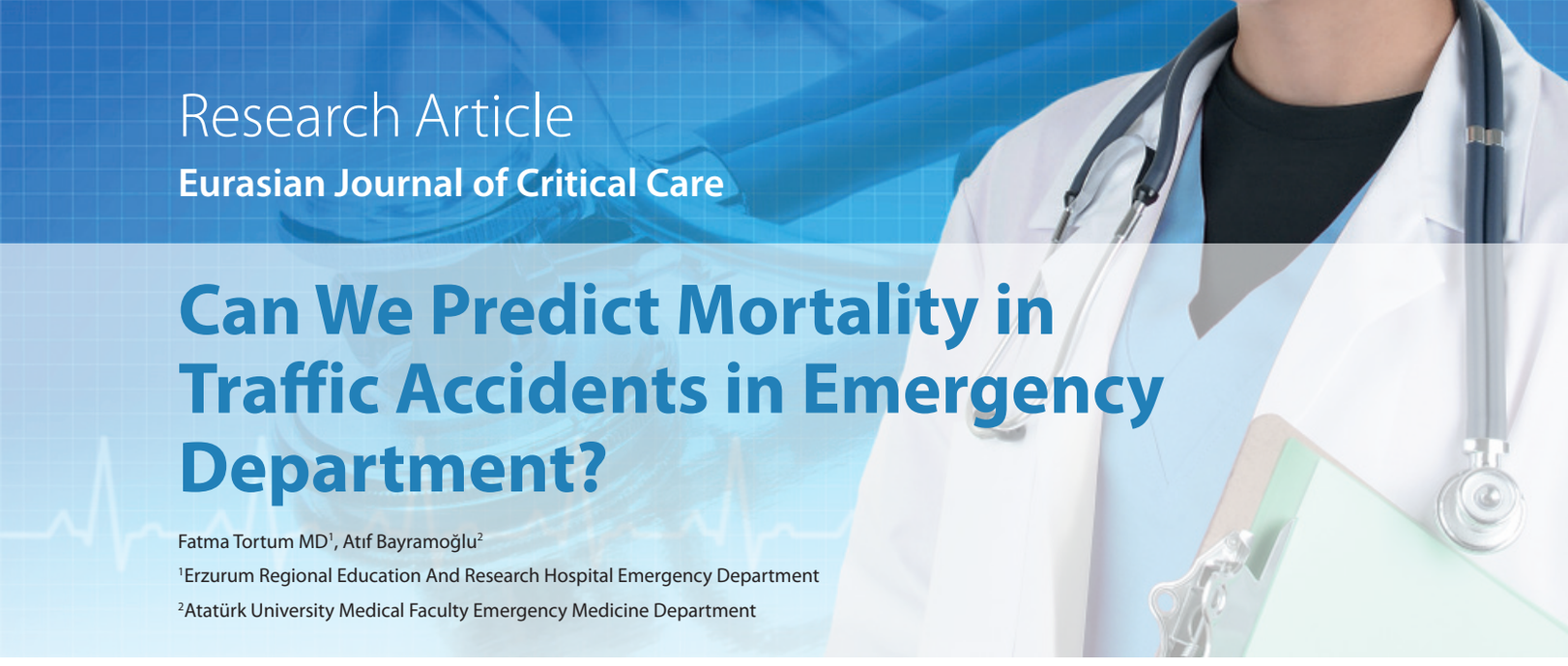
Research Article
Eurasian Journal of Critical Care



Can We Predict Mortality in Traffic Accidents in Emergency Department?

Fatma Tortum MD[1], Atıf Bayramoğlu[2]
[1]Erzurum Regional Education And Research Hospital Emergency Department
[2]Atatürk University Medical Faculty Emergency Medicine Department

Abstract

Introduction and Objective: Traffic accidents are one of the leading causes of mortality in young adults. Several physiological and biochemical parameters were defined for this purpose. Our objective was to investigate the correlation between mortality and the biochemical parameters, hemogram parameters and blood gas parameters.

Materials and Methods: 768 patients, who had applied to the emergency unit of the Atatürk University Research Hospital due to the traffic accident between 01.01.2017 and 01.07.2017, were retrospectively investigated. Two groups were formed from patients, who died (Group 1) and discharged (Group 2). The information about the patients and the biochemical parameters, hemogram parameters, blood gas analyses were retrieved from the electronic patient files and application files in the emergency department. Data were analyzed with SPSS v20 software package. The accepted limit of significance was $p<0.05$.

Results: 42.2 % of patients were hospitalized and treated in the clinics and 1.4 % died. There was a significant difference between the groups regarding pH, lactate, HCO_3, SBC, PCO_2, calcium and albumin levels. However, the differences in respect of hematocrit, platelet,WBC levels were insignificant (Table 1).

Discussion and Conclusion: An increase in the base deficit, which emerges due to the metabolic acidosis and lactic acidosis as a result of hypovolemia, was described in several studies focused on the patients injured in traffic accidents. Our study confirmed the findings in the literature and showed that the values of pH, HCO_3, SBC, SBE, calcium and albumin were lower in the patients, who died, compared to the discharged patients.

Key words: carbon monoxide, poisoning, hyperbaric oxygen, carboxyhemoglobin

Introduction and Aim

Background: Traumas are one of the leading causes of adult deaths in the world. One of the most important causes of trauma is traffic accidents. Traffic accidents account for 25% of all injuries. More than 1 million people die as a result of traffic accidents each year, and 20-50 million people are injured in these accidents[1]. Traffic accidents are one of the leading causes of morbidity worldwide. It is expected to be the fifth cause of mortality in the world in the year two thousand and thirty[2]. Most of the fatal accidents occur in developing countries where less protected vehicles are used in traffic accidents such as bicycles or motorcycles[3]. According to TurkStat (Turkish Statistical Institute) data, a total of 1 million 182 thousand 491 traffic accidents occurred in 2016 in Turkey. Of these accidents, 182 thousand 128 are with fatal injuries. In these accidents, 3 thousand 493 people died at the scene, while 3 thousand 807 people lost their lives in the health care institutions (www.tuik.gov.tr).

The mortality resulting from a traffic accident can be examined in three periods. The deaths caused by the laceration of the central nervous system or the large vessels usually occur at the scene (immediate deaths). Deaths within the first few hours of trauma are defined as early deaths. Early deaths account for 30% of all deaths. If patients with external or internal bleeding or hemopneumothorax do not receive appropriate medical assistance within the first few hours (golden hours), they result in early deaths. The source of bleeding for these patients may be subdural-epidural hematomas, injury to the parenchymal organs such as the spleen-liver or pelvic fractures. Late deaths are usually caused by multiorgan failure or sepsis[4, 5]. Early predictions of mortality in emergency services are possible in the early death group where we can change the result with the right interventions.

Corresponding Author: Fatma Tortum **e-mail:** drcitirik@hotmail.com
Received: 13.12.2018 • **Accepted:** 21.02.2019
©Copyright 2018 by Emergency Physicians Association of Turkey - Available online at www.ejcritical.com

In order for early prediction of mortality, many trauma scores and parameters have been developed. Again, for this purpose, many biochemical and physiological parameters are evaluated. Some of the most commonly used scoring methods for physiological parameters are Glasgow Coma Scale, Revised Trauma Score and Prehospital Index. The revised trauma score Glasgow coma scale, defined 30 years ago, consist of physiological parameters including systolic blood pressure and respiratory rate. It does not require advanced medical devices and examinations. It is suitable for use at the scene and at the time of the first application to the emergency service for the determination of the severity of the trauma[6]. Some scoring systems assess the anatomic localization in determining the severity of trauma. Abbreviated injury scale (AIS), injury severity score (ISS) and TRISS, developed by combining both are the most commonly used anatomic trauma scoring systems[7]. Each of these scoring systems have disadvantages and advantages, and none can precisely predict mortality.

Aim: In this study, we aimed to investigate the efficacy of biochemical, blood gas and hemogram tests that are routine examinations for most of the trauma patients in emergency services in predicting mortality.

Materials and Methods

Study design-setting: Our study was performed retrospectively in the Emergency Medicine Clinic of the Medical Faculty Research Hospital in Ataturk University. The Medical Faculty Research Hospital in Ataturk University is the largest university hospital in Eastern Anatolia. It also often accepts patients from the surrounding cities. The patients who applied to the emergency medicine clinic with the complaint of traffic accident between 01.01.2017-01.07.2017 were examined.

Participants: All patients who had a traffic accident and admitted to the emergency service of our hospital were examined. Patients with multisystem injury who were hospitalized for further examination and treatment due to mortality risk were included in the study and divided into two groups. The study group consisted of patients who resulted in exitus in our hospital due to traffic accidents. The control group consisted of patients who were discharged after inpatient treatment in any clinic or intensive care unit. Of the patients admitted to our clinic due to traffic accidents, outpatients, those with minimal trauma and those without multisystem injury were excluded from the study due to the low risk of trauma-related mortality.

Variables: Blood gas analyzes of the cases were examined. Of the blood gas parameters, Ph, HCO_3, SBE (standard base excess), SBC (standard bicarbonate), Na (sodium), K (potassium), glucose, PO_2 (partial oxygen pressure) and PCO_2 (partial carbon dioxide pressure) were evaluated. In addition, in hemogram, WBC (White blood cell), hemoglobin, hematocrit, MCH (mean corpuscular hemoglobin), MCHC (mean corpuscular hemoglobin concentration), MCV (mean corpuscular volume) and platelet values were evaluated, and in biochemistry, serum Na, serum glucose, serum K, CK (creatine kinase), CK-MB, AST (aspartate transaminase), ALT (alanine aminotransferase), GGT (gamma-glutamyl transferase), total bilirubin, direct bilirubin, Ca and albumin values were evaluated.

Data source-measurement: The hemogram, biochemistry and blood gas analyzes of the patients at the time they first applied to the emergency service were examined. Hemogram parameters are measured in whole blood with a hemogram-specific Sysmex brand hemogram device in the laboratory. Biochemical parameters were studied on a Beckman Co Ulter AU 5800 brand device. For blood gas analysis, samples were collected with special heparin injectors and ABL 800 Flex brand devices were used.

All the data of the patients were obtained from the electronic records in the hospital information management system "ENLIL" used in our hospital.

Study size: 768 patients were admitted to the emergency service of our hospital with the complaint of traffic accident between 01.01.2017-01.07.2017. 433 of these patients were minor trauma outpatients who were discharged from the emergency service of our hospital. This group was excluded from our study. The remaining 324 patients received inpatient treatment in the clinics and intensive care units at our hospital and were discharged afterwards. Eleven patients resulted in exitus in our hospital.

Statistical methods: In descriptive statistics, for categorical data, percentage frequency analysis was used, and mean (±) standard deviation and minimum maximum values were calculated for numerical data. Chi-squared test was used to compare the categorical values between the study and control groups, and student's t-test was used to compare the numerical data. P value <0.05 was considered significant.

Findings

Participants: In our study, 768 patients who were admitted to our hospital due to traffic accidents were examined. Of these patients, 433 without multisystem trauma, which we called minor trauma, were excluded from our study. Of the three hundred and thirty-five patients, 11 (3.3%) were included in our study group because they resulted in exitus. 324 (96.7%) patients who were treated and discharged were evaluated as the control group.

Of the patients examined, 116 (34.6%) were females and 219 (65.4%) were males. The mean age of the patients who applied to the emergency service due to traffic accidents was found as 34. The mean age of the group that resulted in ex-

itus in our study was 36. There was no statistically significant difference between the two groups (p=0.671). When the blood gas analysis of the patients who resulted in exitus was examined, the Ph value of this group was found to be lower than the control group. This decrease was statistically significant (p<0.001). Again, the base excess and lactate values of the group that resulted in exitus were statistically significantly higher (p=0.008, p=0.018, respectively). The bicarbonate and standard bicarbonate concentrations of the group that resulted in exitus were statistically significantly lower (p=0.004, p=0.038, respectively). The PCO_2 value was higher in the exitus group than the control group (p=0.021).

Serum Ca (calcium) and albumin levels were found to be lower in the study group (p=0.016, p=0.019, respectively). Among the hemogram parameters, hemoglobin levels were lower in the study group (p=0.045). However, there was no significant difference between hematocrit, platelet and WBC values. In the study group, MCHC was found to be lower (p=0.07) and MCV values were found to be higher (p=0.044). (Table 1).

Discussion

Key result: In our study, we concluded that lactate and blood pH values of blood gas parameters may be useful in predicting mortality.

The most common cause of in-hospital deaths that occur as a result of traffic accidents is hypovolemia caused by head trauma and bleeding[8]. Perfusion diffusion due to hemorrhagic shock developing based on bleeding and tissue hypoxia are the main causes of mortality[9]. This results in the development of metabolic acidosis. In some studies, the development of hypothermia, metabolic acidosis and coagulopathy in trauma patients has been defined as the triad of death[10, 11]. At the same time, serum lactate levels increase with tissue hypoxia resulting from perfusion diffusion. It has been shown in some studies that mortality is associated with increased lactate values[12,13]. There are even publications suggesting that lactate values can be utilized during the diagnosis and treatment of hypovolemic shock. In the study conducted by Blow in 1990, increased mortality was

Table 1. Patients' blood gas analyze, hemogram and biochemikal parameters

	Group 1 Mean ± standard deviation	Group 2 Mean ± standard deviation	P value	Total Mean ± standard deviation	Reference range
Age	**37 ± 24**	**34 ± 20**	**0.671**	**34 ± 20**	
Ph	7.20 ± 0.19	7.39 ± 0.07	0.028	7.38 ± 0.1	7.35-745
Lactate	6.1 ± 3.3	2.5 ± 1.9	**0.018**	2.7 ± 2.2	0.5-1.6
HCO_3 (mmol/L)	17.8 ± 5.6	22.2 ± 1.4	**0.004**	21.9 ± 4.3	21.2-28.3
SBC	16.9 ± 6	22.2 ± 3.3	**0.038**	22.1 ± 3.7	
SBE (mmol/L)	-8.3 ± 8.5	-2.5 ± 5.8	**0.008**	-2.8 ± 6	0-0
PCO_2 (mmHg)	44.6 ± 6.8	37.8 ± 8	**0.021**	38.2 ± 8.2	32-45
PO_2 (mmHg)	66 ± 31	65 ± 46	0.941	65 ± 45	83-108
Blood gas Na	139 ± 5	138 ± 3	0.672	138 ± 3	135-148
Blood gas K	3.9 ± 1.1	3.8 ± 3.5	0.815	3.8 ± 0.5	3.4-4.5
Blood gas glucose	214 ± 217	142 ± 58	0.414	145 ± 75	10-105
Serum Na (mmol/L)	137 ± 5	137 ± 2	0.822	137 ± 2.5	136-146
Serum Glucose (mg/dL)	225 ± 193	128 ± 52	0.147	131 ± 61	74-106
Serum K (mmol/L)	4.4 ± 2	4 ± 0.4	0.465	4 ± 0.5	3.5-5.1
CK (U/L)	1121 ± 1442	614 ± 1104	0.162	635 ± 1120	0-0
CK-MB (U/L)	763 ± 1563	50 ± 50	0.168	79 ± 329	1-24
AST (U/L)	386 ± 529	52 ± 84	0.077	62 ± 133	1-50
ALT (U/L)	236 ± 294	39 ± 70	0.064	45 ± 91	1-50
GGT (U/L)	19 ± 7	23.7 ± 23.3	0.520	24 ± 23	1-55
Total bilirubin (mg/dL)	0.4 ± 0.2	0.6 ± 0.5	0.243	0.6 ± 0.5	0.3-1.2
Direct bilirubin (mg/dL)	0.1 ± 0.03	0.1 ± 0.3	0.688	0.1 ± 0.3	0-0.2
Ca (mg/dL)	8 ± 0.9	8.8 ± 0.7	**0.016**	8.9 ± 0.7	8.8-10.8
Albumin (g/dL)	3.2 ± 0.6	3.9 ± 0.5	**0.019**	3.9 ± 0.5	3.5-5.2
WBC (10^3/µL)	16 ± 8	12 ± 5.4	0.197	12 ± 5.5	4.3-10.3
Hemoglobin (g/dL)	12.9 ± 2.9	14.4 ± 2	**0.045**	14.4 ± 2	13.6-17.2
Hematocrit (%)	39.4 ± 8	41.8 ± 6	0.216	42 ± 6	39.5-50.3
MCH (pg)	28.4 ± 2	28.8 ± 2	0.627	28.2 ± 2	27.2-33.5
MCHC (g/dL)	32.7 ± 1.1	34.4 ± 1.3	0.07	34.4 ± 1.3	32.7-35.6
MCV (fL)	87 ± 6	83.6 ± 5	**0.044**	83.7 ± 5	80.7-95.5
Platelet (10^3/µL)	229 ± 86	258 ± 76	0.240	257 ± 76	150-450

shown in patients whose lactate levels could not be reduced or normalized in the first 24 hours[12, 13]. For this reason, the first 24 hours are defined as the silver day for trauma patients. Applications to be planned for the treatment of the patient such as emergency surgery or intensive resuscitation should be planned within the first 24 hours under the guidance of lactate value[14]. Increased lactate levels together with tissue hypoxia leads to metabolic acidosis in patients. The importance of acidosis, where the blood Ph value was defined as <7.35, in the diagnosis and treatment of hemorrhagic shock was determined by studies[15]. In this case, decreased serum Ph value will also be associated with mortality[15]. The increased production of organic acids with trauma and the reduction of the removal of organic acids deepens metabolic acidosis. In this case, some buffer systems are activated and homeostasis is tried to be provided. The most important chemical buffer system is the HCO_3/CO_2 buffer system. With the activation of this system, serum HCO_3 amount is decreased in patients[16]. All these metabolic changes are associated with perfusion diffusion after volume loss. In order to recover this condition, the volume lost during the trauma resuscitation is attempted to be recovered. However, there is no strong evidence in the literature stating that fluid therapy prevents death in trauma patients[17]. In recent years, the definition of damage control resuscitation, which includes definitions such as permissive hypotension, balanced intravenous crystalloid fluid replacement and balanced delivery of blood products for trauma patients, has started to enter emergency services[14, 18].

Intra-abdominal injuries are important in traffic accident cases because of the mortal bleeding they will cause. Intra-abdominal bleeding is the third most common cause of death due to trauma. 50% of these deaths can be prevented by early diagnosis and treatment[19]. Therefore, ruling out intra-abdominal injury is important in cases of traffic accidents admitted to emergency services. For this purpose, physical examination, ultrasonography (USG), computed tomography (CT), laparotomy and laparoscopy can be used[20]. Some biochemical parameters showing liver function can be used together with imaging techniques and physical examination to guide the treatment of the patient[21]. In our study, no significant difference was found between the AST, ALT, GGT and bilirubin values of the patients who resulted in exitus after the traffic accident and the patients who were treated and discharged.

Albumin is a plasma protein that is involved in the transport of physiologically important molecules in blood such as drugs, vitamins, hormones and fatty acids. Albumin is also important in the regulation of plasma oncotic pressure. Previous studies determined that low albumin levels were associated with prolongation of hospital stay, increase in re-admission and impaired immunological functions[22]. Yukl et al. reported in their study related to trauma that mortality was increased in patients with low albumin who experienced blunt trauma[23]. Similarly, in our study, albumin levels of the study group patients were found to be lower than the control group.

Previous studies have shown a poor relationship between hypocalcemia and clinical improvement in patients treated under intensive care[24, 25]. At the same time, the blood gas Ph values of patients with hypocalcemia were found to be more alkalotic than the other patients[24]. Ionized calcium levels are found to be low as the binding of calcium to albumin will increase in the case of alkalosis. In the case of acidosis, the binding of calcium to albumin decreases and ionized calcium is found to be high. However, the cause of hypocalcemia following trauma may be due to external bleeding and fluid treatments during resuscitation of the trauma[26]. In our study, serum calcium levels were found to be low in the study group. However, contrary to the studies mentioned, the blood Ph values in the hypocalcemic group were more acidotic.

Hemoglobin and hematocrit values are expected to decrease in patients with post-traumatic bleeding. In many studies, hemogram and hematocrit values have been shown to be closely related to hemorrhagic shock, increased emergency surgery or mortality in trauma patients. Therefore, it is also a common practice to check the control hemogram and hematocrit values during the follow-up of traffic accident cases in emergency services. Madsen et al. showed that hematocrit values were not suitable for the diagnosis of hemorrhage[27]. In our study, there was no difference between the study and control groups interns of hematocrit, WBC and platelet values. However, hemoglobin and MCHC values were low and MCV values were high between the groups.

Limitation: The limitation of our study was that it was performed in a single center and the number of patients in the study group that resulted in exitus were insufficient.

References

1. Bazeli J, Aryankhesal A, Khorasani-Zavareh D. Exploring the perception of aid organizations' staff about factors affecting management of mass casualty traffic incidents in Iran: a grounded theory study. Electronic physician. 2017;9(7):4773-9.
2. Herman J, Ameratunga S, Jackson R. Burden of road traffic injuries and related risk factors in low and middle-income Pacific Island countries and territories: a systematic review of the scientific literature (TRIP 5). BMC public health. 2012;12:479.
3. Rezaei S, Arab M, Karami Matin B, Akbari Sari A. Extent, consequences and economic burden of road traffic crashes in Iran. Journal of injury & violence research. 2014;6(2):57-63.
4. Varol O EH, Oguzturk H, Korkmaz İ, Beydilli İ. Investigation of The Patients Who Admitted After Traffic Accident To The Emergency Department Cumhuriyet Üniversitesi Tıp Fakültesi Dergisi. 2006 28 (2):55 - 60.

5. Neklapilova V, Zelnicek P. [Epidemiology of severe injuries from the viewpoint of the trauma center]. Casopis lekaru ceskych. 2003;142(11):676-8.
6. Jeong JH, Park YJ, Kim DH, Kim TY, Kang C, Lee SH, et al. The new trauma score (NTS): a modification of the revised trauma score for better trauma mortality prediction. BMC surgery. 2017;17(1):77.
7. Osler T, Glance L, Buzas JS, Mukamel D, Wagner J, Dick A. A trauma mortality prediction model based on the anatomic injury scale. Annals of surgery. 2008;247(6):1041-8.
8. Ernstberger A, Joeris A, Daigl M, Kiss M, Angerpointner K, Nerlich M, et al. Decrease of morbidity in road traffic accidents in a high income country - an analysis of 24,405 accidents in a 21 year period. Injury. 2015;46 Suppl 4:S135-43.
9. Jousi M, Reitala J, Lund V, Katila A, Leppaniemi A. The role of pre-hospital blood gas analysis in trauma resuscitation. World journal of emergency surgery : WJES. 2010;5:10.
10. Weinberg DS, Narayanan AS, Moore TA, Vallier HA. Prolonged resuscitation of metabolic acidosis after trauma is associated with more complications. Journal of orthopaedic surgery and research. 2015;10:153.
11. Rotondo MF, Zonies DH. The damage control sequence and underlying logic. The Surgical clinics of North America. 1997;77(4):761-77.
12. Gonzalez-Robledo J, Martin-Gonzalez F, Moreno-Garcia M, Sanchez-Barba M, Sanchez-Hernandez F. Prognostic factors associated with mortality in patients with severe trauma: from prehospital care to the Intensive Care Unit. Medicina intensiva. 2015;39(7):412-21.
13. Blow O, Magliore L, Claridge JA, Butler K, Young JS. The golden hour and the silver day: detection and correction of occult hypoperfusion within 24 hours improves outcome from major trauma. The Journal of trauma. 1999;47(5):964-9.
14. Duchesne JC, Barbeau JM, Islam TM, Wahl G, Greiffenstein P, McSwain NE, Jr. Damage control resuscitation: from emergency department to the operating room. The American surgeon. 2011;77(2):201-6.
15. Summersgill A, Kanter M, Fraser RM, Caputo ND, Simon R. Determining the utility of metabolic acidosis for trauma patients in the emergency department. The Journal of emergency medicine. 2015;48(6):693-8.
16. Shane AI, Robert W, Arthur K, Patson M, Moses G. Acid-base disorders as predictors of early outcomes in major trauma in a resource limited setting: An observational prospective study. The Pan African medical journal. 2014;17:2.
17. Dabrowski GP, Steinberg SM, Ferrara JJ, Flint LM. A critical assessment of endpoints of shock resuscitation. The Surgical clinics of North America. 2000;80(3):825-44.
18. Chang R, Holcomb JB. Optimal Fluid Therapy for Traumatic Hemorrhagic Shock. Critical care clinics. 2017;33(1):15-36.
19. Shojaee M, Faridaalaee G, Yousefifard M, Yaseri M, Arhami Dolatabadi A, Sabzghabaei A, et al. New scoring system for intra-abdominal injury diagnosis after blunt trauma. Chinese journal of traumatology = Zhonghua chuang shang za zhi. 2014;17(1):19-24.
20. Kendall JL, Kestler AM, Whitaker KT, Adkisson MM, Haukoos JS. Blunt abdominal trauma patients are at very low risk for intra-abdominal injury after emergency department observation. The western journal of emergency medicine. 2011;12(4):496-504.
21. Gunes Tatar I, Yilmaz KB, Ergun O, Balas S, Akinci M, Deryol R, et al. [The effect of clinical, laboratory and radiologic results on treatment decision and surgical results in patients admitted to the emergency department with blunt abdominal trauma due to traffic accident]. Ulusal travma ve acil cerrahi dergisi = Turkish journal of trauma & emergency surgery : TJTES. 2015;21(4):256-60.
22. Herrmann FR, Safran C, Levkoff SE, Minaker KL. Serum albumin level on admission as a predictor of death, length of stay, and readmission. Archives of internal medicine. 1992;152(1):125-30.
23. Yukl RL, Bar-Or D, Harris L, Shapiro H, Winkler JV. Low albumin level in the emergency department: a potential independent predictor of delayed mortality in blunt trauma. The Journal of emergency medicine. 2003;25(1):1-6.
24. Chernow B, Zaloga G, McFadden E, Clapper M, Kotler M, Barton M, et al. Hypocalcemia in critically ill patients. Critical care medicine. 1982;10(12):848-51.
25. Zaloga GP, Chernow B, Cook D, Snyder R, Clapper M, O'Brian JT. Assessment of calcium homeostasis in the critically ill surgical patient. The diagnostic pitfalls of the McLean-Hastings nomogram. Annals of surgery. 1985;202(5):587-94.
26. Ward RT, Colton DM, Meade PC, Henry JC, Contreras LM, Wilson OM, et al. Serum levels of calcium and albumin in survivors versus nonsurvivors after critical injury. Journal of critical care. 2004;19(1):54-64.
27. Madsen T, Dawson M, Bledsoe J, Bossart P. Serial hematocrit testing does not identify major injuries in trauma patients in an observation unit. The American journal of emergency medicine. 2010;28(4):472-6.