



Predictive value of serum amylase level in outcome of multiple trauma patients

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Abstract

Introduction: The early detection of injury in multiple trauma patients can lead to decreased mortality, length of stay, and improved clinical status of the patient. It is shown that there is a relation between increased level of serum amylase and pancreatic injury in trauma patients. The aim of this study is to evaluate serum amylase level in hospital outcomes of patients with abdominal blunt trauma.

Methods: This study was a cross-sectional survey that was conducted at the emergency room of Imam Reza (AS) Medical and Educational Center in Tabriz, Iran, during a year (April 2014-April 2015) on 101 patients with blunt abdominal trauma. Serum amylase levels were measured 6 hours after injury. The outcome of patients during hospitalization including the need for laparotomy and mortality were followed. Data were analyzed by SPSS software. $P < 0.050$ was considered significant.

Results: A significant relationship between elevated serum amylase level by laparotomy and mortality was observed ($P < 0.001$). 15 patients had serum amylase higher than 100 U/L. All patients with abnormal serum amylase died.

Conclusion: Determination of serum amylase level can be valuable in the prognosis of patients with blunt abdominal trauma, especially in determining mortality and proceed to laparotomy. However, studies with larger research community are required to investigate the precise role of amylase in the diagnosis and prognosis of patients with blunt abdominal trauma.

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Introduction

Trauma is any blunt and penetrating injury or injury caused by external factors intentionally or unintentionally. According to predictions by the World Health Organization (WHO), by 2020, injuries caused by accidents alone will be the second leading cause of lost years of life around the world.¹ Management of trauma patients is highly important and principled

dealing with these patients reduces deaths.^{1,2} Trauma is the leading cause of death in the first 4 decades of life. Abdomen is the third most common organ involved in trauma and will require surgery in 25% of cases.³ The prevalence of abdominal trauma continues to rise. Abdominal trauma is any injury and trauma in the abdominal area. This trauma can be penetrating or blunt. In general,

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mortality caused by blunt trauma is much more than penetrating one.⁴ Computed tomography scan (CT Scan) of the abdomen is an important and accurate diagnostic method in stable patients with abdominal trauma.⁵

Alpha-amylases (1 and 4, di glucanohydrolase) are hydrolytic enzymes that catalyze the polymeric carbohydrates. It is showed that there is a relationship between increased levels of serum amylase and pancreatic injury in trauma patients, and serum amylase level has been always considered as a parameter for the diagnosis of pancreatic trauma injuries.⁶ However, no relationship observed in some studies and no application in the management of patients with blunt abdominal trauma were reported in laboratory evaluation.^{7,8} Elevation of serum amylase level indicates the severity of injuries to pancreas. Serum amylase levels were normal, even in patients who had suffered pancreatic duct injuries.⁹ Kumar et al.,⁷ in the study, have noted that due to the contradictions and challenges facing this problem, few studies have been conducted to evaluate laboratory tests such as amylase in patients with abdominal trauma, especially in serum levels.

Few studies have been performed to determine the prognostic value of serum amylase and predict the intra-abdominal and out-pancreas injuries following blunt abdominal trauma. Therefore, this study aimed to determine the predictive value of serum amylase in determining the multiple trauma patients' need for laparoscopy, laparotomy, and mortality.

Methods

A cross-sectional study was conducted in the emergency room of Imam Reza Medical Research and Training Hospital (which has an admission rate of 25000 trauma patients per year and 9% of traumatic patients have been hospitalized) in Tabriz, Iran, from April 2014 to April 2015 on 101 patients with multiple trauma, and also, they had blunt abdominal trauma. Imam Reza Medical Research and Training Hospital is a referral

governmental general hospital in Tabriz, and it is the trauma center of East Azarbaijan province.

Inclusion criteria included patients with blunt abdominal trauma requiring admission to hospital. Exclusion criteria included a history of renal failure, patients with cardiopulmonary arrest, deep peritoneal lavage performed before sampling, penetrating abdominal trauma, time interval between injuries and admitted more than 6 hours, pregnant patients, patients discharged from the emergency department or leave hospital emergency room with personal satisfaction, and dissatisfaction to participate in the study. Sampling strategy was convenient. Based on our inclusion and exclusion criteria, 510 patients were excluded and 101 patients were included in the study period.

Written informed consent was obtained from all patients in the study, after explaining the circumstances. This study has been approved by the Ethics Committee of Tabriz University of Medical Sciences under the number 7616 on 02.12.2013.

After arriving patients to our emergency room, diagnostic and therapeutic measures were routinely done for them. Variables such as age, sex, educational level, occupation, cause of the accident, the scene of accident, heart rate (HR), mean arterial pressure (MAP), and Glasgow Coma Scale (GCS) were recorded. Serum amylase levels were measured 6 hours after injury. Then, the patients were hospitalized. The variables related to the outcomes including the type of surgery, the number of patients who require laparotomy or laparoscopy, the number of patients who died, the number of days of hospitalization, the diagnosis of intra-abdominal organ injuries, and mortality were registered. Following the patients continued until hospital discharge. Discharge from the hospital included discharge by the doctor or the patient death.

The alpha-amylase serum amount was evaluated using quantitative alpha-amylase diagnosis test kits of Pars Co. and Biotechnica Instruments BT-3000 analyzer made in Italy.

The test was on the enzymatic colorimetric method basis. In this method, 4, 6-ethylidene-(G7) -p-nitrophenyl- (G1) - α -D-maltohetaoside (EPS-G7) is broken into several pieces by alpha-amylase. In the second step, these parts are hydrolyzed by glucosidase and produced glucose and P-nitrophenol. According to the reference range of the kit used, the amount more than 100 U/L (cutoff point) was considered as the abnormal level of serum amylase.

A statistical analysis was conducted using SPSS software (version 17, SPSS Inc., Chicago, IL, USA). Descriptive statistical analyses were used. Normality of data distribution was examined by Kolmogorov-Smirnov test. For comparing the qualitative data between two groups, the independent sample's t-test was used. In addition to compare the qualitative data, the chi-square test was used. P value was calculated for all relations, and $P < 0.050$ was considered significant. To determine the cutoff point of serum amylase and the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV), and receiver operating characteristic (ROC) curve was used.

Results

Of the 101 participants in the study, 71 (70.3%) were male and 30 (29.7%) female. The mean \pm standard deviation (SD) age of the participants in this study was 32.47 ± 20.51 years. The mean \pm SD length of hospitalization was 8.27 ± 11.39 with the range of 1-70 days. The mean \pm SD patients' vital signs included HR 17.33 ± 105.15 minutes, MAP 73.11 ± 17.43 mmHg, and GCS 12 ± 3 . 10 patients needed laparotomy, but none of them had not evidence of pancreatic injury. Of those, 5 cases had spleen injury, two cases had liver injury, and 3 patients had hollow viscus injury. One patient needed laparoscopic operation and who had a diaphragmatic injury. Demographic characteristics of the patients are shown in table 1.

The mean \pm SD serum amylase of the

Table 1. Demographic features of patients

| Variables | |
|--------------------------------|--------------------|
| Age (year) (mean \pm SD) | 32.47 ± 20.51 |
| Sex | |
| Male | 71 patients |
| Female | 30 patients |
| Educational level [n (%)] | |
| Uneducated | 22 (21.8) |
| Elementary school | 21 (20.8) |
| Middle school | 12 (11.9) |
| High school | 5 (5.0) |
| Diploma | 27 (26.7) |
| High diploma | 6 (5.9) |
| BSc | 8 (7.9) |
| Occupational status [n (%)] | |
| Unemployed | 35 (34.7) |
| Employee | 06 (5.9) |
| Self-employee | 42 (41.6) |
| Student | 18 (17.8) |
| Mechanism of trauma [n (%)] | |
| Motor vehicle | 75 (74.3) |
| Falling | 24 (23.8) |
| Others | 02 (2.0) |
| Trauma place [n (%)] | |
| Inside the city | 60 (59.4) |
| Outside of city | 41 (40.6) |
| Need surgery [n (%)] | |
| Yes | 70 (69.3) |
| No | 31 (30.7) |
| Surgery type (70 patients) (%) | |
| Cranial | 27 patients (26.7) |
| Spinal | 9 patients (8.9) |
| Thorax | 12 patients (11.9) |
| Laparotomy | 10 patients (10.9) |
| Orthopedic | 10 patients (9.9) |
| Laparoscopy | 1 patients (1.0) |
| Maxillofacial | 1 patient (1.0) |
| Mortality (%) | |
| Yes | 29 patients (28.7) |
| No | 72 patients (71.3) |

SD: Standard deviation

patients was 67.09 ± 28.04 U/L in the range of 21-141. The mean \pm SD serum amylase in laparotomized and non-laparotomized patients were 95.80 ± 30.37 and 63.94 ± 26.07 , respectively. The mean \pm SD serum amylase in the dead and survived patients were 94.83 ± 34.23 and 55.93 ± 14.31 , respectively. Mann-Whitney U-test showed that there is a

Table 2. Comparison the outcome of patients based on serum amylase level

| Characteristics | Abnormal amylase level | Normal amylase level | P |
|-----------------|------------------------|----------------------|---------|
| Laparotomy | | | < 0.001 |
| Yes | 5 (123.40 ± 10.57) | 5 (68.20 ± 7.72) | |
| No | 10 (123.80 ± 14.18) | 81 (56.55 ± 15.47) | |
| Laparoscopy | | | 0.352 |
| Yes | 0 | 1 (41.00 ± 00.00) | |
| No | 15 (123.66 ± 12.70) | 85 (57.42 ± 15.33) | |
| Mortality | | | < 0.001 |
| Yes | 15 (123.67 ± 12.70) | 14 (63.93 ± 19.04) | |
| No | 0 | 72 (55.93 ± 14.31) | |

statistically significant difference between serum amylase levels in the laparotomized patients and other patients as well as dead patients and other patients ($P < 0.001$). Due to the cutoff point = 100 for serum amylase level, these variables were divided into two groups of normal and abnormal levels. Accordingly, the outcome of the patients were compared in these two groups. 15 patients had abnormal serum amylase levels. Table 2 shows mortality and patients' need for laparotomy and laparoscopy according to abnormal serum amylase level, and the mean \pm SD serum amylase and its comparison in each group with particular outcomes.

Table 2 shows that all patients with abnormal serum amylase have died. A significant relationship was observed between the normal or abnormal amylase and the need for laparotomy and mortality in patients ($P < 0.001$). No significant relationship was observed between laparoscopy need and serum amylase level ($P = 0.352$).

To determine the diagnostic value of amylase in determining the patients' outcome in need of laparotomy and mortality, ROC curve was used (Figures 1 and 2). Table 3 shows cutoff point, sensitivity, specificity, PPV and NPV, area under the curve (AUC), Youden index and serum amylase for each of the outcomes.

Discussion

Trauma is one of the most common health problems and leads to mortality and disability. Road traffic accidents are the most common cause of trauma in society.¹⁰ Immediate diagnosis and treatment of

injuries resulting from trauma lead to mortality reduction.³

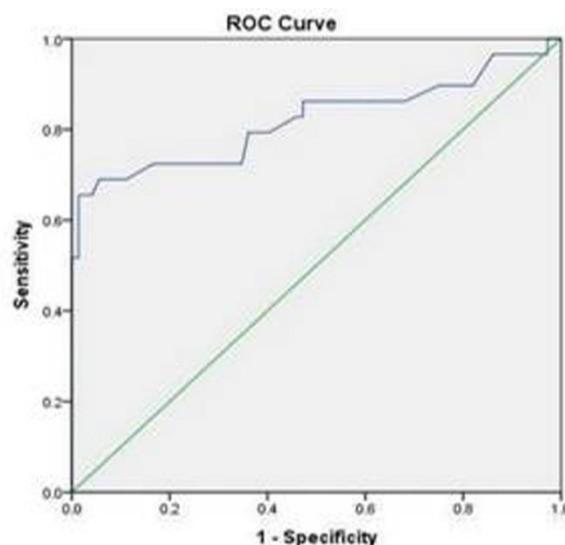


Figure 1. Receiver operating characteristic (ROC) curve to determine the diagnostic value of serum amylase for mortality

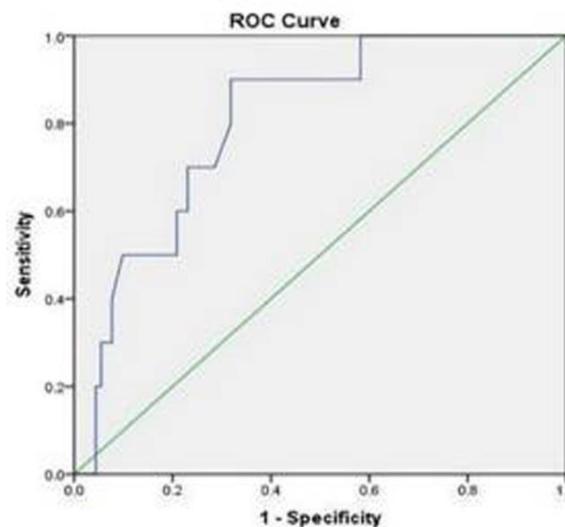


Figure 2. Receiver operating characteristic (ROC) curve to determine the diagnostic value of amylase for laparotomy

Table 3. Cut off point, sensitivity, specificity, NPV, PPV, AUC, and Youden index of serum amylase for predicting mortality and need for laparotomy in multiple trauma patients'

| Outcome | Cut off point | AUC | Youden index | SPE | SEN | NPV | PPV |
|------------|---------------|------|--------------|------|------|------|------|
| Mortality | 77 | 0.82 | 0.63 | 0.94 | 0.69 | 0.75 | 0.92 |
| Laparotomy | 71 | 0.81 | 0.41 | 0.71 | 0.70 | 0.70 | 0.71 |

AUC: Area under the curve; PPV: Positive predictive value; NPV: Negative predictive value; SPE: Specificity; SEN: Sensitivity

Various criteria are introduced to determine the severity of trauma and the risk of mortality in patients including injury severity score (ISS), revised trauma score, trauma-ISS, mechanism, glasgow coma scale, age, and arterial pressure (MGAP), and GAP.¹¹⁻¹⁵

In this study, our main objective was to determine the prognostic value of primary serum amylase level in the outcome of adult patients with multiple trauma. 101 patients were enrolled, out of which, 15 patients had abnormal amylase level and all of them died during the study period. Increased levels of serum amylase and lipase are usually recommended as a marker for pancreatic injuries in children.^{16,17}

Amylase release into the blood circulatory system is the result of injury to tissues containing high levels of the enzyme or other items. Increased levels of amylase occur in pancreatitis (inflammation/swelling of the pancreas), cholecystitis (inflammation/swelling of the gallbladder), perforation of abdomen hollow organs, decreased renal clearance, infection, and inflammation of the salivary glands.^{18,19}

Kumar et al.⁷ concluded in their study that the most important factor that influences the serum amylase level is the admission time of patients with pancreatic blunt trauma from the injury time. Determination of serum amylase in < 3 hours of trauma, regardless of the type of injury is not possible. Hence, to prevent lack of pancreatic injury diagnosis, amylase levels should be measured at least 3 hours after the trauma. Measuring amylase after 3 hours can help the physician to differentiate between Types I and II pancreatic injury. Mayer et al.²⁰ confirmed these results and suggested that serum amylase levels should be evaluated as a

routine laboratory parameters after trauma. Although, in the study of Adamson et al.,²¹ increased level of serum amylase was not associated with attempt to surgery and severity of the injuries. Capraro et al.²² evaluated the routine laboratory studies as screening tools for children with abdominal trauma. They concluded that the findings of the routine traumatic panel should not be considered as screening tools in children with blunt abdominal trauma to understand intra-abdominal injuries.

In this study, more than half of those who died, had high levels of serum amylase, while none of those who survived had high levels of serum amylase; in other words, all the patients who were finally discharged from the hospital had normal levels of serum amylase. This result can be very valuable and effective in subsequent decisions. In our study, a significant statistical relationship was found between the need for laparotomy and serum amylase abnormal levels.

As mentioned, there were contradictions between the various studies on using serum amylase level determination after trauma, but what most studies agree on it, is the high predictive value of alternate and serial measurement of serum amylase at least a few hours after trauma.²³ They suggest that although serum amylase is not reliable as a screening test, its alternate measurement hours after trauma can indicate the need path for non-invasive interventions.²⁴⁻²⁷

Now the laboratory tests performance at the initial examination and subsequent management of patients with blunt trauma is challenging. In addition, most studies have been done on the pediatric population, and few studies have been conducted on adult trauma patients. The limitations of this study include low sample size, single-centered study and

single measurement of the serum amylase level. Furthermore, in this study, we have not identified the intra-abdominal injuries and their relationship with serum amylase levels.

Conclusion

Serum amylase levels along with other laboratory tests can be valuable in the prognosis of patients with blunt abdominal trauma. Studies with a larger sample size as well as serial check of serum amylase level to investigate the exact role of amylase in the diagnosis and prognosis of patients with blunt abdominal trauma are required.

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Conflict of Interests

Authors have no conflict of interest.

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