Non-operative management in blunt splenic trauma: A ten-years-experience at a Level 1 Trauma Center

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Abstract

Spleen injuries are among the most frequent trauma-related injuries. The approach for diagnosis and management of Blunt Splenic Injury (BSI) has been considerably shifted towards Non-Operative Management (NOM) in the last few decades. NOM of blunt splenic injuries includes Splenic Angio-Embolization (SAE). Aim of this study was to analyze Pisa Level 1 trauma center (Italy) last 10-years-experience in the management of Blunt Splenic Trauma (BST), and more specifically to evaluate NOM rate and failure. Retrospective analysis of all patients admitted with blunt splenic trauma was done. They were divided into two groups according to the treatment: hemodynamically unstable patients treated operatively (OM group) and patients underwent a non-operative management (NOM group). The CT scan performed in all NOM group patients. Univariate analysis was performed to identify differences between the two groups. Multivariate analysis adjusting for factors with a p value < 0.05 or with clinical relevance was used to identify possible risk factors for NOM failure. 193 consecutive patients with blunt splenic trauma were admitted. Emergency splenectomies were performed in 53 patients (OM group); 140 were managed non-operatively with or without SAE (NOM group). NOM rate in high grade injuries is 57%. Overall NOM failure rate is 9%, and success rate in high grade splenic injuries is 48%; multivariate analysis showed AAST score ≥3 as a risk factor for NOM failure. Non-operative management currently represents the gold standard management for hemodynamically stable patient with blunt splenic trauma even in high grade splenic injuries. AAST ≥3 spleen lesion is a failure risk factor but not a contraindication to for non-operative management.

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Introduction

Trauma represents the 4th cause of death in the world population, and it's the first cause of death between the under-40 population of high-income countries. Up to 20-30% of polytraumatized patients, are likely to have abdominal organ injuries.[1-3] Spleen injuries are one of the most frequent trauma-related injuries, especially in case of blunt abdominal trauma.[4] During the last few decades, the management of stable hemodynamic patients with Blunt Splenic Trauma (BST) has considerably shifted towards Non-Operative Management (NOM).

At the beginning of 20th century, the immunological function of the spleen was widely demonstrated.[5-16]

Actually NOM of blunt splenic injuries has been widely accepted and it was also facilitated by the implementation of interventional radiology techniques.[17-19] Splenic Angioembolization (SAE), was initially utilized to reduce spleen volume in hypersplenism.[20] In 1995, Sclafani *et al.*[21] first introduced the concept of the splenic angioembolization as an effective tool in splenic trauma management. Nowadays, the majority of hemodynamically stable ST are treated nonoperatively. NOM includes observation and splenic angio-embolization. NOM presents evident benefits as avoiding a surgical intervention, preserving the spleen and its immunological function in order to prevent OPSI, reducing hospital costs, intra-abdominal complications rate and blood component transfusion.[22-25] Successful rate of conservative management is reported to be nearly 90%, in high-volume trauma centers with all the conditions previously described (OR, ICU, radiology 24/7 available).[23,26] NOM failure rate, defined as the need for splenectomy in BST patients who have been initially approached non-operatively, ranges between 4 and 15%.[23,26-36] Many studies attempted to identify possible risk factors for NOM failure.[4,26,27,33,37-39] Currently, there's no clear-cut conclusion yet, concerning which are sure risk factors for the NOM failure. Present study reports the last 10-years-experience of the Pisa level I Trauma Center, focusing on the success rate of NOM and trying to identify any risk factor for NOM failure.

Materials and Methods

Population

This is a single center retrospective study, including all patients admitted to the Pisa Level 1 Trauma Center (Italy), with BST between December 2010 and September 2021.

Trauma management is multidisciplinary (Surgeon, Emergency Medicine Physician, Anesthesiologist). Patients hemodynamically unstable not responder to intravenous fluid administration with positive E-FAST were directly undergone to emergency surgical procedures. All hemodynamically stable patients had a contrast-enhanced CT scan. Injuries were classified according to the American Association for the Surgery of Trauma Organ Injury Scale (AAST-OIS) grading system.[40]

The detection at CT scan of vascular lesion such as contrast blush or pseudoaneurysm was an indication to perform angiography with subsequent angio-embolization.

Two groups were identified: Operative Management group (OM group), including patients who underwent to emergency splenectomy during the index intervention, and the Non-Operative Management group (NOM group) in which patients were treated conservatively, with or without SAE. The primary aim of this study was to identify the NOM failure rate within our cohort, defined as the needed for a splenectomy when first attempt had been spleen-preserving, and any potential risk factor. Morbidity and mortality, hospital length of stay, were our secondary outcomes.

Data Collection

Following data were collected: demographic data (age and gender), injury data [mechanism of injury (MVC, MCC, Fall…), AAST grade, Presence of vascular lesion, ISS value at admission], complications (hematologic, infection), outcomes (hospital length of stay, ICU-length of stay, mortality). The cut-off value "age > 55" was used considering its role as a possible risk factor for NOM failure,[23] and that's been demonstrated how elderly patients who fail NOM, has a higher risk of mortality compared to younger NOM-failure population.[41] Data collection was performed using a computerized spreadsheet and analyzed using SPSS Statistics 23 (SPSS Inc., Chicago, IL). Descriptive statistics were calculated for all clinical variables described. Continuous variables are represented as median [Interquartile Range (IQR)]. Categorical variables are presented as n (%). Univariate analysis was performed to identify differences between the two groups OM and NOM; we also compared patients who underwent only monitoring with the ones who underwent SAE, within the NOM group. The Mann-Whitney

Table 1. Patients characteristics, clinical data and outcomes.

	Total 193 (%)	Operative management (OM) 53 (28%) (%)	Non-operative management (NOM) 140 (72%) (%)	P value
DEMOGRAPHICS				
Age	48 (28-62 y.o.)	54 (26-64 y.o.)	45 (28-61 y.o.)	0.442
Age ≥ 55	74 (38)	25 (47)	49 (35)	0.137
Gender				0.359
Female	49 (25)	16 (30)	33 (24)	
Male	144 (75)	37 (70)	107 (76)	
INJURY DATA				
Mechanism of injury				0.733
MVC	87 (45)	26 (49)	61 (44)	
MCC	44 (23)	10 (19)	34 (24)	
AVP	10 (5)	3 (6)	7 (5)	
Fall	45 (23)	11 (21)	34 (24)	
Crush	7 (4)	3 (6)	4 (3)	
AAST grade				<0.001
1	36 (19)	3 (6)	33 (24)	
2	47 (24)	3 (6)	44 (31)	
3	67 (35)	18 (34)	49 (35)	
4	35 (18)	23 (43)	12 (9)	
5	8 (4)	6 (11)	2 (1)	
AAST ≥ 3	110 (57)	47 (89)	63 (45)	<0.001
ISS	18 (12-27)	27 (20-32)	16 (9-25)	<0.001
ISS > 15	122 (63)	50 (94)	72 (51)	<0.001
Vascular lesion	48 (25)	3 (6)	45 (32)	<0.001
COMPLICATIONS				
Infection	10 (5)	6 (11)	4 (3)	0. 028
Hematologic	7 (4)	4 (8)	3 (2)	0.09
OUTCOMES				
ICU-LOS	3 (1-10)	3 (1-8)	3(1-10)	0.259
HLOS	10 (7-16)	8 (5-16)	10 (7-17)	0.072
Mortality	10 (5)	7 (13)	3 (2)	0.005

MVC: Motorvehicle Crash; MCC:Motorcycle Crash; AVP: auto vs pedestrian; AAST: American Association for the Surgery of Trauma; ISS: Injury Severity Score; ICU-LOS: Intensive Care Unite-Length of Stay; HLOS: Hospital Length of Stay

test was used to compare continuous variables. Pearson's chi-squared test or Fisher exact test were used to compare categorical variables. Multivariate analysis adjusting for factors with a p value < 0.05 or with clinical relevance was used to identify possible risk factors for NOM failure.

Results

Over the study period, 193 patients presented with blunt splenic trauma: 144 male (75%), the median age of the population was 48 years. Motor-vehicle crash was the most frequent mechanism of injury: MVC (Motor-vehicle Crash) 45%, MCC (Motorcycle Crash) 23%, fall 23%, AVP (Auto Vs. Pedestrian) 5% and crush 4%.

One hundred and forty patients (72%) were managed conservatively (NOM group), fifty-three patients underwent immediate emergency splenectomy (OM group; Table 1). NOM group includes thirty-three female (24%) and one-hundred and seven male (76%), with a median age of forty-five years. 35% of the NOM population was > 55 years old, within the OM group this percentage was 47%.

Comparing the characteristics of these two groups (Table 1), the AAST grade was higher in the OM group, same when using the AAST≥3 cut-off value. Number of patients with ISS >15 was higher in the OM group.

Within the NOM population, patients treated only with monitoring and those underwent SAE (EMBO sub-group) were compared (Table 2). Overall, NOM failure rate was 9%; there was no statistically significative difference regarding the failure rate between the two sub-groups, with a p = 0.086. The H-LOS was higher in the EMBO sub-group, likewise the AAST grades and the ISS values. Vascular lesions finding at admission CT scan, was higher in the EMBO sub-group, an intrinsic data considering that the presence of vascular lesions represents the main indication to the angioembolization itself.

Table 3 shows a comparison between different types of angioembolization (proximal, distal, combined) regarding failure rate and causes. Neither the reason of failure nor the failure rate were related to the type of SAE.

Logistic regression (Table 4) identified AAST≥3 as an independent risk factor for NOM failure (p di 0.03; odds ratio=4.876). ISS>15 was excluded from this model because of its co-linearity with AAST≥3.

Discussion

NOM is nowadays the standard of practice for BSI in hemodynamically stable patients[23] or rapid responder ones, without associated lesion requiring surgery.[23,27,37] NOM in higher grade splenic injuries should only be attempted in hospital with 24/7 available operating room, ICU, radiology department and blood bank. The most recently published guidelines,[23] confirmed hemodynamic status as the cornerstone for the management choice in patients with splenic injuries. A new classification system has also been introduced: splenic injuries were usually classified according to the AAST grading system,[40] which is an "anatomical" classification, while WSES classification is based on both "anatomical" grade (AAST-OIS grading) of the lesion, and the physiological status of

Table 2. Non-operative management.

	Total 140 (%)	NOM 76 (54%) (%)	NOM + AE 64 (46%) (%)	P value
DEMOGRAPHICS				
Age	45 (28-61)	49 (28-66)	42 (29-57)	0.258
Age ≥ 55	49 (35)	30 (40)	19 (30)	0.28
INJURY DATA				
AAST grade				<0.001
1	33 (24)	31 (41)	2 (3)	
2	44 (31)	33 (43)	11 (17)	
3	49 (35)	12 (16)	37 (58)	
4	12 (9)	-	12 (19)	
5	32 (1)	-	2 (3)	
AAST ≥ 3	63 (45)	12 (16)	51 (80)	<0.001
ISS	16 (9-25)	13 (8-18)	22 (13-27)	<0.001
ISS > 15	72 (51)	25 (33)	47 (73)	<0.001
Vascular lesion	45 (32)	2 (3)	43 (6)	<0.00
OUTCOMES				
Failure	13 (9)	4 (5)	9 (14)	0.086
Failure Reason				0.070
Bleeding	7 (5)	4 (100)	3 (33)	
Abscess	6 (4)	-	6 (67)	
ICU-LOS	3(1-10)	3 (1-12)	3 (2-10)	0.318
HLOS	10 (7-17)	8 (6-12)	13 (10-21)	<0.001
Mortality	3 (2)	-	3 (5)	0.093

AAST: American Association for the Surgery of Trauma; ISS: Injury Severity Score; ICU-LOS: Intensive Care Unite-Length of Stay; HLOS: Hospital Length of Stay.

the patients.[42] This concept endorses the importance of evaluating BST patients in a global and multidisciplinary way to increase the NOM rate, despite of the anatomical severity of injury.

The advantages of NOM are unquestionable: the conservative management avoids surgery, preserves the spleen reducing the possible immunological weakness, reduces comorbidity, mortality and is resource and costs-saving.[22-25] In this study too, the infectious complications (p-value <0. 028) and the mortality (p-value <0.005) were higher in the OM group. This may be also due however to the different lesions patterns that may be associated to the hemodynamic instability leading to the OM and the consequent physiological derangements.

During the last few decades, the angioembolization has given contributions to the improvement of NOM success rate, especially in high grade injuries. Many authors have underlined the important role of SAE. It has been demonstrated by multi-institutional studies that SAE is an independent indicator of spleen preserving, and that NOM failure rate is lower in trauma center with higher SAE volume,[43] especially in high grade splenic injuries.[44] Many systematic review and meta-analyses have upheld the potential impact of SAE in the management of BST.[45-47]

There's different embolization technique such as proximal, distal or combined: the choice between these options is still debated, as present data are still insufficient as emerged from a meta-analysis[48] to define which one may reduce the failure rate. As showed in Table 3, in this analysis there are no significant differences in term of failure between the angioembolization's techniques. The overall NOM failure rate found in this study was 9%, consistent with the literature.[23,27,29,30,36,37,45] Within the NOM group, the subgroup of patients underwent SAE did not experienced a reduced failure rate (p value 0.086). This is not in line with the literature as NOM is a facilitating tool in order to increase the rate of NOM in spleen injuries. This data may be explained with the large time lapse encompassing the study period and therefore the different treatments received form the patients during the eleven years study period.

To ulteriorly improve the success of NOM, more refined failure predictive factors definition should be attempted. During the past decades many retrospective and prospective studies have tried to defined NOM failure risk factor as vascular lesion at the admission CT-scan, age >55 year old, ISS >15 and AAST grade≥3.[4,23,25,26,31,34,35,36,41,49] Present study reports a frequency of attempted NOM in high-grade injuries of 57%, higher compared to previous published data by the Eastern Association for the Surgery of Trauma published in 2000;[4] moreover NOM success rate NOM in high grade injuries is 48%. In a retrospective study published in 2006,[38] NOM failure in high-grade splenic injuries reached up to 54.6%, in present series is 16%. In other studies the successful rate of NOM in high grade lesions seems higher, achieving 87% of success,[23,27] probably also thanks to the improvement of the angioembolization technique.[50-52]

In this analysis, AAST grade of lesion and ISS were higher in the OM group when compared with NOM one. Despite there's no statistical significance in the hospital length of stay of the two groups, the undisputed advantage of NOM emerges from the analysis of the outcomes: in the conservative group there was a minor rate of infective complications.

Present study multivariate analysis confirmed AAST score ≥3 is a risk factor for NOM failure. The finding of AAST≥3 as a risk factor must not question about the application of NOM even in high-grade splenic injuries. In this experience 45% of NOM group was AAST≥3. In term of the overall population, NOM in the AAST grade injury ≥3 group was the 57% (n: 110): forty-seven patients (43%) underwent an emergency splenectomy, ten patients (9%), at first approached conservatively, had a splenectomy due to NOM failure (Figure 1). NOM overall success in patients with high grade lesions was 48% in this study: almost half of these patients were able to preserve their spleen and avoiding surgery, underlining the importance of attempting a conservative strategy even in lesion with AAST grade ≥3. The complication rate regarding bleeding and abscess rates were 5% and 4% respectively. Confirming the absolute feasibility and safety of NOM in high grade injuries.

The retrospective design of this study represents an implicit limitation, as from the first years of the study up to nowadays tools and protocols for polytraumatized patients management have been implemented.

Table 3. SAE failure.

	Proximal AE (%) 26 (40)	Distal AE (%) 28 (44)	Combined AE (%) 10 (16)	P value
Failure	4 (15)	3 (11)	2 (20)	0.709
Failure Reason				0.143
Bleeding	1 (25)	-	2 (100)	
Abscess	3 (75)	3 (100)	-	

Table 4. Multivariate analysis for failure in patients with blunt splenic trauma.

	Adjusted p	OR	95 % CI	
Age ≥ 55	0.450	1.610	0.468	5.534
AAST ≥ 3	0.031	4.876	1.159	20.519
Vascular lesion	0.827	1.148	0.333	3.955

NOM: Non-Operative Management; AAST: American Association for the Surgery of Trauma; ISS: Injury Severity Score. *Binary logistic regression was performed with potentially causative variables in which p value was <0.2 in the univariate analysis or clinically relevant. Multi-co-linearity test was check before doing multivariate analysis. Hosmer & Lemershow Goodness of fit test p 0.028. AUROC = 0.697 (0.567-0.826).

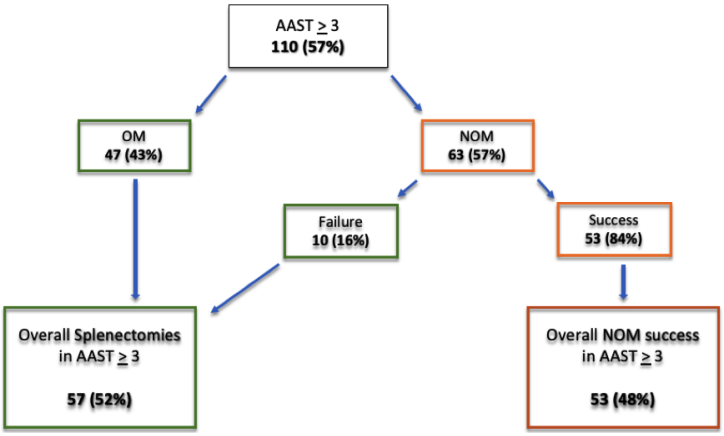

Figure 1. AAST≥3 spleen trauma patients flow chart.

Conclusions

Non-operative management currently represents the gold standard management for hemodynamically stable patient with blunt splenic trauma even in high grade splenic injuries. AAST≥3 spleen lesion is a failure risk factor but not a contraindication to for non-operative management.

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