Value of white blood cell count as a predictor of organ injury in adults with abdominal trauma

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Abstract

Introduction: Trauma is the leading cause of death in the first 4 decades of life, and the abdomen the third most affected location. For a complete lesion assessment in abdominal trauma, CT scan is the reference. Blood count is one of the first biological tests available in emergency, the white blood cell (WBC) could serve as a predictor of the existence of abdominal organ injury and therefore, the severity of the trauma. Our aim is to evaluate the ability of WBC count to predict an abdominal organ injury. **Results:** Sixty-eight patients were included. The mean of age was 31.3 years ± 20.7. The sex ratio was 12.9. There were blunt trauma in 54.4% of cases and penetrating trauma in 45.6% of cases. There was intra-abdominal organ injury in half of the patients (n = 34). The WBC count was higher in patients with organ injury (14690 elements per mm3 ± 5252.7) compared to those without injury (9752.38 elements per mm3 ± 4168.7). This difference was statistically significant (p = 0.001). The realization of the ROC curve found an AUC of 0.804 (IC: 0.672-0.935). There was a statistically significant relationship between leukocytosis and existence of an organ injury (p <0.001). The sensitivity was 82.3% and the specificity was 61.7%, with a PPV of 68.2% and a VPN of 77.7%. **Conclusion:** Our study shows that, WBC count is an important factor in the decision-making strategy for abdominal trauma. A high number of WBC even in the absence of alarming clinical signs, should make to suspect an occult injury. However, WBC isolated could not exclude the existence of an abdominal injury.

INTRODUCTION

Trauma is the leading cause of death in the first 4 decades of life, and the abdomen the third most affected location [1]. The major therapeutic progress in recent years is the conservative treatment that must be done as much as possible. However, the indication of this treatment follows very specific criteria, the main ones being existence and severity of abdominal organ injury [2,3]. In addition, identification and early treatment of these lesions provide a better prognosis [4].

For a complete initial assessment, CT scan is the reference with a sensitivity of up to 99%. But it has certain disadvantages such as elevated cost, irradiation and toxicity of the contrast agents [5]. Given these disadvantages and in a context of limited resources, the realization of imaging must be rationalized. Their prescription should be motivated essentially by a strong suspicion of the existence of abdominal organ injuries likely to indicate a surgical treatment. Hence the interest of criteria that can guide the request for this examination [4].

Since the blood count is one of the first biological tests available in emergency, the white blood cell (WBC) count could be one of these criteria. It can serve as a predictor of the existence of abdominal organ injury and therefore the severity of the trauma. The increase in the number of WBC after trauma would be related to the release of neutrophils contiguous to the vessel wall (margination) and to the release of catecholamines and cortisol, and not necessarily to an acute infection [6,7]. Several studies have explored the diagnostic value of WBC counts in patients with trauma and the main hypothesis is that severe injuries are associated with a higher rate of WBC [6].

The aim of this study is to evaluate the ability of WBC count to predict the existence of an abdominal organ injury.

METHOD

This is a descriptive cross-sectional and retrospective study from January 2012 to March 2017 at the General Surgery Department of Aristide Le Dantec Hospital. Patients aged 15 years and older with abdominal trauma (blunt or penetrating) were included. The excluded patients were those in pregnancy, with an associated infection, on immunosuppressive therapy or corticotherapy. The studied parameters, collected at the admission of the patient were: age, sex, delay of admission, type of accident, hemodynamic state, existence of fever, hemoglobin rate, WBC count and abdominal organ injuries. Leukocytosis was defined as a WBC more than 10,000 cells per mm3.

The existence of abdominal organ injuries has been defined as a traumatic anomaly of any organ, apparent or occult (peritoneal effusion of any kind). These lesions were identified by ultrasound, CT scan and / or surgical exploration. Data analysis was done by SPSS software version 23.

Statistical Analysis

Qualitative variables were described in number with proportion, quantitative variables as mean with standard deviation. A univariate analysis using the t-test of Student was done to study the link between WBC count and the existence of an abdominal organ injury. The difference was considered significant when p-value was less than 0.05. The predictive ability of WBC count was estimated by the ROC (Receiver Operating Characteristics) curve. The area under the curve (AUC) was estimated with his interval of confidence (IC). Specificity, sensitivity, positive predictive value (PPV) and negative predictive value (NPV) were calculated using the usual formulas.

RESULTS

Sixty-eight patients were included. The mean of age was 31.3 years ± 20.7. The sex ratio was 12.9. The mean admission time was 9.6 hours ± 18.3. These were blunt trauma in 54.4% of cases and penetrating in 45.6% of cases. Patient characteristics are detailed in Table 1. There was intra-abdominal organ injury in half of the patients (n = 34). The affected organs are described in Table 2. The mean WBC count was 12573.8 elements per mm3 with a standard deviation of 5371.7. The WBC count was higher in patients with organ injury (14690 elements per mm3 ± 5252.7) compared to those without injury (9752.38 elements per mm3 ± 4168.7). This difference was statistically significant (p = 0.001). The realization of the ROC curve found an AUC of 0.804 (IC: 0.672-0.935) (Figure 1). There was a statistically significant relationship between leukocytosis, and the

existence of an organ injury (p <0.001) (Table 3). The sensitivity was 82.3% and the specificity was 61.7%, with a PPV of 68.2% and a VPN of 77.7%.

Table 1: Characteristics of patients (n=68)

Characteristics of patient	Mean ± Standard deviation Number (%)
Age (years)	31,3 ± 20,7
Age groups	
Under 50	6(8,8)
Over 50	62(91,2)
Gender	
Male	63(92,6)
Female	5(7,4)
Type de trauma	
Blunt	37(54,4)
Penetrating	31(45,6)
Polytrauma	
Yes	14(20,6)
No	54(79,4)
Type accident	
Public road	20(29,4)
Brawl	37(54,4)
Domestic	2(2,9)
Sport	3(4,4)
Work	5(7,4)
Admission delay (hours)	9,6±18,3
Hemodynamic state	
Stable	62(91,2)
Unstable	6(8,8)
Fever	
Yes	17(25)
No	51(75)
WBC	12573,8±5371,7
Leukocytosis	
Yes	41(60,3)
No	27(39,7)
Hemoglobin rate	12,7±2,1
Abdominal Organ injury	
Yes	34(50)
No	34(50)

Table 2: Characteristics of organ injury

Organ injury	Number(n=68)	Proportion(%)
None	34	*50*
Liver	6	*8,8*
Spleen	8	*11,8*
Kidney and small bowel	3	*4,4*
Small bowel	8	*11,8*
Stomach	2	*2,9*
Omentum	3	*4,4*
Colon	1	*1,5*
Bladder	3	*4,4*
Total	68	*100*

Table 3: Univariate analysis between leukocytosis and abdominal organ injury (p <0.001)

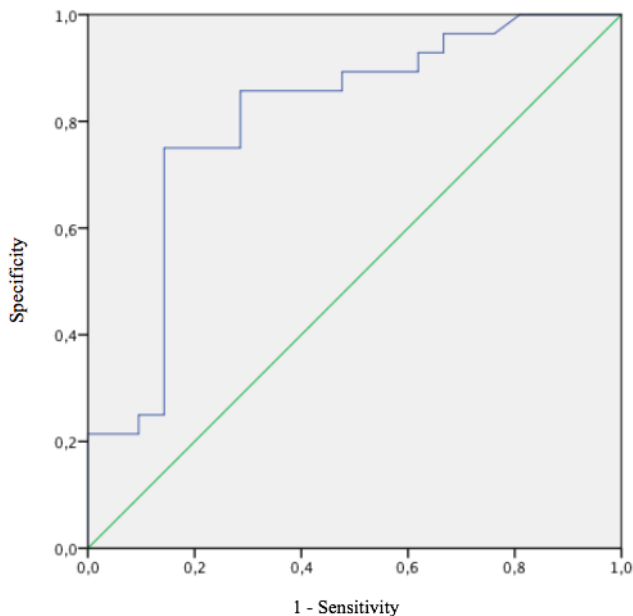|		Abdominal organ injury		Total
		Yes	No	
Leukocytosis	Yes	28	13	41
	No	6	21	27
	Total	34	34	68

Figure 1: ROC curve between WBC count and abdominal organ injury AUC = 0.804, Confidence Interval: 0.672-0.935

DISCUSSION

We performed a retrospective cross-sectional study evaluating the correlation between WBC count and organ injury. Our hypothesis was that, this factor could be a predictor of intra-abdominal organ injury in abdominal trauma. We found that the existence of an organ injury was statistically significantly associated (p = 0.001) with a higher WBC count.

The mechanism of an increasing WBC after trauma is not well known. Some studies argue that the increasing level of catecholamines and cortisol during stress caused by trauma may play a role [7]. According to others, it is due to neutrophilia, caused by the release of neutrophils in margination, and not by an increased production of bone marrow. However, the phenomenon is not permanent and lasts only a few minutes to a few hours if there is no acute infection and if the cause of the stress is eliminated [6].

Several studies have explored the value of WBC count in trauma (blunt or penetrating). Indeed, in the initial evaluation which main objective is achieving a conservative treatment, the WBC count could be beneficial. It would make it possible by predicting the existence of intra-abdominal organ injury and the need for early realization of a CT scan for an exhaustive injury assessment. Which would improve the prognosis by an early and adequate treatment.

However, the majority of the studies carried out, focuses on specific groups of patients (children, blunt trauma, penetrating wound) [6,8,9]. Our study was realized in adults. It involved abdominal trauma without prejudging their nature (blunt or penetrating trauma). We found that leukocytosis has a good sensitivity (82.3%) and specificity (61.7%) in the prediction of organ injury. In the literature, different results are found. The reason for this variation is related to the difference in definition of the existence and severity of intra-abdominal organ injury. For example, Santucci found in patients admitted for blunt trauma, a significant difference between patients with mild and severe trauma in terms of mean of WBC count. However, these researchers reported that the correlation between WBC count and injury severity was low and that the discriminating power of leukocytosis for the detection of severe trauma was moderate [6]. In Hershkovitz et al study on a serie of pediatric patients, a WBC count higher than 14,000 was strongly correlated with the positive results of CT scan [10]. It is the same for Holmes et al, but these authors were unable to identify a clinically useful threshold value for distinguishing groups [11]. Schnüriger found a limited predictive value especially in hollow viscus injury [9].

The WBC count has an important contribution in the initial assessment of abdominal trauma. Obtaining the WBC count is accessible and quickly available in an emergency context. Despite this, it is not considered enough in the initial assessment of the severity of abdominal trauma. In our study, leukocytosis suggests the existence of organ injury, however its absence does not allow to eliminate it formally. Several studies have demonstrated the predictive ability of WBC count especially when combined with other parameters such as transaminases or hematocrit [10]. In this sense, a more in-depth study integrating this variable into predictive models for scoring, would clarify its value [6].

Limitations

The small size of our cohort (n=68) is the main limitation of our study. In addition, the majority of our patients were predominantly young, with 91.2% of them under the age of 50. The retrospective nature did not also make it possible to evaluate the existence of other causes of leukocytosis.

CONCLUSION

A high number of WBC in patients admitted for abdominal trauma could be a significant predictor of the existence of organ injury. Our study shows that, the WBC count is an important factor in the decision-making strategy for trauma to the abdomen. A high rate of WBC even without alarming clinical signs, should make to suspect an occult injury. It would also

suggest the early achievement of a CT scan for an adequate injury assessment. However, WBC isolated could not exclude an abdominal injury. Future studies with prospective enrollment with a larger size would better evaluate this marker.

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None

Authors' contributions

All authors made substantial contributions to conception and design of the study.

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Conflicts of Interest

All authors declared that there are no conflicts of interest.

REFERENCES

1. Gad MA, Saber A, Farrag S, Shams ME, Ellabban GM. Incidence, patterns, and factors predicting mortality of abdominal injuries in trauma patients. North Am J Med Sci.2012;4(3):129-34.
2. Fanomezantsoa R, Davidà RS, Tianarivelo R, Fabienne RL, Aina RTM, Auberlin RF, et al. Traumatismes fermés et pénétrants de l'abdomen: analyse rétrospective sur 175 cas et revue de la littérature. Pan Afr Med J. 2015; 16(20):129.
3. Mutter D, Schmidt-Mutter C, Marescaux J. Contusions et plaies de l'abdomen. EMC-Médecine. 2005;2(4):424–447.
4. Moura FHB, Parreira JG, Mattos T, Rondini GZ, Below C, Perlingeiro JAG, et al. Ruling out intra-abdominal injuries in blunt trauma patients using clinical criteria and abdominal ultrasound. Rev Colégio Bras Cir. 2017;44(6):626-32.
5. James MK, Schubl SD, Francois MP, Doughlin GK, Lee S-W. Introduction of a pan-scan protocol for blunt trauma activations: what are the consequences? Am J Emerg Med. 2017;35(1):13-9.
6. Santucci CA, Purcell TB, Mejia C. Leukocytosis as a Predictor of Severe Injury in Blunt Trauma. West J Emerg Med. 2008;9(2):81-5.
7. Salehi S, Faridaalaee G, Mohammadi N. Correlation of WBC count and severity of injury in abdominal trauma; a cross-sectional study. J Med Physiol.2016;1:25-30.
8. Ibrahim AAA. Leukocyte Count as a Predictor of Severity of Injury in Pediatric Blunt Abdominal Trauma. Pediatr Surg. 2019;2:3.
9. Schnüriger B, Inaba K, Barmparas G, Eberle BM, Lustenberger T, Lam L, et al. Serial WBC Counts in Trauma: Do They Predict a Hollow Viscus Injury?: J Trauma Inj Infect Crit Care. 2010;69(2):302-7.
10. Hershkovitz Y, Naveh S, Kessel B, Shapira Z, Halevy A, Jeroukhimov I. Elevated WBC count, decreased hematocrit and presence of macrohematuria correlate with abdominal organ injury in pediatric blunt trauma patients: a retrospective study. World J Emerg Surg.2015;10(1):41.
11. Holmes JF, Sokolove PE, Land C, Kuppermann N. Identification of Intra-abdominal Injuries in Children Hospitalized Following Blunt Torso Trauma. Acad Emerg Med. 1999;6(8):799-806.