

## Review of the Penetrating Neck Injuries in 279 Patients, Analysis of a Single Institution

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### Abstract

**Background:** Penetrating neck trauma represents only 1.04% of all trauma injuries. In the civilian centers of trauma a mortality of 3% to 6% is reported. Currently, selective management is based on clinical exploration, detecting signs of vascular or air-digestive damage, regardless of the anatomical landmarks. The objective of this study is to perform an analysis of all penetrating neck injuries using as a guide the selective management.

**Methods:** A retrospective, observational and descriptive study was conducted from January 2012 to December 2014. All patients admitted to the emergency department with penetrating neck trauma were included. In all patients selective neck trauma management protocols were used.

**Results:** During the period studied, 326 patients were found in our records to be treated for penetrating neck injuries. 279 completed the inclusion criteria and 47 left the analysis. The most frequent injuries in 54.8% (n = 153) were the stab wounds, followed by the gunshot wounds in 44.1% (n = 123). Penetrating trauma occurred in 63.4% (n = 177). 26.9% (n = 75) had added injuries. The Injury Severity Score (ISS) median was 7. The most frequent lesions were vascular lesions, 71.83% (n = 51). Surgical treatment was performed in 29.7% (n = 83). The percentage of negative explorations found was 7.5%. The mortality reported was 7.9%

**Conclusion:** Penetrating neck trauma remains a major cause of mortality. The severity of the injuries depends on the mechanism of injury found. Selective management of penetrating trauma of the neck is a valid tool in our trauma center, allowing the surgeon to individualize the intervention required in each case.

**Keywords:** Neck trauma, Penetrating, Neck injuries, Selective management

### Introduction

The neck is a vulnerable structure that contains vital structures protected only by muscle planes. Any direct trauma can produce severe damage. Penetrating neck trauma represents only 1.04% of all trauma injuries. However due to its complexity, its management remains a challenge regardless of the type of exploration performed. In the civilian centers of trauma a mortality of 3% to 6% is reported, resulting most of the time due to complex vascular lesions [1-4].

En 1969 Monson divided the neck into three trauma zones to identify lesions of vital structures [5]. The management described by Roon and Christensen, based on anatomical landmarks, currently has been disused by presenting a high percentage of failed explorations [6]. These negative explorations have been reported up to 53-56% [7].

Currently, selective management is based on clinical exploration, detecting signs of vascular or air-digestive damage, regardless of the anatomical landmarks. Thus reducing negative explorations by 1-2% and demonstrated safety and efficacy [7-9].

However, for the surgeon who faces penetrating neck trauma, it is still a challenge to make the decision to operate or give selective management. The objective of this study is to perform an analysis of all penetrating neck injuries using as a guide the selective management in a civilian trauma care center.

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## Patients and Methods

A retrospective, observational and descriptive study was conducted from January 2012 to December 2014. The information was extracted from the Panamerican Trauma Society (PTS) database of the Hospital Universitario del Valle (HUV) of Cali, Colombia.

All patients admitted to the emergency department with penetrating neck trauma were included. Penetrating neck trauma was defined by platysma muscle section, the patients were examined for the wound and did not comply with this criterion were excluded from the study, since the injuries that do not go through the platysma muscle are not considered penetrating, the wound is washed and sutured and the patient is discharged. All gunshot wounds were considered penetrating. In all patients selective neck trauma management protocols were used.

Patients with penetrating neck trauma and "hard signs", including signs of vascular injury (shock, active bleeding, pulsatile bleeding, expanding hematoma, airway compromise, wound bubbling, stridor) or aerodigestive injury (air bubbling or saliva through the neck wound and massive subcutaneous emphysema), were taken directly for immediate neck exploration. The patients with "soft signs" (dysphagia, hemoptysis, stable hematoma, subcutaneous emphysema), were taken to diagnostic investigation to rule out injuries to other organs such as: esophagoscopy, fibrobronchoscopy and/or angiotomography of neck vessels as required by each case.

And asymptomatic patients were taken for observation and serial physical examinations were made for a period of 48 hours, if the patient presented some change in his evolution or showed soft signs, he entered into the management algorithm of each case, but if he did not show changes, the patient discharged at the end of the observation [10].

The inclusion criteria were all patients admitted to the emergency department of the HUV who presented penetrating neck trauma. The exclusion criteria were patients who patients did not have a penetrating wound in the neck, this means that they did not go through the platysma muscle, or who did not complete their surgical treatment within the hospital, who requested voluntary discharge or who did not have a complete record of the variables analyzed.

Data collection included demographic data (age, sex), type of injury, mechanism of injury, trauma classification Injury Severity Score (ISS), type of surgical intervention, negative exploration rate, type of injury presented, days of stay in the unit intensive care, and mortality.

Descriptive statistics, crossed tables, and Chi square test and ANOVA test were used for the analysis. The statistical analysis was performed with the IBM Statistical Package for Social Sciences program (SPSS, Statistics version 24.0, Inc., Chicago, IL).

## Results

During the period studied, 326 patients were found in our records to be treated for penetrating neck injuries that were admitted to the emergency department of the Hospital Universitario del Valle. Of these patients 279 completed the inclusion criteria and 47 left the analysis for not completing

the analyzed variables or having requested voluntary discharge during their stay.

The median age was 27.56 with a range of 8 to 66 years and standard deviation (SD) of +10.91. Of these 93.5% (n = 261) were male and 6.5% (n = 18) female. Regarding the mechanism of injury, 54.8% (n = 153) patients were injuries caused by gunshot, 44.1% (n = 123) had a stab wound, 0.7% (n = 2) had injuries by self-aggression and 0.4% (n = 1) had injuries by shotgun.

Demographics characteristics of our population are shown in (Table 1).

Of these injuries, penetrating trauma occurred in 63.4% (n = 177) and non-penetrating in 36.55% (n = 102). Of the penetrating trauma in 35.1% (n = 98) were gunshot wounds, 27.2% (n = 76) injuries by stab wounds, 0.45% (n = 1) shotguns wounds and in 0.7% (n = 2) for self-inflicted injuries, without finding significance between the comparison (p=0.59).

26.9% (n = 75) had added injuries. Of these, 88% (n = 66) presented in penetrating trauma and in 12% (n = 9) in non penetrating trauma, finding significance between the comparison (p=0.000).

The Injury Severity Score (ISS) median was 7. Finding significance in the comparison (p = 0.000).

Characteristics of penetrating trauma are shown in (Table 2).

Surgical management was performed in all patients with hard signs at the time of admission, as well as in patients with soft signs that showed deterioration of their condition, or in case of injury confirmed.

Table 1: Demographics characteristics of our population

Descriptive Statistics of our population		
Characteristics	N:279	%, SD
Age, (median), SD	27.56	SD+10.91
Gender (Male), (n) %	261	93.5 %
Gunshot wounds, (n) %	153	54.8%
Stab wounds, (n) %	123	44.1%
Shotgun wounds, (n) %	1	0.4%
Self-inflicted injuries, (n) %	2	0.7%
Penetrating wounds	177	63.4%
ISS (median), (n) SD	7	SD+ 6.91
Added injuries, (n) %	75	26.9%
Days in ICU, (n) SD	1.05	SD+ 5.32
Surgical exploration, (n) %	83	29.7%
Negative Neck exploration, (n) %	2	0.71%
Death, (n) %	22	7.9%

ISS= Injury Severity Score, SD=Standard Deviation, ICU=Intensive Care Unit

Table 2: Characteristics of penetrating trauma

Incidence of injuries in our population	Non-penetrating	Penetrating	p=
Gunshot wounds	55 (19.7%)	98 (35.1%)	
Stab wounds	47 (16.8%)	76 (27.2%)	
Shotgun wounds	0	1 (0.4%)	
Self-inflicted injuries	0	2 (0.7%)	
Added injuries	9 (12%)	66 (88%)	0.000
Surgery	0	83 (29.7%)	0.000

**Table 3:** Characteristics of injuries

Injuries of our population	N 71	%
Vascular injuries	51	71.83%%
-Venous injuries, (n)%	32	45.07%
-Arterial injuries, (n)%	19	26.76%
Digestive injuries, (n)%	4	5.63%
Airway injuries, (n)%	7	9.85%
Neurological injuries, (n)%	9	12.67%
Added injuries, (n)%	75	26.9%

In the patients with soft signs, follow-up studies were carried out according to their manifestations, which included TAC Computed Tomography, high endoscopy, or contrasted studies. Patients with penetrating trauma in the absence of hard or soft signs continued in serial observation until pathology was ruled out. Under this management, surgical treatment was performed in 29.7% (n = 83). Of these 66.9% (n = 165), they did not require surgical treatment and remained stable, being statistically significant in the comparison (p = 0.00). Of the patients operated mostly 26.8% (n = 75) unilateral cervicotomy was performed for exploration of the lesion, 1.1% (n = 3) bilateral cervicotomy was performed and in 2.2% (n = 6) was performed tracheostomy, without finding significance in the comparison between groups. The percentage of negative explorations found was 7.5%.

The most frequent lesions were vascular lesions, 71.83% (n = 51). Of these 11.5% (n = 32) were venous lesions, 6.8% (n = 19) arterial injuries that required vascular management, 1.4% (n = 4) esophageal lesions, 2.5% (n = 7) airway lesions and 3.2% (n = 9) neurological lesions were found, without finding statistical significance.

Characteristics of injuries are shown in (Table 3).

After surgical treatment only 9.6% (n = 27) required a stay in the intensive care unit. Of which the majority required 1 to 3 days with an average of 1.73, with a range of 1 to 47 days, (SD ±5.32).

Of these patients, 22 patients died with a general mortality of 7.9% (SD +0.35). With a mortality in the operated patients of 3.6% (n = 10) and in non-operated patients of 4.3% (n = 12) without finding statistical significance.

## Discussion

The neck is an important anatomical area which contains vital structures and its injury results in significant morbidity and mortality. Penetrating neck trauma is still uncommon, and in developed countries its incidence is decreasing according to the world literature [10-13].

However, unfortunately, in our country, its frequency is still high. In our series, we found that in two years of study, 279 patients were treated for this cause. Showing that in Latin American countries the penetrating trauma mainly by firearms is still frequent, as reported in the Global Mortality from Firearms carried out in five countries of America (Brazil, United States, Mexico, Colombia, Venezuela and Guatemala). This is probably due to the vandalism and crime that is experienced in America [14].

Unlike what is reported in most studies where the median age ranges from 30 to 33 years as reported by Kasbekar et al, in

United Kingdom, the median age in our study cohort was 27.6 years, almost five years less. This is due to an earlier age in which young people begin their contact with criminal life and violence [3, 11, 12, 14].

The gender in our population most frequently affected was the male sex, which coincides with the majority of retrospective studies and similar to that reported by Bell et al., and the Global mortality from Firearms, which reports a higher frequency of penetrating trauma in men. [3,14]. This is probably due to a greater predisposition to the aggressiveness of the male sex, its participation in vandalism, as well as being the target of this vandalism, unlike the female sex [3, 4, 12].

In most of the retrospective cohorts penetrating trauma occurs in 10% of neck injuries, in our serie we found an important difference, because penetrating trauma was present in 63.4% of neck injuries, 50% % more than reported in other studies. This is probably due to the type of weapon used in most of the injuries in our cohort [10,11].

In the civilian trauma centers, the most frequently reported injury mechanism is stab wounds, unlike this in our population, stab wounds were the second in frequency, presenting in 44.1% almost half of the 85.93% reported by Mahmoodie et al. The most frequent lesion in our series was that produced by gunshot arms in 54.8% and in second place those produced by stab wounds. This is due to greater access to firearms in our population which are used for criminal causes and vandalism [12,15].

Unlike other studies where they report a frequency of 11.98% of aggregated lesions, we found a higher frequency, 26.9% (n = 75) had aggregate lesions, in 88% (n = 66) patients with penetrating trauma and in 12% (n = 9) in non-penetrating trauma [12,15].

29.7% required surgical treatment, however, in most studies an approximate figure of 35% is reported, in agreement with that reported with Kasbekar et al., And coincides with multiple studies reporting approximately one third [11,15].

In our data we found that the most frequent lesions were vascular lesions, found in a 71.3% higher frequency than reported by Madsen et al., Which reports that these lesions occur in approximately one third. This is due to the greater frequency of injuries by firearm which produced more severe injuries. The airway injuries were the second in frequency in 9.85%, these lesions vary in the different series reported but coinciding with studies where there is a high prevalence of firearm injuries. The injuries of the digestive tract are the lesions that present with greater variation among the series studied, this probably because it depends on the mechanism of injury as well as the weapon used. In our series, these lesions were the least frequent, contrary to that reported by Madsen et al., Which reports 20% of these lesions [16,17].

The management of the trauma based on the anatomical zones changed due to the large number of negative explorations reported up to 50%. The literature has shown that selective management reduces the frequency of negative examinations despite the affected area of the neck. In our study, we reported a frequency of negative explorations of 0.71%, a very acceptable number and below studies that report a frequency of negative explorations of 15 to 30%. Remaining this management as safe and effective in the population we serve [1, 3, 7, 9, 10, 15, 18]

In the literature referred to, an approximate mortality of 3-6% is reported, and in some studies up to 1%, in this series mortality was slightly higher than 7.9%. This difference is related to the severity of the trauma presented in our population, as well as the type of injuries found, which were mostly due to fire, and a higher frequency of added injuries [19, 20].

## Conclusion

Penetrating neck trauma remains a major cause of mortality. The severity of the injuries depends on the mechanism of injury found. Selective management of penetrating trauma of the neck is a valid tool in our trauma center, allowing the surgeon to individualize the intervention required in each case.

## Conflict of interest statement

The authors declare that they have not conflict of interest.

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