Management of blunt splenic injuries
Retrospective cohort study of early experiences in an Acute Care Surgery Service recently established

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AIM: *To identify patients with splenic injuries, who should benefit from a conservative treatment, and to compare in-hospital follow-up and hospital length of stay (LOS), in patients treated by non-operative management (NOM) versus immediate-splenectomy (IS).*
MATERIAL OF STUDY: A *retrospective cohort study on consecutive patients, with all grade of splenic injuries, admitted between November 2010 and December 2014 at the Acute Care Surgery Service of the S. Anna University Hospital of Ferrara. Patients were offered NOM or IS.*
RESULTS: *Fifty-four patients were enrolled; 29 (53.7%) underwent IS and 25 (46.3%) were offered NOM. Splenic artery angioembolization was performed in 9 patients (36%) among this latter group. High-grade splenic injuries (IV-V) were more represented in IS group (65.5% vs 8%), while low grade (I-II) were more represented in NOM group (64% vs 10.3%). Failure of NOM occurred in 4 patients (16%). Hospital LOS was longer in IS group (p=0.044), while in-hospital and 30-day mortality were not statistically significant different between the two groups.*
CONCLUSIONS: *Hemodynamically stable patients, with grade I to III of splenic injuries, without other severe abdominal organ injuries, could benefit from a NOM; the in-hospital follow-up should be done, after a control CECT scan, with US. Observation and strictly monitoring of splenic injuries treated with NOM do not affect patients' hospital los.*

KEY WORDS: Non-operative management, Splenic Rupture, Surgery

Introduction

Blunt splenic injuries are increasingly treated with non-operative management (NOM) and it is now accepted as the treatment of choice in minor splenic trauma (grades I and II); NOM for more severe splenic injuries is still debated and depends on the multidisciplinary team of the hospital, which admit the traumatized patient[1]. Angiography and embolization, adjunct to NOM, can improve the success of conservative treatment and were first described in blunt splenic trauma management in 1981[2]. Even though large number of studies have been published about this topic, the lack of high quality evidence challenges guidelines composition. Last published practice guidelines about blunt splenic injury, by Eastern Association for the Surgery of Trauma[3], state that "angiography should be considered for patients with American Association for the Surgery of Trauma-Organ Injury Scale (AAST-OIS)[4] grade greater than III injuries, presence of a contrast blush, moderate

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haemoperitoneum, or evidence of ongoing splenic bleeding" (Level II recommendation). Moreover, literature agrees with the consideration that NOM, alone or with angioembolization (AE), should only be done in adequate environment, which provides intensive care unit (ICU), available operating room for urgent laparotomy, capabilities for monitoring and skilled interventional radiologist (level II recommendation)[3]. Open questions remain about clear guidelines for the follow-up and the preservations of splenic immune function after NOM, moreover after splenic angioembolization[3]. A recent study demonstrate that centers with higher rate of splenic artery angioembolization use have higher spleen salvage rates and less NOM failure[5]. On the other hand, NOM is not appropriate in patients with generalized peritonitis, hemodynamic instability and presence of other abdominal organ injuries that required surgery[6]. In fact, other abdominal organ injuries occur in 3% of patients with blunt splenic trauma and they are more commonly associated with massive splenic injury on its own than with lesser degrees of splenic injury. This information may be helpful in selecting patients for NOM[7]. The selection of patients eligible for non-operative treatment is nowadays easier than the past years because of the modern contrast-enhanced computed tomography (CECT) scan, which is the imaging modality of choice for evaluating stable blunt abdominal trauma victims[8]. Failure of non-operative management (f-NOM) is defined as the need of operation after observation or angioembolization, and some authors identified different predictors of f-NOM such as age >55, injury severity score >25, grade of splenic injuries (IV-V), lower level trauma centers admission, inappropriate indications for non-operative treatment and associated organ injuries (brain injuries)[9,10,11] . Concerns remained about NOM in patients with AAST-OIS grade III, in which the decision for conservative approach instead of splenectomy should depend on careful risk-benefit analysis for each patients as well as on the expertise of the surgeon and of the hospital multidisciplinary team[1].
The primary objective of the present study was to identify patients with splenic injuries, who should benefit from NOM. The secondary objective was to compare in-hospital follow-up and hospital length of stay (LOS), in patients treated by NOM versus splenectomy.

Material and Method

This is a retrospective cohort study on consecutive patients with splenic injuries who were admitted between November 2010 and December 2014 at the Acute Care Surgery Service of the S. Anna University Hospital of Ferrara, Italy. All patients with splenic trauma were identified retrospectively from a hospital discharge database. Patients who have had access to the Emergency Room (ER) of our hospital, with all AAST-OIS grade of blunt splenic injuries and older than 18 years old were included in the study. Patients in whom splenic injuries had been a complication of elective surgery and patients with spontaneous splenic injuries related to own disease were excluded from the study. Patients were divided in two groups, according to the type of management: 1) non-operative management (NOM group), and 2) immediate splenectomy (IS group). A retrospective analysis was obtained from database in which patients data were collected with details about patients' features, trauma severity, and type of treatment and outcome, which included f-NOM, mortality and length of hospital stay. All patients were first managed in ER by a trauma team (ER Physician, General Surgeon, Anesthetist and Radiologist/Neuroradiologist), according to the ATLS® (Advance Trauma Life Support)[12] protocol, which advised Focused Assessment with Sonography in Trauma (FAST) exam and, in hemodynamically stable patients, a total body CECT scan. Trauma severity was assessed according to the Injury Severity Score (ISS), which is an anatomically scoring system and takes values from 0 to 75[13]. The AAST-OIS grading was used to establish the CECT grade of splenic injuries at ER admission[4]. Moreover, CECT scan was useful to define patients who should benefit from angioembolization on the bases of the presence of a contrast blush, moderate haemoperitoneum or evidence of ongoing splenic bleeding[3], and to discover other associated organs or bones injuries. When CECT scan was not indicated (hemodynamic instability)[3], AAST-OIS grade was assessed intraoperative. Major bone fractures included spine cord, pelvic bones and long bones fractures. Trauma-related pulmonary disease included lung contusions, pleural effusion, pneumonia and pneumothorax. Treatment was established as IS or NOM. Splenectomy was performed in the operating room, in not hemodynamically stable patients, large haemoperitoneum and presence of other associated abdominal lesions, which required surgery. NOM was offered to hemodynamically stable patients with I to IV AAST-OIS grade of splenic injuries, with eventually associated abdominal organ lesions, which did not require any operation. In NOM group, proximal or distal splenic artery angioembolization (NOM-AE) was performed in hemodynamically stable patients, with contrast blush at the first CECT scan. All patients were monitored in Acute Care Surgical Service ward or in ICU with serial blood tests, common abdominal ultrasound (US), contrast-enhanced ultrasounds (CEUS) and CECT scan. Failure of NOM was defined when urgent laparotomy and splenectomy were performed after observation or angioembolization, due to persistent bleeding or complications of conservative approach. All patients who underwent splenectomy were vaccinated for Streptococcus pneumoniae, Neisseria meningitides and Haemophilus influenza type b[14], while this therapy was not given to patients treated non-operatively. Antiplatelet therapy at discharge was prescribed for treatment

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of reactive thrombocytosis, when platelet count was > 500000/μL[15].
Each study subject provided written informed consent. Data collection and analysis was performed according to the Declaration of Helsinki.

Statistical Analysis

The Shapiro-Wilk test was used to assess the assumption of normality, and data were expressed as mean ± standard deviation (SD) or median (interquartile range – IQR25-75) according to the distribution. Categorical data are presented as number (%). Data were analyzed using Chi-square, ANOVA, and Mann-Whitney tests as appropriate.

Results

Fifty-four patients were enrolled in this study; 29 (53.7%) underwent immediate splenectomy (IS group) and 25 (46.3%) were offered non-operative management (NOM group). Among this latter group, splenic artery angioembolization was performed in 9 patients (36%). Demographic data, patients and trauma characteristics at ER admission, are reported in Table I. No differences were found between the two groups regarding gender, age, comorbidities (diabetes and cardiovascular disease) and oral antiplatelet or oral anticoagulant home therapy. Patients who underwent IS had a significantly lower systolic blood pressure (p=0.009), diastolic blood pressure (p=0.003), and hemoglobin level (p=0.041) compared to NOM group. Among the associated lesions, a significant higher presence of abdominal organ injuries were found in patients underwent IS than in patients treated non-operatively (p= 0.005). High grade splenic injuries (IV-V AAST-OIS grade) were significantly more represented in IS group than in NOM group (65.5% vs 8%), while low grade (I-II AAST-OIS grade) were more represented in NOM group than IS group (64% vs 10.3%). For grade III, there are not a statistically significant difference between the two groups (28% NOM vs 27.6% IS). Among patients with grade III splenic injuries, all the non-operative management (7 patients) were proposed and supported by a dedicated staff of Acute Care Surgery Service, while splenectomy (8 patients) were planned by the others in-active service General Surgeons. The associated abdominal organ injuries in grade III splenic lesions were found in one (14.3%) patient of NOM group and in 4 (50%) patients of splenectomy group. Performed CECT scan at ER

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Table I - *Demographic data and characteristics of all patients with traumatic blunt splenic injuries*

	Non operative management (N = 25)	Splenectomy	p (N = 29)
Gender (N - %)			0.272
Male	19 (76.0)	18 (62.1)	
Female	6 (24.0)	11 (37.9)	
Age (yrs.)	53.4±21.9	52.14 ±19.56	0.824
Diabetes (N - %)	2 (8.0)	2 (6.9)	0.636
Cardio-vascular disease (N - %)	4 (16)	7 (24.1)	0.346
Oral anticoagulation or Oral antiplatelet therapy (N - %)	5 (20)	5 (17.2)	0.534
SPB (mmHg)	123.6±17.9	106.9±25.9	0.009
DPB (mmHg)	74.8±7.8	63.1±17.1	0.003
Heart rate (bpm)	81.2±10.3	88.6±17.7	0.072
Hb admission (g/dl)	13.0±2.4	11.7±2.2	0.041
Hematocrit admission (%)	39.0 ±7.8	35.6±6.3	0.067
ISS	25.4±11.4	30.8±11.9	0.095
Brain injuries (N-%)	2 (8.0)	5 (17.2)	0.277
Others abdominal organ injuries (N-%)	2 (8.0)	12 (41.3)	0.005
Major fractures (N-%)	9 (36.0)	10 (34.5)	0.566
AAST-OIS grade (N - %)			<0.0001
1	5 (20.0)	–	
2	11 (44.0)	3 (10.3)	
3	7 (28.0)	8 (27.6)	
4	2 (8.0)	15 (51.8)	
5	–	3 (10.3)	
CT scan at ER admission (N - %)	25 (100)	20 (68.9)	0.037
Splenic artery angioembolization (N-%)	9 (36.0)	–	

SPB systolic blood pressure; DPB diastolic blood pressure; Hb hemoglobin; ISS Injury Severity Score; AAST-OIS American Association for the Surgery of Trauma-Organ Injury Scaling; US ultrasounds; ER Emergency Room; CT computed tomography.

TABLE II - *In-hospital follow-up and clinical outcomes*

	Non operative management (N = 25)	Splenectomy (N = 29)	P
Trauma-related pulmonary disease (N - %)	4 (16.0)	13 (44.8)	0.023
Trauma-related intra-abdominal collection (N - %)	2 (8.0)	3 (10.3)	0.572
ICU admission (N-%)	9 (36.0)	17 (58.6)	0.083
ICU length of stay (day)	4.5 (2.0-11.0)	7.0 (2.5-12.0)	0.395
In-hospital Follow-up (N-%)			
Total number of abdominal US*	1(0-3)	0 (0-1)	<0.0001
Total number of abdominal CT scan*	1(0-1)	0 (0-1)	0.165
Total number of blood tests*	10.0 (8.0-15.5)	13.0 (8.0-19.0)	0.217
f-NOM (N - %)	4 (16.0)	–	
In-hospital mortality (N-%)	1(4.0)	–	0.463
Hospital length of stay (day)	12.0 (9.0-17.0)	16.0 (8.5-27.0)	0.044
30-day mortality (N-%)	–	2 (6.8)	0.284
Platelet count at discharge (10^3 /µl)	350 (212-579)	585 (465-695)	0.002
Indication of antiplatelet therapy at discharge (N - %)	4 (16.0)	19 (65.5)	<0.0001

*f-NOM failure of non operative management, ICU intensive unit care, US ultrasounds, CT computed tomography; * per patient*

admission was significantly higher in NOM group than in IS group (p=0.037). Five (55.6%) out of 9 NOM group patients who underwent angioembolization had distal embolization, while the other 4 (44.4%) underwent proximal embolization. Distal embolizations were performed in one patient with AAST-OIS grade I (20%), in one patient with grade II (20%), in two patients with grade III (40%), and one patient with grade IV (20%). Proximal angioembolizations were performed in three patients with AAST-OIS grade III (75%), and in one patient with grade IV (25%).

In-hospital follow-up and clinical outcomes are shown in Table II. Trauma-related pulmonary disease were significantly more represented in IS group than NOM group (p=0.023). During hospitalization, follow-up was performed with CECT scan and/or abdominal US, specifically: 30 patients underwent CECT scan (17 patients in NOM group and 13 in IS group; p= 0.075), while 23 patients underwent abdominal US (17 patients in NOM group and 7 in IS group; p=<0.0001). No difference was found in total number of CECT scan between the two groups, while the total number of abdominal US per patient was significantly higher in NOM group compare to IS group (p<0.0001). Among the 9 patients of NOM group who underwent AE, 4 (44.4%) were followed-up with CEUS. No patient in IS group underwent CEUS. Hospital LOS was significantly longer in IS group as opposed to NOM group (p=0.044). In-hospital mortality and 30-day mortality after discharge were not statistically significant different between the two groups. Blood platelet count (10^3/µl) at discharge was significantly higher in IS group than in NOM group (p=0.002) and then, antiplatelet therapy was indicated in 65.5% of IS group patients and in 16% of NOM group patients (p<0.0001). Failure of NOM occurred in four patients (16%), specifically: in one AAST-OIS grade II patient, after 5 days from trauma, without other associated organ injuries; in two AAST-OIS grade III patients (one patient with associated brain injury, after 5 days and one with associated abdominal organ injury, within 24 hours); and in one AAST-OIS grade IV patient, after 21 days, without other associated organ injuries. NOM was applied in grade I to IV and the failure rate was 0% in grade I, 9.1% (one out of 11 patients) in grade II, 28.6% (two out of 7 patients) in grade III, 50% (one out of 2 patients) in grade IV. All patients, in whom NOM failed, underwent urgent splenectomy.

Discussion and Comments

This retrospective study shows that not only patients with AAST-OIS grade I-II splenic injury but also patients with AAST-OIS grade III without severe associated abdominal organ lesions, should be treated with non-operative management.

Non-operative management of splenic trauma is now accepted as initial standard of care for hemodynamically stable patients, not only in children (rates above 90-95%) but also in adults (60-77%)[16]. It should only be considered in an environment that provides capabilities for monitoring, has a skilled multidisciplinary team in managing non operatively and has an available 24/7 operating room in case of urgent laparotomy[3]; the collaboration of different specialists is critical for the correct selection of patients who might benefit from NOM and for the further follow-up[17]. Some controversial issues in NOM of splenic lesions are still open (i.e. safety in higher-grade injury) [11], and the lacking of evidence-based

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guidelines for clinical assessment for selection of patients remains one of the causes of f-NOM[18,19]; however, NOM success rate has been shown to be 80%[20]. Moreover, McIntyre et al. considered age > 55 years old as a contraindication for NOM and one possible cause of NOM failure[9]. By contrast, recent study and guidelines stated that NOM could be applied regardless of age[3,21-23]. Accordingly, in this study, 46.3% (25 out of 54) of patients was treated with NOM, and 48.0% of these patients had age >55 years old; the success rate was 84%. Recent guidelines suggested hemodynamically instable patients should underwent urgent surgery, without CECT scan[3]. Given this, in this study, patients who underwent IS had a significantly both lower blood pressure and prevalence of high-grade splenic injuries (IV-V; Table 1), which suggested a more complex patient, compare to NOM group and CECT scan was performed only in 68.9% of patients. The CECT scan played an important role in selecting hemodynamically stable patients with splenic injuries, who could benefit from angioembolization and the combined use of CECT scan and selective arteriography could optimize the chance for both early diagnosis and successful nonsurgical management[24]. In this study, all patients treated with NOM underwent CECT scan at ER admission and in 36% of patients (9 out of 25) selective arteriography and splenic artery angioembolization was performed. The AAST-OIS grade of splenic injury influenced the choice of treatment, specifically 65.5% of patients with grade I-II splenic injuries were offered NOM, while 64% of grade IV-V splenic injuries underwent splenectomy. Concerns remained about grade III, where the distribution was almost equal in the two group (28% NOM vs 27.6% IS). To point out, the choice for NOM instead of splenectomy in grade III was strongly influenced by the Surgeon staff, which managed the trauma. In particular, all the non-operative management (7 patients) were proposed and supported by the Acute Care Surgery Service staff, while splenectomy (8 patients) were indicated by the others in-active service General Surgeons. Furthermore, in grade III NOM group only one patient had a minor kidney contusion conservatively treated, while in grade III IS group four patients had associated abdominal organ injuries, which could justify the operation. Given this, more experience in non-operative management of splenic lesions could increase the spleen salvage rate in patients with grade III splenic injuries. Application of NOM to high-grade splenic lesions (IV-V) is still under debate, even though they not represent an absolute contraindication of the conservative treatment[3]. However, Peitzman and Richardson demonstrated that NOM failure rate was related directly to AAIS-OIS splenic injuries grade, until 75% of f-NOM in grade V[25] and then, attention has to be paid when NOM is applied in high-grade (IV-V) splenic injuries[26]. In this study, a low number of patients with high-grade splenic injuries were treated with NOM (two patients with grade IV) and the failure rate was 50%. Furthermore, in a retrospective multicenter study on 388 patients with a grade IV or V splenic injuries, Velmahos et al. found a significantly higher failure rate (38%) in grade IV-V blunt splenic injury patients, and they identified both splenic injury grade V (OR 3.01; 95% C.I. 1.36-6.67) and brain injury (OR 2.82; 95% C.I. 1.14-7.01) as independent predictors of failure of NOM[11]. In our study, failure of NOM occurred in four patients (16.0%) and in one of these, which had AAST-OIS grade III splenic injury and associated brain injury, f-NOM arose after 5 days from admission. Splenic artery angioembolization in blunt splenic trauma was first described in 1981[2] and since then, its use seemed to improve NOM success rate[27], even though concerns remained about the safety in higher grade (IV-V)[1]. In the present study, angioembolization was applied in 9 patients out of 25 and the failure of NOM occurred in two of these: one patient with AAST-OIS grade IV treated with proximal angioembolization and one patient with AAST-OIS grade III treated with distal angioembolization. However, a recent prospective study demonstrated that AE was a helpful adjunct to NOM of splenic injuries when it was applied in a protocolled way and led to an important improved splenic salvage rate[28]. On the other hand, AE was an interventional procedure and a series of complications could occur: splenic infarction, abscess formation, cyst formation, contrast induced impairment, bleeding, pyrexia, left pleural effusion, coil migration[29]. Tartaglia et al reported a case of splenic abscess as a complication of a AAST-OIS grade IV splenic injuries, treated with splenic artery AE: the authors suggested that inflammatory and infectious aspects had to be monitored as well as hemodynamic parameters, in patients who underwent splenic artery angioembolization[30]. In this study, one patients with AAST-OIS grade IV treated with NOM and proximal embolization, developed a splenic abscess after 21 days, which led to splenectomy.

Data about in-hospital monitoring of patients treated with NOM are still lacking in literature: a survey of the Eastern Association for the Surgery of Trauma showed no consensus regarding this topic[31] and a recent review did not found an in-hospital follow-up protocol for patient who had had non-operative management of splenic injury [32]. In our study, monitoring was performed with blood tests, abdominal US, CECT scan, and in selected patients, with CEUS. The number of patients underwent US, and the total number of abdominal US per patient in NOM group was significantly higher than in IS group (p=< 0.0001 and p=<0.0001, respectively). The 68.0% of NOM group patients and the 44.8% of those in IS group underwent CECT scan during hospitalization, accordingly to ATLS follow-up protocols on the bases of trauma severity[12]. This suggested that NOM needs a closer in-hospital follow-up, which can be performed with an available radiological imaging, low-costs and without X-ray irradiations, as the abdominal US. In

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adjunct to normal US, CEUS was another technique for patients who underwent splenic angioembolization[19]. Filiotis et al stated that CEUS should be preferred for traumatized patients' follow-up, as it was a low-costs and easy to use radiological instrument, and it had the same sensibility of CECT[33]. In this study, among NOM group, in four selected patients, who underwent angioembolization, CEUS was performed. Splenectomy was considered one of the main causes of reactive thrombocytosis[34]. In our study, the median platelet count at discharge after splenectomy was significantly higher than in spleen salvage (585 vs 350; p= 0.002); however, some studies in literature showed increased numbers of platelets in both the angioembolized and splenectomised patients, so the spleen function preservation after NOM was still under debate[35]. Consequently to this, antiplatelet therapy was prescribed to the 75.8% of patients underwent splenectomy and to the 28.0% of patients treated with NOM, to reduce the risk of thrombosis. Concerns remained about benefit of splenic salvage regarding the alteration of patient immunological system: the use of post-splenectomy vaccinations had been recognized for around 40 years[36] and we prescribed common vaccinations to all our splenectomised patients. On the other side, no vaccinations were prescribed to NOM group without having evidence of immunosuppression during follow-up. In literature there were no clear indications: some authors declared that routine immunization for patients with splenic injuries managed conservatively was not recommended[32], while others stated that vaccination recommendations for embolized patients should be similar to those for patients undergoing splenectomy[37]; recently, some studies confirmed that very few patients might have evidence of hyposplenism[38,39]. Finally, some authors declared that one of the benefit of NOM was immune function preservation and the reduction of rates of Overwhelming Post-Splenectomy Infection (OPSI)[17,40].

Hospital LOS was longer in IS group than in NOM group (16.0 vs 12.0; p=0.044), probably because other associated injuries could require prolonged hospitalization. Similar result is reported in literature[21,41], even though other studies reported a longer hospital stay for NOM than splenectomy[42,43].

Di Saverio et al. reported that mortality rate could increase after f-NOM[44] and could be affected by high AAST-OIS grade of splenic injuries in patient treated with NOM, and in particular, in those with grades IV-V of splenic injuries mortality rate was lower in IS group than NOM group[41,45,46]. Recently, Swaid et al. in an analysis of Israel National Trauma Registry database showed that the f-NOM might led to high mortality rate (12.6%), while splenectomy intervention had got < 1% mortality and post-splenectomy sepsis was rare and could be prevented with vaccinations[7]. Moreover, as stated by another Author, the mortality rate from OPSI was 1/10,000, which was 20 times lower than the odds of patients who died from NOM failure[47].

In the present study, in-hospital mortality occurred in one patient treated with NOM-AE and subsequent splenectomy due to f-NOM, and was related to cardiac complication, confirmed by autopsy. The 30- day mortality arose in two IS group patients, owing to cardiopulmonary disease.

Conclusions

Hemodynamically stable patients, with AAST-OIS grade I, II, and III of splenic injuries, without other associated severe abdominal organ injuries, could benefit from a non-operative management, which could include splenic artery angioembolization. In-hospital follow-up of splenic injuries treated with NOM should be easily done, after a control CECT scan, with common abdominal US and/or CEUS, if worsening of clinical conditions does not appear. Observation and strictly monitoring of splenic injuries, treated with NOM, do not affect patients' length of hospital stay. Finally, with a dedicated Surgical team of Acute Care Surgery Severe, probably more patients with AAST-OIS grade III could have been treated with NOM; given this, it is necessary a prospective study on patients with AAST-OIS grade III to identify factors associated to NOM success.

Riassunto

Il trattamento conservativo dei trauma splenici è ormai il "*gold standard*" per i bassi gradi di lesione splenica (I-II grado), mentre è ancora dibattuta la gestione dei traumi splenici severi (IV-V grado). Controversa rimane la gestione dei traumi splenici di III grado, che potrebbero beneficiare del trattamento conservativo, associato o meno ad angioembolizzazione dell'arteria splenica, in centri specializzati ed idonei alla gestione conservativa dei traumi degli organi parenchimatosi. Le ultime linee guida pubblicate dalla "*Eastern Association of Surgery of Trauma*" risalgono al 2012 e provvedono a dare solo delle raccomandazioni di livello II-III sulla gestioni dei traumi splenici. Il fattore che maggiormente influenza il successo del trattamento conservativo è la selezione dei pazienti che potrebbero beneficiare di tale gestione. Alla luce di ciò, l'obiettivo primario del nostro studio è di identificare i pazienti con lesioni spleniche post-traumatiche, che dovrebbero essere sottoposti a trattamento conservativo; l'obiettivo secondario è di confrontare il decorso clinico e la durata della degenza nei pazienti trattati conservativamente e in quelli sottoposti a splenectomia. Tutti i pazienti con trauma splenico, ricoverati presso l'U.O. di Chirurgia d'Urgenza dell'Azienda Ospedaliera-Universitaria Sant'Anna, Ferrara (Italia) tra Novembre 2010 (anno in cui è stata istituita l'U.O.) e Dicembre 2014, sono stati inclusi nello studio, per un totale di 54 pazienti. Di questi 54 pazienti, 29 (53.7%) sono stati

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immediatamente sottoposti ad intervento chirurgico di laparotomia esplorativa e splenectomia, mentre 25 (46.3%) sono stati sottoposti a trattamento conservativo. I pazienti sottoposti ad angioembolizzazione sono stati 9 su 25 (36%). Sono stati raccolti dati epidemiologici, dati riguardanti il decorso clinico e le indagini laboratoristiche e radiologiche a cui i pazienti sono stati sottoposti al momento dell'accesso in Pronto Soccorso e durante la degenza, dati sulla mortalità, sul fallimento del trattamento conservativo e sulla durata della degenza. E' stata eseguita un'analisi statistica che ha evidenziato risultati statisticamente significativi ($p \leq 0.05$) sui dati clinici all'ingresso (pressione arteriosa, livelli di emoglobina, grado di lesione splenica, presenza di lesioni ad altri organi addominali) che hanno indirizzato verso una gestione conservativa o chirurgica. Inoltre, è stato dimostrato che nonostante il follow-up intraospedaliero nei traumi conservativi richieda uno stretto monitoraggio clinico, laboratoristico e strumentale, questo non determina una maggiore durata delle degenza. I dati raccolti concordano con la letteratura internazionale che afferma come i traumi splenici di basso gradi (I-II) possano essere trattati con sicurezza in modo conservativo, mentre per quanto riguarda i traumi severi (IV-V grado) l'applicazione del trattamento conservativo può essere seguita da un tasso di fallimento fino al 75% nel V grado con un tasso di mortalità del 12%, a fronte di un tasso di mortalità < dell'1%, correlato all'intervento chirurgico di splenectomia. In conclusione, i pazienti con lesioni spleniche di grado I, II, III, senza traumi di altri organi intraddominali che necessitano di un intervento chirurgico in regime d'urgenza, dovrebbero essere trattati in modo conservativo, non precludendo tuttavia tale possibilità anche a lesione di grado IV, in pazienti selezionati. Il monitoraggio intraospedaliero dei pazienti trattati conservativamente può essere effettuato in maniera semplice con ecografie addominali seriate o ecografie addominali con mezzo di contrasto; l'osservazione e lo stretto monitoraggio clinico non influenza la durata dell'ospedalizzazione. Studi prospettici su pazienti con lesioni spleniche di III grado sarebbero necessari per identificare i fattori correlati al successo del trattamento conservativo.

References

1. Cirocchi R, Boselli C, Corsi A, et al: *Is non operative management safe and effective for all splenic blunt trauma? A systematic review.* Crit Care, 2013; 17:R185.

2. Sclafani SJ: *The role of angiographic hemostasis in salvage of the injured spleen*. Radiology, 1981; 141:645-50.

3. Stassen NA, Bhullar I, Cheng JD, et al: Eastern Association For The Surgery Of Trauma: *Selective nonoperative management of blunt splenic injury: An Eastern Association for the Surgery of Trauma practice management guideline*. J Trauma Acute Care Surg, 2012; 73:S294-300.

4. Moore EE, Shackford SR, PachteR HL, et al.: *Organ injury scaling: Spleen, liver, and kidney*. J Trauma, 1989; 29:1664-666.

5. Banerjee A, Duane TM, Wilson SP, et al.: *Trauma center variation in splenic artery embolization and spleen salvage: a multicenter analysis*. J Trauma Acute Care Surg, 2013; 75:69-74.

6. Stassen NA, Bhullar I, Cheng JD, et al.:Eastern Association for the Surgery of Trauma: *Nonoperative management of blunt hepatic injury: An Eastern Association for the Surgery of Trauma practice management guideline*. J Trauma Acute Care Surg, 2012; 73:s288-93.

7. Swaid F, Peleg K, Alfici R, et al: Israel Trauma Group, Kessel B: *Concomitant hollow viscus injuries in patients with blunt hepatic and splenic injuries: An analysis of a National Trauma Registry database.* Injury, 2014; 45:1409-412.

8. Brownstein MR, Bunting T, Meyer AA, et al.: *Diagnosis and management of blunt small bowel injury: A survey of the membership of the American Association for the Surgery of Trauma*. J Trauma, 2000; 48:402-07.

9. McIntyre LK, Schiff M, Jurkovich GJ: *Failure of nonoperative management of splenic injuries: causes and consequences*. Arch Surg, 2005; 140:563-68.

10. Bhangu A, Nepogodiev D, Lal N, et al.: *Meta-analysis of predictive factors and outcomes for failure of non-operative management of blunt splenic trauma.* Injury, 2012; 43:1337-346.

11. Velmahos GC, Zacharias N, Emhoff TA, et al.: *Management of the most severely injured spleen: A multicenter study of the Research Consortium of New England Centers for Trauma (ReCONECT*). Arch Surg, 2010; 145:456-60.

12. Atls subcommittee; American College of Surgeons' Committee on Trauma; International ATLS Working Group: *Advanced trauma life support (ATLS®): the ninth e*dition. J Trauma Acute Care Surg, 2013; 74:1363-366.

13. Baker Sp, O'Neill B, Haddon W JR, et al.: *The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care.* J Trauma, 1974; 14:187-96.

14. Davies Jm, Lewis Mp, Wimperis J, Et Al: British Committee For Standards in Haematology: *Review of guidelines for the prevention and treatment of infection in patients with an absent or dysfunctional spleen: prepared on behalf of the British Committee For Standards In Haematology By A Working Party Of The Haemato-Oncology Task Force.* Br J Haematol, 2011; 155:308-17.

15. Greer Jp, Foerster J, Lukens Jn, et al.: *Wintrobe's Clinical Hematology* 11th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 198; 1128-134.

16. Tinkoff G, Esposito TJ, Reed J, et al.: *American Association for the Surgery of Trauma Organ Injury Scale I: spleen, liver, and kidney, validation based on the National Trauma Data Bank*. J Am Coll Surg, 2008; 207:646-55.

17. Miniello S, Nacchiero M, Balzanelli MG, et al.: *Conservative treatment of the splenic traumas*. Ann Ital Chir, 2005; 76:553-57.

18. Peitzman AB, Harbrecht BG, Rivera L, et al.: Eastern Association for the Surgery of trauma:Multiinstitutional Trials Workgroup: *Failure of observation of blunt splenic injury in adults: Variability in practice and adverse consequences*. J Am Coll Surg, 2005; 201:179-87.

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19. Tugnoli G, Bianchi E, Biscardi A, et al: *Nonoperative management of blunt splenic injury in adults: There is (still) a long way to go. the Results of the Bologna-Maggiore Hospital Trauma Center experience and development of a clinical algorithm*. Surg Today, 2014; 5.

20. Tan KK, Chiu MT, Vijayan A*: Management of isolated splenic injuries after blunt trauma: An institution's experience over 6 years*. Med J Malaysia, 2010; 65:304-6.

21. Raza M, Abbas Y, Devi V, et al.: *Non operative management of abdominal trauma. A 10 years review*. World J Emerg Surg, 2013; 8:14.

22. Myers JG, Dent DL, Stewart RM, et al.: *Blunt splenic injuries: Dedicated trauma surgeons can achieve a high rate of nonoperative success in patients of all ages*. J Trauma, 2000; 48:801-5.

23. Tugnoli G, Casali M, Villani S, et al.: *The treatment of splenic injuries from splenectomy to non-operative management: our experience on 429 cases*. Ann Ital Chir, 2003; 74:37-41.

24. Shanmuganathan K, Mirvis SE, Boyd-Kranis R, et al.: *Nonsurgical management of blunt splenic injury: use of CT criteria to select patients for splenicarteriography and potential endovascular therapy*. Radiology, 2000; 217:75-82 .

25. Peitzman AB, Richardson JD: *Surgical treatment of injuries to the solid abdominal organs: A 50-year perspective from the Journal of Trauma*. J Trauma, 2010; 69:1011-21.

26. Böyük A, Gümüş M, Önder A, et al*.: Splenic injuries: Factors affecting the outcome of non-operative management*. Eur J Trauma Emerg Surg, 2012; 38:269-74.

27. Requarth JA, D'Agostino RB JR, Miller PR: *Nonoperative management of adult blunt splenic injury with and without splenic artery embolotherapy: A meta-analysis*. J Trauma, 2011; 71:898-903.

28. Miller PR, Chang MC, Hoth, et al.: *Prospective trial of angiography and embolization for all grade III to V blunt splenic injuries: Nonoperative management success rate is significantly improved*. J Am Coll Surg, 2014; 218:64448.

29. Ekeh AP, Khalaf S, Ilyas S, et al.: *Complications arising from splenic artery embolization: A review of an 11-year experience.* Am J Surg, 2013; 205:250-54.

30. Tartaglia D, Galatioto C, Lippolis PV, et al: *Splenic abscess after splenic blunt injury angioembolization.* Ann Ital Chir, 2014; 85(ePub)

31. Fata P, Robinson L, Fakhry SM: *A survey of EAST member practices in blunt splenic injury: A description of current trends and opportunities for improvement.* J Trauma, 2005; 59:836-41.

32. Hildebrand DR, Ben-Sassi A, Ross NP, et al.: *Modern management of splenic trauma.* BMJ, 2014; 348:g1864

33. Filiotis N, Sammarco G, Teodossiu G, et al.: *The ultrasound microbubble contrast in the diagnosis and the decisional iter of the treatment of the traumatic spleen lesions*. Ann Ital Chir, 2006; 77:411-15.

34. Buss DH, Cashell AW, O'Connor ML, et al.: *Occurrence, etiology, and clinical significance of extreme thrombocytosis: A study of 280 cases*. Am J Med, 1994; 96(3):247-53.

35. Skattum J, Titze TL, Dormagen JB, et al.: *Preserved splenic function after angioembolisation of high grade injury*. Injury, 2012; 43:62-6.

36. Singer DB: *Postsplenectomy sepsis*. Perspect Pediatr Pathol, 1973; 1:285-311.

37. Raikhlin A, Baerlocher MO, AschMR, et al.: *Imaging and transcatheter arterial embolization for traumatic splenic injuries: review of the literature*. Can J Surg, 2008; 51:464-72.

38. Pirasteh A, Snyder LL, Lin R, et al.: *Temporal assessment of splenic function in patients who have undergone percutaneous image-guided splenic artery embolization in the setting* of trauma. J Vasc Interv Radiol, 2012; 23:80-2.

39. Skattum J, Naess PA, Gaarder C: *Non-operative management and immune function after splenic injury*. Br J Surg, 2012; 99:59-65.

40. Rosito M, Lattarulo S, Pezzolla A, et al: *The conservative treatment in the splenic* trauma. Ann Ital Chir, 2009; 80:231-36.

41. Duchesne JC, Simmons JD, Schmieg RE Jr, et al: *Proximal splenic angioembolization does not improve outcomes in treating blunt splenic injuries compared with splenectomy: A cohort* analysis. J Trauma, 2008; 65:1346-51.

42. Mooney DP, Rothstein DH, Forbes PW: *Variation in the management of pediatric splenic injuries in The United State*s. J Trauma, 2006; 61:330-33.

43. Crawford RS, Tabbara M, Sheridan R, et al*.: Early discharge after nonoperative management for splenic injuries: increased patient risk caused by late failure?* Surgery, 2007; 142:337-42.

44. Di Saverio S, Moore EE, Tugnoli G, et al.: *Non operative management of liver and spleen traumatic injuries: A giant with clay feet*. World J Emerg Surg, 2012; 7:3.

45. Jim J, Leonardi MJ, Cryer HG, et al.: *Management of high-grade splenic injury in children*. Am Surg, 2008; 74:988-92.

46. Scapellato S, Sciuto G, Maria S, et al.: *Blunt splenic injury: Authors' experience and comparison to literature.* Minerva Chir, 2009; 64:407-14.

47. Franklin GA, Casós SR: *Current advances in the surgical approach to abdominal trauma.* Injury, 2006; 37:1143-156.

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