Leukocytosis as Prognostic Factor for Severe Multiple Injuries

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ABSTRACT:

Objective: The objective of this study was to determine if the white blood cell (WBC) count can predict severity of injuries and can be considered as a bad prognostic sign in multiple injured patients.

Methods: This was a comparative study comparing two groups of multiple injured patients according to the severity of injury, intensive care unit (ICU) admitted group with severe injuries and ward admitted one without significant injuries, and comparing their initial WBC in the first day. Also, the ICU admitted group was divided into two subgroups, survived and died one, comparing the decline in WBC count between them in the first 3 days.

Results: There was a difference in mean WBC count between ICU group with severe injuries and ward one without significant injury that was statistically significant ($p<0.0001$). Also there was a significant resistance of WBCs to decline to normal level in the died ICU subgroup as survived patients in the first three days ($p<0.0001$, $p<0.0001$ and $p<0.0001$ respectively).

Conclusion: A significant elevation in WBC count in severe multiple injured patients is found and it can be considered as a bad prognostic sign for those with slow decline to normal level within first three days.

KEY WORDS: multiple injured patient, leukocytosis, white blood cell count =WBC, ICU and ward.

INTRODUCTION:

Emergency physicians are continually searching for early prognostic signs that efficiently differentiate trauma patients with major versus minor injury. Normal vital signs are not sufficiently sensitive to reliably exclude brain, bowel, vascular or solid organ injuries[1-3]. Lipsky showed that a significant proportion of trauma patients who eventually die had normal vital signs in the emergency department[4].

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Theoretically, multiple injuries are considered as major stressful conditions, which induce neuronal and hormonal response, epinephrine and cortisol, producing leukocytosis from both bone marrow and splenic sources[5-7]. It has been hypothesized that elevation of trauma patient's WBC count may be a surrogate marker of neurohormonal activation and be valuable in identifying patients with major injuries. Tissue swelling (edema) occurring after trauma is probably an inflammatory response due to local cytokine production and increased leukocyte adhesion as a result of a direct effect on vascular permeability and leukocyte activation [8-12]. Since the complete blood analysis is one of the first tests obtained from trauma patients in the emergency department, WBC count can serve as an easy obtained marker for a serious injury.Studies on blunt trauma patients have shown higher WBC counts in the more severely injured patients[13-15]. Although, Paladino et al showed that WBC count was not a useful addition as a diagnostic indicator of major trauma[16], Rovlias et al in their study of head trauma patients in the neurosurgical intensive care unit (ICU) showed that WBC count was significantly higher in patients with severe head injury compared to those with minor to moderate injury[17].In this study, we tried to find out whether there was a high WBC count associated with severity of injuries and can be considered a bad prognostic sign or not.

PATIENTS AND METHODS:

The study was conducted at Alsadr Teaching Hospital, which receives approximately 100,000 yearly emergency-department visits and 5000 trauma activations per year. We measured the WBC counts of 334 (227 males and 107 females) severe and non-severe multiple injured patients, whom were admitted to the hospital between February 2009 and February 2013. Data collected included WBC count on admission, patient's age and sex, drug (steroids, immuno-suppressants, lithium, beta agonists) history, the Injury Severity Score (ISS) on arrival. Co-morbid conditions that might affect the degree of leukocytosis were recorded, including pregnancy, chronic infection, diabetes, cardiovascular disease, pulmonary disease, cancer, liver disease, pancytopenia on presentation, and immunologic diseases. Surgical procedures were excluded except emergency measures tracheostomy and chest tube. Also died patients at day arrival to hospital were excluded.The age range was 5 to 68 years and the mean age was 29.5.The WBC counts of the patients were obtained daily within the first three day and the patients were divided into two groups: First severe group who multiple injured patient admitted to ICU, 130 (96 male and 34 female) with either severe head injury Glasgow Coma Scale (GCS) scores less than 8 all intra-abdominal and intracranial injuries, spinal and skull fractures, pelvic diastasis, pulmonary contusions, hemothorax, pneumothorax, flail chest.The non-severe multiple injured group, 184 patient (131 male, 53 female) that admitted to the ward with minor injuries that do not meet the significant injury specifications outlined above, such as patients with head injury GCS above 8, non-emergent extremity fractures, as well as all patients, who did not develop significant injuries, had been admitted for observation.

RESULTS:

A total of 334 blunt trauma patient records were reviewed. Of these, 130 were found to be severe multiple injured patients admitted to ICU and 184 non-severe multiple injured patients admitted to ward. Of those patients with severe multiple injuries, fifty patients died in the ICU, 15 died in second day, 11 died in third day and 24 died after three days. Eighty severe multiple injured patients, whom were admitted to the ICU, survived, shifted to ward, and discharged home after observation. Of those with non-severe multiple injuries, 184 were admitted for observation then discharged home.

Table (1) shows a comparison between WBC count in severe and non-severe multiple injured patients. The mean WBC count in the severe multiple injured patients was 17.94 x 10^9/l compared to 11.48 x 10^9/l in the non-severe multiple injured patients. The difference in WBC count values between the two groups was statistically significant ($p<0.0001$).

Table (1): WBC count in severe (ICU group) and non-severe (ward group) multiple injured patients in the first day of admission

Severity	N	Mean	S.D	P value
ICU	130	17.94	3.565	0.0001
Ward	184	11.48	2.659	

The next step divided severe multiple injured group in to two subgroups, died and survived patients (Table 2). We compared WBC count for those two subgroups in the 1st, 2nd and 3rd days of admission. In the 1st day, the mean WBC count of died subgroup, 19.44 x 10^9/l, compared to that of the survived subgroup, 17.00 x 10^9/l. In the 2nd day, the mean WBC count of the died subgroup 16.00 x 10^9/l compared to the mean WBC count of the survived subgroup, 11.55 x 10^9/l. After 2nd day, the mean WBC count of the died subgroup, 13.04 x 10^9/l compared to the mean WBC count of survived subgroup 6.09 x 10^9/l. There were statistically significant differences between WBC count for died subgroup as compared with survived subgroup in the first, second and after second days in the ICU ($p<0.001$, $p<0.0001$ and $p<0.0001$ respectively).

Table (2): Comparison of WBC count in the survived to the died ICU patients in the first, second and after second days of admission

WBC counts	Fate	N	Mean	SD	P value
Day 1	Survived	80	17.00	3.257	0.001
	Died	50	19.44	3.552	
Day 2	Survived	80	11.55	2.690	0.0001
	Died	35	16.00	3.134	
After Day 2	Survived	80	6.09	2.307	0.0001
	Died	25	13.04	2.051	

DISCUSSION:

Multiple injured patients seem to have elevated, or at least high normal, WBC count values on presentation. This suggests that the stress of trauma incident itself can result in marked demargination. The role of catecholamines and corticosteroids has been reported in the literature [18–22].Catecholamines increase the leukocyte count by release of the marginated cells into the circulating pool. Corticosteroids increase the neutrophil count by releasing the cells from the storage pool in the bone marrow into the blood and by preventing egress from the circulation into these tissues [18–22].

Another mechanism through which leukocytes number can be associated with tissue damage is the traumatic rupture of microvessels followed by physical occlusion. The leukocytes are less deformable than the erythrocytes, and a greater pressure gradient is therefore required to force them through the capillaries with small diameter. Under conditions of reduced perfusion pressure, the capillaries may be have liked a sieve and trap the leukocytes to increase the WBC number. After the entrapment, the leukocytes form a common area of contact with the endothelium and may not be dislodged even after the perfusion pressure returns to normal [23-26]. The mechanical occlusion of the capillaries may become more evident as a result of the release of a number of cytotoxic chemicals that leads to increased leukocyte endothelial interactions [27].In this study, blood WBC levels relationships are:

1- Patients with a mean WBC value of 17.94 x 10^9/l were associated with severe multiple injuries, where as patients with a mean WBC value of 11.48 x 10^9/l were associated with non-severe multiple injuries in first day of admission (Figure 1).

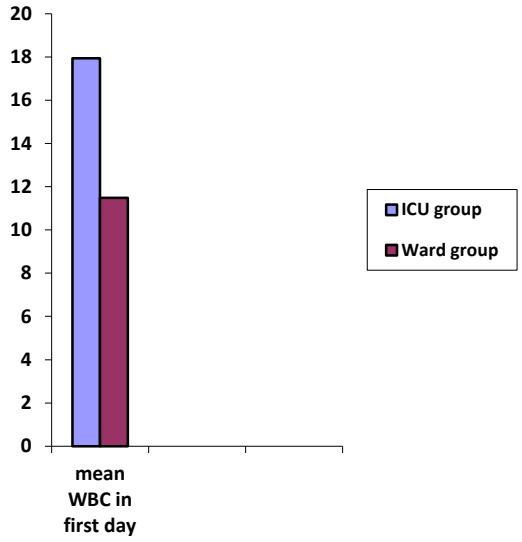

Figure (1): Diagram comparing mean WBC value of severe multiple injured patients to the mean WBC value of non-severe multiple injured patients in first day of admission.

2- Resistance of WBCs number to decline to normal level in the died subgroup. The mean WBC count 19.44 x 10^9/l in the 1st day, 16.00 x 10^9/l in the 2nd day and 13.04 x 10^9/l in after 2nd day, can be considered as a bad prognostic sign for patients who died in the ICU. Whereas, patients with rapid decline to normal WBC level in survived subgroup, 17.00 x 10^9/l in 1st day, 11.55 x 10^9/l in 2nd day and 6.09 x 10^9/l in after 2nd day, was associated with a favorable outcome (Figure 2).

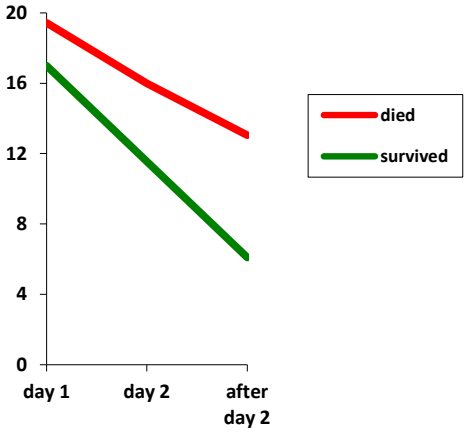

Figure (2): Diagram comparing the mean WBC count trend in died subgroup to the mean WBC count in the survived subgroup in the ICU.

Past studies studied several variables affecting WBC count, and have shown mixed results. Review of literature reveals several relevant studies:
Akköse et al[28] performed a retrospective study evaluating 713 blunt trauma patients showing that WBC count was proportionally associated with ISS. Harris et al[29] retrospectively studied 46 patients after blunt abdominal trauma. They found that, in patients without obvious indications for invasive evaluation of the abdomen (e.g., peritoneal lavage, laparoscopy, laparotomy), leukocytosis was associated with intestinal injury. Paladino et al[16] in a heterogeneous blunt and penetrating trauma cohort (excluding isolated head injury) found that although there was a statistically significant higher WBC count in patients with major injuries, WBC count was not a useful addition as a diagnostic indicator of major trauma in their study population. Gürkanlar et al[30] retrospectively studied 59 patients with head injury and found patients with severe head injury had significantly higher WBC count than those with moderate or minor injury.

CONCLUSION:

Elevated WBC count directly proportionally associated with severity of injury and those with slow decline of WBC count to the normal level carries a bad prognosis.

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ارتفاع كريات الدم البيضاء عامل تنبؤي للإصاباتِ المتعدّدةِ الحادّةِ

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الخلاصه

الهدف: الهدف من هذه الدراسةِ هي أَنْ تُقرّرَ إذا ارتفاع عدد كرية الدمِّ البيضاءِ يُمْكِنُ أَنْ يَتوقّعَ شدَّةَ الإصاباتِ ويُمْكِنُ أَنْ يُعتَبرَ كإشارة تنبؤية سيئة في المرضى المصابينِ المتعدّدين.

الطرق: هذا هي دراسة مقارنة ،تُقارنُ ارتفاع عدد كرية الدمِّ البيضاءِ في اليومِ الأولِ بين إثنان مِنْ مجموعاتِ المرضى المصابينِ المتعدّدينِ طبقاً لشدَّةِ الجرحِ، المجموعة الأولى تضم المرضى الراقدين في وحدة العنايةِ المركّزةِ والذين يعانون من اصابة شديدة مع المجموعة الثانية تضم المرضى الراقدين في الردهة والذين يعانون من اصابة غير شديدة.كما قسمت مجموعة المرضى الراقدين في وحدة العنايةِ المركّزة إلى مجموعتين فرعيتين، الناجين والمتوفين، قورن عدد كرية الدمِّ البيضاءِ بينهم في الأيامِ الأولى الثلاثة.

النَتائِج: كان هناك إختلاف هام في إحصاءِ عدد كرية الدمِّ البيضاءِ بين مجموعةِ وحدة العنايةِ المركّزةِ والردهةِ للأصابات المتعددة الحادّةِ ($p <0.0001$). أيضاً كان هناك a مقاومة هامّة عدد كرية الدمِّ البيضاءِ للإنحِدار إلى مستوى طبيعيٍ في الموتوفين مقارنة بالناجين من المرضى في العناية المركزة في الأيامِ الأولى الثلاثة ($p <0.001$, $p <0.0001$ و $p <0.0001$ على التوالي).

الخاتمة: الإرتفاع في عدد كرية الدمِّ البيضاءِ يُعتَبرَ إشارة تنبؤية سيئة للأصابات المتعددة الحادّةِ وخصوصا الذين ببطيئِ يَنحدرُ إلى مستوى طبيعيٍ ضمن ثلاثة أيامِ أولى.