

LEUKOCYTOSIS IN PENETRATING TRAUMA (ABDOMINAL AND OSSEOUS/THORACIC): A CROSS SECTIONAL STUDY IN JUÁREZ, MÉXICO

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Summary

Objective: *the objective of this study is to compare white blood cells (WBC) count in patients with penetrating abdominal trauma isolated and associated with osseous and/or thoracic injury. Material and methods:* cross-sectional study that compares the WBC count as factor associated with major injury in two groups of patients with abdominal penetrating trauma; group patients with penetrating abdominal trauma isolated (PATI) versus group patients with penetrating abdominal trauma associated with osseous and or thoracic injury (PAT/OT). **Results:** *one hundred and eighty six patients are included. Ninety five (87.2%) patients in PATI group have leukocytosis vs 67 (87%) patients in PAT/OT have leukocytosis. The mean of WBC for PATI group is 14,200 per mm³ (±3.500); whereas, whereas the mean of WBC for PAT/OT group is 16,400 per mm³ (±4.700). This study shown a statistically significance difference in mean of leukocytosis between groups (p=0.01). Conclusion:* a significant elevation of WBC count in patients with PAT/OT is observed in comparison with PATI patients.

Key Words: *leukocytosis, leukocyte Count, abdominal Injuries, wounds, penetrating.*

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Leucocitosis en trauma penetrante (abdominal vs torácico/óseo): estudio transversal en Ciudad Juárez, México

Resumen

Objetivo: el objetivo de este estudio es comparar el nivel de leucocitos en pacientes con trauma abdominal penetrante aislado y asociado a trauma óseo y/o torácico.

Materiales y métodos: estudio analítico y transversal que compara dos grupos de pacientes con trauma abdominal penetrante; un grupo con trauma abdominal penetrante aislado (TPAA) y el otro grupo con trauma abdominal penetrante asociado a trauma óseo y/o torácico (TPA/OT). Se examina si el promedio de leucocitos entre los dos grupos está asociado a una mayor lesión. **Resultados:** ciento ochenta y seis pacientes fueron estudiados, no se observó diferencia en la proporción de pacientes que sufrieron de leucocitosis entre los grupos. Sin embargo, en los promedios de leucocitos si existe una diferencia estadísticamente significativa (14,200 vs 16,400 per mm^3 ; $p = 0.01$) en el promedio de leucocitos entre los dos grupos, a favor del grupo con TPA/OT. **Conclusiones:** una elevación significativa del promedio de leucocitos en pacientes con TPA/OT es observada en comparación con el grupo de pacientes con TPAA y esto traduce en una mayor respuesta inflamatoria.

Palabras clave: leucocitosis. recuento de Leucocitos. traumatismos abdominales. heridas penetrantes.

Introduction

Penetrating abdominal trauma (PAT) affects approximately 35% of patients admitted to urban trauma centers in United States¹. The abdominal trauma is an important cause of morbidity and mortality, abdomen is the third lead zone of human anatomy affected by traumatism that require surgery (20%) and hospitalization (90%)².

The evaluation of PAT aims to identify patients who need operation to prevent submitting them to the risks of unnecessary surgical procedures. It is still debated whether the examination is reliable or additional tests should be routinely ordered. Identifying significant injury - in trauma patients - with early markers of injury could aid the physical, anamnesis, and other tests in detecting and/or measuring severe injury in penetrating trauma victims.

Major injury is associated with a major stress-induced neurohumoral response to stimulate the secretion of epinephrine and cortisol, these stress-induced hormones produce leukocytosis from both bone marrow and splenic sources³. Leukocytosis is defined as a white blood cells (WBC) count greater than 11,000 per mm^3 (11×10^9 per L)⁴. Leukocytosis in trauma or stress is due to neutrophilia, caused by neutrophil margination, and not to increase bone marrow production or releases immature cells or bands⁵. During normal circumstances, estimated life span of WBC is 11 to 16 days, in inflammation states this phenomenon is short-lived though, lasting only minutes to a few hours, at which time apoptosis occurs⁶.

There are few studies that compare levels of leukocytes in patients with abdominal trauma^{3,5,7}. Therefore, WBC count could serve as an easy-to-obtain early marker for serious

injury^{4,5,8,9}. The hypothesis is that patients with significant injury should have higher levels of leukocytosis compared to patients with minor injuries. The objective of this study is compare the WBC count in patients with PAT isolated (PATI) *versus* patients with PAT associated with osseous and/or thoracic injury (PAT/OT).

Materials and methods

This is a cross sectional and analytic study that is conducted at *Hospital General de Ciudad Juárez* (HGCJ), a Second Health Care Level Hospital, in *Juárez (México)*. The local institutional review board of *Universidad Autónoma de Ciudad Juárez* and HGCJ reviewed and approved this study according to bioethics statutes (NOM-012-SSA3-2012).

Entry criteria included patients aged over 14 years old and under 50 years old; with abdominal gunshot trauma isolated and associated with osseous and/or thoracic injury; treated with therapeutic laparotomy; and admitted from April 1, 2008 to December 31, 2010. Exclude criteria included hemodynamically instability, non-gunshot penetrating abdominal trauma (e.g., stab wound trauma), lack of WBC count on admission, and early or late death by morbidity related to trauma.

Patients are divided into two groups: patients with PATI (group I) *versus* patients with PAT/OT (Group II). Data collected are: age, gender, period of time from trauma to hospitalization, drugs or alcohol intoxication, associated osseous or thoracic injuries, intra-abdominal organs injured, preoperative WBC count, preoperative level of neutrophilia, preoperative level of hemoglobin, preoperative level of hematocrit, and hospital stay. Variables measured in nominal scale are compared with χ^2 test and variables measured in numerical scales are compared with *t-student* test. The p value = <0.05 is used to declare statistically significance difference for all comparisons. Data are entered and analyzed using STATA 10® Data Analysis Statistical Software (Texas, USA).

Results

One hundred eighty six patients are included, the mean age is 28.8 years old (± 9.6). One hundred sixty eight (90.3%) patients are male and 18 (9.7%) patients are female. One hundred and nine (59%) patients met criteria for PATI, and 77 (41%) patients are classified as PAT/OT.

The general mean of time from trauma to hospitalization is 90 minutes (± 66). The mean of time from trauma to hospitalization in PATI group, is 87 minutes (± 53); while in PAT/OT group is 93 minutes (± 82), there is not statistically significance difference ($p = 0.284$).

There are 92 (84%) patients with intoxications (alcohol and/or drugs) in PATI group, and there are 60 (78%) patients with intoxication in PAT/OT group, there is not statistically significance difference ($p = 0.26$). The organ more affected in both groups is large bowel, followed by small bowel and solid organs. The rest is shown in table 1.

Table 1. Organs injured by number of patients and percentages

Organs	PATI	%	PAT/OT	%
Stomach	15	13.8	21	27.3
Duodenum	3	2.7	2	2.6
Small bowel	55	50	33	42.3
Large bowel	55	50	42	54.5
Liver	19	17.4	15	19.5
Spleen	5	4.6	20	26
Kidney	2	1.8	1	1.3
Bladder	7	6.4	2	2.6
Pancreas	0	0	2	2.6
Diaphragm	0	0	22	28.6
Total	161	-	160	-

Source: Electronic files – HGCJ

Ninety five (87.2%) patients have leukocytosis in PATI group, whereas 67 (87%) patients have leukocytosis in PAT/OT group, there is not statistically significance difference ($p = 0.977$). The mean of WBC for all patients is 15,100 per mm^3 (± 4.200); the mean of WBC for PATI group is 14,200 per mm^3 (± 3.500); whereas,

whereas the mean of WBC for PAT/OT group is 16,400 per mm^3 (± 4.700) ($p = 0.01$). The mean of hemoglobin level is 13.7 gr/dL (± 2.4) in PATI group, the mean of hemoglobin level is 12.8 gr/dL (± 2.1) in PAT/OT, there is not statistical significance difference ($p = 0.069$). The mean of hospital stay for all patients is 9.5 days (± 10); the mean of hospital stay for PATI is 8.2 days (± 7) and the mean of hospital stay for PAT/OT is 11.6 days (± 13), there is statistical significance difference ($p = 0.039$) (table 2).

Table 2. Comparative of laboratory variables by groups and p value.

Laboratory variable	PATI	PAT/OT	Total	p
Leukocytosis [yes (%)]	95 (87%)	67 (87%)	162	0.977 *
WBC mean (per mm^3)	14,200	16,400	15,100	0.01 **
Hemoglobin mean (gr/dL)	13.7	12.8	13.3	0.069 **
Hospital Stay (days)	8.2	11.6	9.5	0.039 **

* X2 test ; ** t-Student test
Source: Electronic Files - HGCJ

In PAT/OT group, there are 20 (26%) patients with PAT and thoracic injury (PAT/T) with leukocytosis mean level of 17,400 per mm^3 (± 5.165); thirteen (17%) patients with PAT and any arm fracture (PAT/A) with leukocytes mean level of 14,100 per mm^3 ($\pm 3,240$); eighteen (23.4%) patients with PAT and any leg fracture (PAT/L) with leukocytosis mean level of 17,100 per mm^3 ($\pm 3,600$); six (8%) patients with PAT and arm also leg fracture (PAT/AL) with leukocytosis mean level of 15.300 per mm^3 (± 5.500); ten (13%) patients with PAT and thoracic also arms injury (PAT/TA) with leukocytosis mean level of 15.700 per mm^3 (± 5.800); seven (9%) patients with PAT and thoracic also leg injury (PAT/TL) with leukocytosis mean level of 17.300 per mm^3 (± 5.200); and 3 (4%) patients with PAT and thoracic also arm and leg injury (PAT/TAL) with leukocytosis mean level of 19.000 per mm^3 ($\pm 4,6,200$). There is not statistical significance difference between these groups and its leukocytosis level ($p = 0.594$) (figure 1).

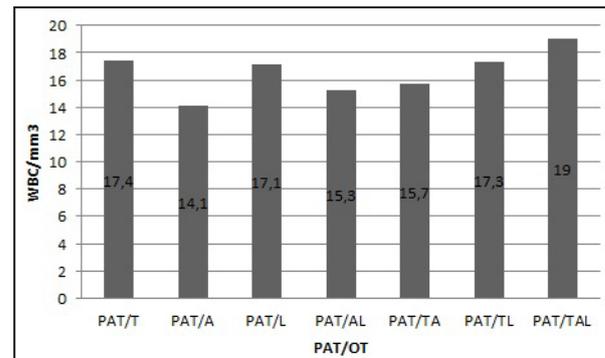


Figure 1. WBC count in patients with PAT/OT separated by regions.

Source: Electronic Files – HGCJ.

Discussion

The purpose of this study is to compare preoperative levels of leukocytosis in patients with PATI and PAT/OT that are underwent to exploratory laparotomy, and observe if the PAT and associated injured in extremities and/or thorax have a major inflammatory response that could mean major leukocytosis.

Diverse Mexican¹⁰⁻¹³ and international¹⁴⁻¹⁶ studies in PAT have shown that productive aged and male gender are the most affected population, this study confirm this statement. The mean of time from injury occurs to hospitalization is 90 minutes, there are not similar studies to compare to this mean, except an anterior study published in patients that were underwent to damage control surgery¹⁷. In that study the mean of time from injury to hospitalization was 55 minutes, but context of patients was different.

Prevalence of intoxication does not play an important role in both groups (PATI and PAT/OT). In a previous study, there are not relation between alterations of conscience by drugs and/or alcohol and incidence of non-therapeutic laparotomy¹⁸.

Several studies shown that solid organs are the most injured during penetrating trauma, followed by large bowel as the second most

injured organ¹⁹⁻²¹. In this study, large bowel is first in frequency, followed by small bowel and solid organs in third place.

The results shown that both groups have leukocytosis (inflammatory response), but PAT/OT group presents major leukocytosis, with statistically significance difference in favor to this group. Several studies have described a significant higher WBC count ($> 12,500$ per mm^3) in their most severely injured trauma patients^{3,5,7}.

An elevation of WBC count typically reflects the normal response of bone marrow to an infectious or inflammatory process. In case of trauma stimuli, leukocytosis is the appropriate response of bone marrow to these external stimuli⁶. The metabolic responses to injury and critical illness include hypermetabolism, accelerated skeletal muscle protein breakdown, glucose intolerance, and insulin resistance²². Neutrophils are predominant cells in moderate and severe leukocytosis (called neutrophilia), and are caused by increased of both release from marrow stores and production, plus extended survival and demargination within vessels²³.

The integral evaluation of PAT aims to identify patients in need of treatment surgical or non-

surgical, and laboratory parameters as a severe leukocytosis may be an early marker for organ or region injured associated with other lesions that may be unsuspected. There is not statistically significance difference in leukocytosis level between the subgroups of PAT/OT. Also, the mean of hemoglobin has not statistically significance difference between groups. The hospital stay is more prolonged in patients with associated trauma, because, these patients suffered any fractures and/or hemothorax, pneumothorax and these injuries need specific treatment.

However, despite great advances in the understanding of immune system made in recent decades, little progress has been made regarding the clinical significance of leukocytosis in trauma patients. Results in this study support that higher WBC count is finding in patients with major injuries. A significant elevation in WBC in PAT/OT patients is a phenomenon awaited, and it suggests severe injury and major inflammatory response.

Conflicts of interest: The authors declare that they not have conflicts of interest.

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