Factors affecting mortality in patients with splenic injuries

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AIM: *Mortality in splenic injuries can create medico-legal problems. Though many studies exist regarding splenic injuries, there are not a sufficient number investigating the factors in splenic injuries influencing mortality. In this study, we aimed to investigate the factors affecting mortality in splenic injuries.*
MATERIALS AND METHODS: *All 237 patients with splenic injury between 2005 to 2014 were retrospectively analyzed. The patients were divided into two groups, survivors and non-survivors. Age, gender, mechanism of injury, grade of splenic injury, pulse, respiratory rate, systolic blood pressure, hemoglobin levels, number of transfusions, surgical procedure, ISS, RTS and hospitalization period were recorded. Univariate and multivariate analysis were used to compare survivors and non-survivors.*
RESULTS: *The average age of the patients was 32 and most (82.7%) were male. Mortality was observed in 18 patients (7.6%). Mortality was found significantly lower in patients who had isolated splenic injury (p=0.048). In univariate analyses, decreased RTS (p<0.001), increased number of blood transfusion (p<0.001), decreased hemoglobin level (p=0, 025) and increased ISS (p<0.001) were found significant in non-survivors. In multivariate analysis; number of transfusions, ISS and RTS were found as independent risk factors for mortality.*
CONCLUSIONS: *We found high number of transfusions, high ISS and low RTS as independent risk factors for mortality in patients with splenic injury.*

KEY WORDS: Mortality, ISS, RTS, Splenic trauma

Introduction

Abdominal trauma is present in 7-10% of all trauma victims, and in cases of severe trauma is often found together with orthopedic, thoracic, or central nervous system injuries [1]. Abdominal trauma can be classified as blunt or penetrating according to the agent and its mechanism of action. The spleen is the most frequently injured organ in abdominal blunt trauma, mainly because of its highly vascularized parenchyma and its anatomic location. In almost 46% of blunt trauma cases, the spleen is the only structure involved [2].
Mortality rates associated with splenic injury were 18%; this higher mortality rate was likely secondary to associated injuries and related post-trauma complications [3]. Mortality is medicolegal problem for all surgeons. In studies conducted in selected groups, low mortality rates could be achieved with non-operative treatment and surgical therapy performed in patients whose grade was high and who did not have additional problems; however, mortality increases in multi-trauma patients. Many scoring systems like Injury Severity Score (ISS), Revised trauma score (RTS), Trauma injury severity score (TRISS) were developed for assessment of trauma patients and are used in trauma centers [4,5]. Despite the presence of studies investigating the effects of these scoring systems

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and factors suggested to be effective for mortality in injuries, including all blunt and penetrating abdominal injuries, specific studies investigating the factors effective on mortality in splenic injuries are not available. In this study, we aimed to investigate the factors affecting mortality in splenic injuries.

Material and Method

237 patients with splenic injury who were admitted to Dicle University, School of Medicine, Department of General Surgery from January 2005 to April 2014 were included in the study. Age, gender, mechanism of injury, grade of splenic injury, pulse, respiratory rate, systolic blood pressure, hemoglobin levels, number of transfusions, surgical procedure, ISS, RTS and hospitalization period were recorded retrospectively. Then, the patients were divided into two groups based on mortality, survivors and non-survivors.

Statistical analyses were performed using the SPSS software version 15. The univariate analyses to identify variables associated with mortality in splenic injury was investigated using Chi-square, Fisher exact, Student's t and Mann-Whitney U tests, where appropriate. For the multivariate analysis, the possible factors identified with univariate analyses were further entered into the logistic regression analysis to determine independent predictors of mortality. A 5% type-I error level was used to infer statistical significance.

Results

The average age of the patients was 32.17 ± 13.36 years. While 215 patients were <55 (90.7%), 22 patients were ≥55 (9.3%). There were 196 (82.7%) male and 41(17.3%) female patients. The mechanisms of injury included: stab wound injury in 31 patients (13.1%), in-vehicle traffic accident in 65 patients (27.4%), out-of-vehicle traffic accident in 28 patients (11.8%), blunt abdominal trauma in 64 patients (27%), and penetrating injury in 49 patients (20.7%).

When patients were evaluated according to grade of splenic injury, there were 32 (13.5%) grade I, 56 (23.6%) grade II, 62 (26.2%) grade III, 80 (33.8%) grade IV, and 7 (3%) grade V patients. Mortality rate was lower in low-grade injuries (Grade I, II, III) compared with high-grade injuries (Grade IV, V), but it was not statistically significant (p= 0, 077).

While 46 (19.4%) patients had isolated splenic injury, 194 (81.9%) patients had also head trauma and 159 (67.1%) patients had also thoracic trauma. Mortality was found significantly low in patients who had isolated splenic injury (p=0.048). Operations occurred in 184 patients (78.6%), while 53 patients (22.4%) underwent NOM. Death occurred in 18 patients (7.6%).

Table I - *Characteristics of the non- survived and survived patients and their comparisons*

	Non-survived (n=18) Mean±SD	Survived (n=219) Mean±SD	P
Age (year)	35.17 ± 13.99	31.92 ± 13.34	0.314
LOHS (Length of)	7.28 ± 4.78	7.52 ± 4.08	0.969
Hg	9.12 ± 2.24	10.44 ± 2.31	0.025
TA	90.56 ± 23.88	98.20 ± 16.41	0.085
NT	3.44 ± 1.46	1.64 ± 1.61	0.000
ISS	22.33 ± 9.60	13.46 ± 8.17	0.000
RTS	5.89 ± 1.16	7.31 ± ±0.79	0.000

Legend: SD: Standard deviation GCS: Glasgow coma scale LOHS: Length of hospital stay, TA: Tansion Arterial, NT: Number of transfusions, ISS: Injury severity score, RTS: Revised trauma score.

Table II - *Comparison of the characteristics of the non-survived and survived patients*

	Non-survived (n=18) n (%)	Survived (n=219) n (%)	P
Gender			
Male	15(83.3)	181(82.6)	0.941
Female	3(16.7)	38(17,4)	
Grade			
1-3	8(44.4)	143(65.3)	0, 077
4-5	10(55.6)	76(34.7)	
AGE			
55<	16(88.9)	199(90.9)	0, 677
55≥	2(11.1)	20(9.1)	
Trauma type			
Blunt	3(16.7)	77(35.2)	0, 111
Penetrating	15(83.3)	142(64.8)	
Thoracic injuries			
Absence	6(33.3)	153(69.9)	0.002
Present	12(66.7)	66(30.1)	
Head injuries			
Absence	7(38.9)	187(85.4)	0.000
Present	11(61.1)	32(14.6)	
Management of patients			
Operation	14(77.8)	170(77.6)	1, 000
NOM	4(22.2)	49(22.4)	

NOM: Non-operative management.

Demographic and clinical characteristics of the patients are shown in Tables I and II.

No differences were found when comparing patients below and above the age of 55 in terms of mortality. Mortality was significantly higher in patients with head or thoracic trauma (p<0.001; P=0.002, respectively).

In all patients, all continuous variables were evaluated for a possible association with mortality. Statistical sig-

Table III - *Predictors for the mortality of splenic injury "Binary Logistic Regression"*

	Odds Ratio	95% C.I.for EXP(B) Lower	Upper	p Value
Age	1.000	0.959	1.042	0.989
NT	0.655	0.445	0.964	0.032
ISS	0.905	0.829	0.987	0.025
RTS	2.140	1.151	3.979	0.016
Constant	1.573			0.875

NT: Number of transfusions, ISS: Injury severity score, RTS: Revised trauma score.

nificance for continuous variables ($p < 0.05$) using univariate analysis was reached for the following factors for non-survivals: hemoglobin level, number of transfusions, ISS and RTS. The factors that were found as independent risk factors to predict mortality were number of transfusions, ISS and RTS in regression analyses. Odds ratios and p values showed in Table III.

Discussion

The spleen is the most frequently injured organ in abdominal blunt trauma, mainly because of its highly vascularized parenchyma and its anatomic location. In almost 46% of blunt trauma, the spleen is the only structure involved [2].

Garber et al. [6] reported a rate of overall mortality of 21% in splenic injuries. A newer study showed that the rate of mortality was 7.9%[7]. Our mortality rate was 7.6%.

Increasing severity of splenic laceration, was not associated with an increase in overall patient mortality; however, this did not take into account the severity of concomitant injuries, delay to presentation, or subsequent management [8]. While these parameters were not effective on mortality, they were effective evaluating the decision to operate in many studies. It has been shown that the degree of splenic injury is the most significant independent predictor associated with splenectomy[3,9], while other studies observe the necessity to operate in patients over the age of 55 with Grade IV or V injuries[10-12]. Other publications are available reporting that the grade of splenic injury is not effective in treatment decision; another study shows that splenic injury grade is not a predictor of successful nonsurgical management[11]. Kohn et al. found that CT scan–determined splenic injury grade did not predict non-operative management failure[11,13]. According to our results, negative effects like mortality of high grade splenic injuries could be eliminated if these patients undergo urgent operation[3]. Age and grade of splenic injury are factors which affect the treatment, but they are not predictive of mortality for patients treated appropriately. Mortality was found to be related with ISS [7].

A study demonstrated that the median ISS in mortality group was 48 compared to 22 in those who survived[8]. In the study by Yanar et al. [14], the GCS and ISS were significantly higher in the failed-NOM group. Bee et al.[15] and Malhotra et al. [16], in almost all of their reports, suggested that the ISS was an independent predictor of failure.

In our study, ISS was detected as another independent risk factor. Mortality increases with the effect of other injuries, particularly head and thoracic injury used for calculation of ISS. Brady et al. showed that no patient with a solitary splenic trauma injury died; however, mortality was approximately 50% in those with concomitant lung, stomach, colon, or diaphragmatic injuries; 60% in those with concomitant head or liver injuries; and over 85% in those with concomitant bladder, cardiac, or aortic injuries. Mortality was significantly associated with head, abdominal, aortic/cardiac, thoracic/diaphragmatic, or other types of concomitant injury [8]. In our study, mortality rates were significantly higher among patients with head and thoracic trauma.

Traub et al.[17] found that 93.8% of patients presented with concomitant injuries. The ratio was 80.6% in our study. Isolated splenic injuries rarely result in mortality [8,18,19]. Previous studies report that 30% of patients with blunt splenic trauma and 90% of patients with penetrating splenic trauma have concomitant additional intra-abdominal injuries [8,17]. In our study, patients who had isolated splenic injury had lower mortality rate. Splenic trauma patients who die succumb to massive blood loss from the spleen and associated abdominal vascular injuries. This may require more liberal criteria when selecting patients with splenic
trauma for early operative treatment[3]. Mortality rates for operative management in blunt injury vary greatly and are generally related to the severity of associated injuries both within and without the abdomen rather than the management of the spleen itself.

Moore et al. demonstrated a dose-response relationship between blood transfusion and the development of multisystem organ failure in unselected trauma patients with an ISS > 15 who survived longer than 48 hours[20, 21]. The detrimental effect of blood transfusion was independent of other measures of shock severity. Further studies have reported that the age of transfused blood correlates with a higher risk of multisystem organ failure in trauma patients[16] and increases mortality in patients with severe sepsis[20,22]. Malone et al. found blood transfusion within the first 24 hours to be an independent predictor of mortality[20,23]. The negative impact of blood transfusion was dose-dependent; each transfused unit of blood was associated with an increased risk of death[20]. Because each unit of blood transfused is associated with incrementally increased mortality[20], mortality

rates for massive transfusion patients range between 20% and 50%[24-27]. Number of blood transfusions was higher in mortality group and was detected to be an independent risk factor in statistical analysis. No difference was found between hemoglobin levels on admission. The initial hemoglobin levels were not significant, and finding the number of blood transfusions significant suggested that continuing hemorrhage was more important than the amount of hemorrhage. A number of authors have studied age in association with splenic trauma outcome[8,28,29]. Although patients over 65 years of age constituted only 8.8% of the cohort in the present study, they had a mortality rate of 68.6% (odds ratio 8.8). In other studies, patients older than 60 years of age who presented with splenic trauma have been shown to have a higher Injury Severity Score, lower Glasgow Coma Scale, and higher mortality compared to those less than 60 years of age [8]. Mortality in patients with blunt splenic injuries increased in patients 55 years old and older . The mortality rate for these older patients is greater than that of younger patients regardless of treatment they may also be indicative of the diminished cardiovascular reserve and decreased physiologic response to hemorrhage present in elderly patients [20]. Nix JA et al. showed that mortality was significantly higher for patients older than 55 regardless of whether they were operated on immediately or initially observed. This higher mortality rate occurred despite lower ISS and average splenic injury grades in patients older than 55 when compared with their younger counterparts[11]. In the present study mortality was seen not to increase in patients above 55 years. The mortality rate was similar for men and women. In a study the mortality rate for each grade of splenic injury was similar between men and women. Mortality rates were also similar in males and females in our study.

Most often, splenic trauma occurs secondary to blunt injuries and not penetrating injuries [8]. Furthermore, blunt splenic trauma is more common among males than females[8]. As in our study, Brady et-al. shows that female sex was identified as an independent variable associated with mortality. However in the present study we could not find any relation between gender and mortality. The proportion of blunt splenic trauma cases among females was 17.9% in those 24 years old and younger and was 60.7% in those 75 years and older, a finding replicated in studies specifically examining outcomes in older splenic trauma patients [8,28]. Delay to diagnosis or missed diagnosis increases the risk of death following blunt splenic trauma [8].

Conclusion

Every surgeon should realize the importance of medicolegal aspect of mortality. We found number of transfusions, ISS and RTS as independent risk factors for mortality in patients with splenic injury. Therefore, it must be considered that patients who have received high number of transfusions, with high ISS and low RTS have a high mortality rate. Timely medical and surgical intervention should be done in these patients and they must be monitored closely. We believe that further comprehensive prospective and multicenter studies including large number of patients are needed.

Riassunto

La mortalità per lesioni spleniche può creare problemi medico-legali. Nonostante numerosi studi riguardanti le lesioni spleniche, non vi sono numeri sufficienti su indagini riguardanti i fattori che influenzano la mortalità in questi casi. Con questo studio ci si propone di indagare appunto questi fattori.

Si è proceduto all'analisi retrospettiva di 237 pazienti con lesioni spleniche compresi tra il 2005 ed il 2014, dividendoli in due gruppi, e cioè i sopravvissuti ed i deceduti, prendendo in considerazione età, sesso, meccanismo del danno, grado di danno splenico, frequenza cardiaca e respiratoria, pressione sanguigna sistolica, livello emoglobinico, numero di trasfusioni, procedimenti chirurgici adottati, ISS (Injury Severity Score) e RTS (Revised Trauma Score), e durata del ricovero.

È stata usata l'analisi univariata e multivariata per confrontare le sopravvivenze ed i decessi.

L'età media dei pazienti era di 32 anni e prevaleva il sesso maschile (82,7%). È stata rilevata la mortalità di 18 pazienti (7.6%), significativamente inferiore in quelli con lesioni spleniche isolate (p= 0,0048). Nei soggetti non sopravvissuti, con l'analisi univariata sono risultati significativi una minore RTS (p<0,001), l'aumento del numero delle trasfusioni (p<0, 001), il minore livello emoglobinico (p=0,025) ed un aumento dell'ISS (p<0, 001).

Con l'analisi multivariata il numero delle trasfusioni, elevato ISS e basso RTS sono risultati fattori di rischio indipendenti per la mortalità da lesione splenica.

References

1. Costa G, Tierno SM, Tomassini F, Venturini L, Frezza B, Cancrini G, Stella F: *The epidemiology and clinical evaluation of abdominal trauma. An analysis of a multidisciplinary trauma registry*. Ann Ital Chir, 2010; 81:95-102.

2. Cirocchi R, Boselli C, Corsi A, Farinella E, Listorti C, Trastulli S, Renzi C, Desiderio J, Santoro A, Cagini L, Parisi A, Redler A, Noya G, Fingerhut A: *Is non-operative management safe and effective for all splenic blunt trauma? A systematic rev*iew. Crit Care, 2013; 17:R185.

3. Carlin AM, Tyburski JG, Wilson RF, Steffes C: *Factors affecting the outcome of patients with splenic trauma*. Am Surg, 2002; 68: 232-39.

4. Gumus M, Boyuk A, Kapan M, Önder A, Taskesen F., Aliosmanoglu I, Tüfek A., Aldemir M.: *Unusual extraperitoneal rectal injuries: A retrospective study*. Eur J Trauma Emerg Surg, 2012; 38: 295-99.

5. Boyuk M. Gumus A. Onder S, Kapan M, Aliosmanoglu I, Taskesen F, Arıkanoglu Z, Gedik E: *Splenic injuries: Factors affecting the outcome of non-operative management.* Eur J Trauma Emerg Surg, 2012; 38:269-74.

6. Garber BG, Yelle JD, Fairfull-Smith R, Lorimer JW, Carson C: *Management of splenic injuries in a Canadian trauma centre.* Can J Surg, 1996; 39:474-80.

7- Cadeddu M, Garnett A, Al-Anezi K, Farrokhyar F: *Management of spleen injuries in the adult trauma population: A ten-year experience*. Can J Surg, 2006; 49: 386-90.

8. Brady RR, Bandari M, Kerssens JJ, Paterson-Brown S, Parks RW: *Splenic trauma in Scotland: demographics and outcomes*. World J Surg, 2007; 31: 2111-116.

9. Moore EE, Cogbill TH, Jurkovich GJ, Shackford SR, Malangoni MA: *Champion HR. Organ injury scaling: Spleen and liver (1994 revision*). J Trauma, 1995; 38: 323-24.

10. Hancock GE, Farquharson AL: *Management of splenic injury.* J R Army Med Corps, 2012; 158:288-98.

11. Nix JA, Costanza M, Daley BJ, Powell MA, Enderson BL: *Outcome of the current management of splenic injuries.* J Trauma, 2001; 50:835-42.

12. Harbrecht BG, Peitzman AB, Rivera L, Heil B, Croce M, Morris JA Jr, Enderson BL, Kurek S, Pasquale M, Frykberg ER, Minei JP, Meredith JW, Young J, Kealey GP, Ross S, Luchette FA, McCarthy M, Davis F 3rd, Shatz D, Tinkoff G, Block EF, Cone JB, Jones LM, Chalifoux T, Federle MB, Clancy KD, Ochoa JB, Fakhry SM, Townsend R, Bell RM, Weireter L, Shapiro MB, Rogers F, Dunham CM, McAuley CE: *Contribution of age and gender to outcome of blunt splenic injury in adults: multicenter study of the eastern association for the surgery of trauma*. J Trauma, 2001; 51: 887-95.

13. Kohn JS, Clark DE, Isler RJ, Pope CF: *Is computed tomographic grading of splenic injury useful in the nonsurgical management of blunt trauma*? J Trauma, 1994; 36:385-89.

14. Yanar H, Ertekin C, Taviloglu K, Kabay B, Bakkaloglu H, Guloglu R: *Nonoperative treatment of multiple intra-abdominal solid organ injury after blunt abdominal trauma*. J Trauma, 2008; 64: 943-48.

15. Bee TK, Croce MA, Miller PR, Pritchard FE, Fabian TC. *Failures of splenic nonoperative management: Is the glass half empty or half full?* J Trauma, 2001; 50: 230-36.

16. Malhotra AK, Latifi R, Fabian TC, Ivatury RR, Dhage S, Bee TK, Miller PR, Croce MA, Yelon JA: *Multiplicity of solid organ injury: influence on management and outcomes after blunt abdominal trauma*. J Trauma, 2003; 54:925-29.

17. Traub AC, Perry JF: *Injuries associated with splenic trauma*. J Trauma, 1981; 21:840-47.

18. Sortland O, Nerdrum HJ, Solheim K: *Computed tomography and scintigraphy in the diagnosis of splenic injury.* Acta Chir Scand, 1986; 152: 453-61.

19. *Splenic injury: A prospective multicentre study on non-operative and operative treatment. The Splenic Injury Study Group*. Br J Surg, 1987; 74:310-13.

20. Robinson WP 3rd, Ahn J, Stiffler A, Rutherford EJ, Hurd H, Zarzaur BL, Baker CC, Meyer AA, Rich PB: *Blood transfusion is an independent predictor of increased mortality in nonoperatively managed blunt hepatic and splenic injuries*. J Trauma, 2005; 58:437-44.

21. Moore FA, Moore EE, Sauaia A: *Blood transfusion: An independent risk factor for postinjury multiple organ failure*. Arch Surg, 1997; 132:620-24.

22. Purdy FR, Tweeddale MG, Merrick PM: *Association of mortality with age of blood transfused in septic ICU patients*. Can J Anaesth, 1997; 44: 1256-261.

23. Malone DL, Dunne J, Tracy JK, Putnam AT, Scalea TM, Napolitano LM: *Blood transfusion, independent of shock severity, is associated with worse outcome in trauma.* J Trauma 2003; 54:898-905.

24. Borgman MA, Spinella PC, Perkins JG, Grathwohl KW, Repine T, Beekley AC, Sebesta J, Jenkins D, Wade CE, Holcomb JB: *The ratio of blood products transfused affects mortality in patients receiving massive transfusions at a combat support hospital*. J Trauma, 2007; 63: 805-13.

25. Malone DL, Hess JR, Fingerhut A: *Massive transfusion practices around the globe and a suggestion for a common massive transfusion protocol*. J Trauma 2006; 60:91-6.

26. Huber-Wagner S, Qvick M, Mussack T, Euler E, Kay MV, Mutschler W, Kanz KG: Working Group on Polytrauma of German Trauma Society (DGU): *Massive blood transfusion and outcome in 1062 polytrauma patients: A prospective study based on the Trauma Registry of the German Trauma Society*. Vox Sang, 2007; 92:69-78.

27. Sauaia A, Moore FA, Moore EE, Moser KS, Brennan R, Read RA, Pons PT: *Epidemiology of trauma deaths: A reassessment.* J Trauma, 1995; 38:185-93.

28. Krause KR, Howells GA, Bair HA, Glover JL, Madrazo BL, Wasvary HJ, Bendick PJ: *Nonoperative management of blunt splenic injury in adults 55 years and older: Atwenty-year experience.* Am Surg, 2000; 66:636-40.

29. Tsugawa K, Koyanagi N, Hashizume M, Ayukawa K, Wada H, Tomikawai M, Sugimachi K: *New insight for management of blunt splenic trauma: Significant differences between young and elderly.* Hepatogastroenterology, 2002; 49: 1144-149.