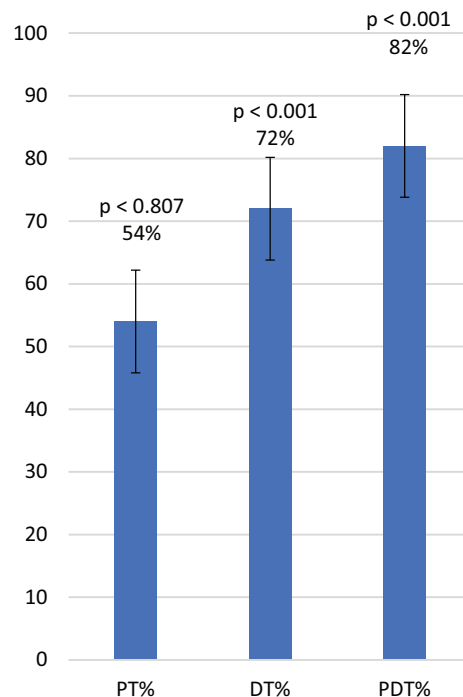


Figure 1. Percentage comparison between the number of pancreatic, duodenal, and pancreatoduodenal traumas. DT: duodenal trauma; PDT: pancreatoduodenal trauma; PT: pancreatic trauma.

signs category). The most significant risk factor for mortality was prolonged stay at intensive care unit. In addition, vital signs obtained at admission to the emergency room and therapeutic interventions were analyzed.

Significant differences were obtained for DT- and PDT-associated mortality, but were not found for PT (Fig. 1).

Discussion

In the present research, the prevalence of abdominal injuries associated with PT, DT, or PDT ranges from 0.8% to up to 8%. There is a clear anatomical relationship between the pancreas and duodenum, which predisposes to multiple organ injury involving both these organs, and in most cases, more intra-abdominal organs¹⁶⁻²⁰.

Taking the above into account, regarding mortality associated with this rare event, it showed a percentage that varies from 18% to 50% between studies^{17,21,22}. In our case, mortality was observed in 53% of the sample, which was consistent with the reviewed evidence and with previous studies. Unfortunately, we

suffered limitations throughout the study regarding organ injury grades reliable data.

As it was to be expected, the results showed higher mortality in patients with PDT²³, mainly due to internal bleeding, vascular injury, and infections^{7,24,25}, in comparison with mortality in patients with PDT, together with DT/PT, DT obtained a difference in total mortality of the sample; on the other hand, PT obtained non-significant results. Despite this result, it is vitally important underscoring the variability regarding mortality between DT and PT, since they were similar in most of existing studies. The latter has not been studied as thoroughly as its mortality deserves, since both these injuries are so anatomically related that they are treated regardless of whether they are considered a single or a shared organ injury²³.

Among associated lesions, there was no great variety in the study with regard to what the literature clarified, with organ injury associated with vascular structures ranking first, followed by injuries to the liver, chest, colon, etc^{13,16,26}. However, we do not agree on the generally-described prevalence of this injury with regard to injuries to the jejunum and ileum, which turned out to be currently scarcely described. Nevertheless, we agree that the percentage of associated injuries in general, within our sample, was equivalent to the currently described figure of approximately 95%²⁷. The method that was largely used to verify organ involvement was exploratory laparotomy, as it is currently standardized⁸.

Cavazos et al.¹ obtained the prevalence of gunshot wounds in their study, which showed the abdomen as the main wounded region, approximately in 40%. The presence of a temperature higher than 37.2 °C increased mortality by 1.3 times with regard to the sepsis that this wound could cause, which was already described above as one of the main complications. The other vital signs were not shown to increase mortality in patients with gunshot wound-associated PDT; this becomes important when reviewing the most common symptoms when experiencing a state of shock, which is to be expected in patients with serious gunshot wounds²⁸.

The ISS injury severity indicator was investigated in gunshot-related abdominal trauma, and it was shown to be useful in the assessment of complications and mortality, and hence it was used in this investigation, as it required a reliable source for standardization of each subject's status. However, in this study, its results were not significant when correlating them with mortality. Twenty-seven percent of the patients had Grade 2 or higher shock. In the literature, the state of

shock was shown to be an important mortality factor^{19,29,30}. However, in the present study, shock grade or presence was not shown to increase mortality.

The lethality PDT implies due to the damage it involves, in addition to the accompanying damage that suffering these intra-abdominal injuries entails has been widely discussed. For this reason, the inclusion of evaluation criteria for admission of this type of patients to the intensive care unit is of vital importance³¹⁻³⁴.

Prolonged hospital stays in a tertiary care hospital, such as that which lasts more than 9 days, was taken into account. Nearly half the patients, 45% (22), met the above criterion. Their mortality increased 10.6 times (odds ratio: 10.6) in comparison with those who remained hospitalized for fewer days. Krige et al.³⁵, in their study with 75 patients, observed an increase in mortality in more than half the wounded subjects who were admitted to the intensive care unit. Sixty-three percent had to be admitted, which showed an increase of 8.5 times in mortality in comparison with those who were not admitted. Fifty-nine percent of the patients had to prolong their stay in the intensive care unit more than 5 days, and this increased mortality 12 times. The fact that a patient with PTD needs to be admitted to the intensive care unit increases his/her mortality, and if his/her stay lasts more than 5 days, it increases considerably, with a 12-fold higher mortality for a prolonged stay. This represented the most important mortality-related variable, followed by a 10-fold higher mortality for a 10-day prolonged stay in the surgery ward and an 8.5-fold mortality for a stay longer than 5 days in the intensive care unit. These results might seem obvious, but the effect level depending on the presence or not of these variables, and their statistical significance, is essential when choosing therapeutic methods, in addition to preventing complications and early defining the prognosis of patients with deep intra-abdominal trauma, not to mention the extreme care that must be reflected when admitting these patients to the intensive care unit.

DT-, PT-, and PDT-associated mortality was compared, and the results obtained were conflicting, given the duodenum and pancreas anatomical position and their close relationship in terms of wounds. The significance found for mortality with regard to PDT and DT, but not for PD, is something that is not commonly replicated in the literature, but it shares similar figures (6-33%)^{36,37}. The results obtained enabled establishing an early prognosis for PDT with respect to DT and partially for PT. However, further analyses are needed to determine the reason for this statistical difference around PT, with a larger sample

size for the comparison of surgical techniques and their survival rates, in addition to separately including the most common DT- and PT-associated injuries to define possible comorbidities they cause, together with their respective frequencies.

As regard surgical techniques for the repair of various wounds, we demonstrated a beneficial survival effect of procedures such as gastric repair, splenectomy, and duodenal repair, with the latter showing a significant protective effect against DT-associated mortality. On the other hand, procedures such as pyloric exclusion and hemostasis were not shown to modify mortality. The remaining analyzed variables failed to obtain statistical significance, including procedures for PT, which failed to modify mortality, except for pancreatic fistula formation, both caused by PT, which practically did not modified the prognosis. Targarona et al.³⁸ refer that, in their study, the most common cause of death was intra-abdominal hemorrhage caused by a pancreatic fistula that eroded a blood vessel or by poor “hemostasis,” which was the cause of 37% of deaths in patients who underwent pancreatoduodenectomy, and thus the latter result regains importance.

Conclusion

The data collected in this study agreed with those provided by the cited literature, which gives a not negligible level of significance to the results, thereby achieving the main purpose of carrying out the interpretation of this information within our responsible institution. As for PDT, it is considered a rare event the morbidity of which has been demonstrated by the literature in general, and now, similarly, by our study.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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Ethical disclosure

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

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained informed consent from the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

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