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Non-operative Treatment of Blunt Spleen Trauma in Adults

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Abstract **Background:** The treatment of blunt splenic trauma has evolved to a large extent toward nonoperative treatment through the evaluation and increasing use of computed tomography (CT). The aim of our study was to analyze and evaluate the results of nonoperative treatment of blunt spleen trauma in adults. **Material and Methods:** This retrospective study was carried out on adult patients with blunt traumatic lesions of the spleen and who were hospitalized in the visceral and digestive surgery department of the University Hospital. of Tiziouzou (Algeria) from 2016 to 2023. The variables studied were extracted from the medical files of the patients. Results such as complications, mortality rate and risk factors were noted. **Results:** We recorded a total of 134 cases of blunt spleen trauma, making 31% (134/440) abdominal trauma. The average age of the patients was 36 years [17 – 72 years] of which 93 (69.41%) were men. Ninety-six (N= 96) patients (71.6%) immediately underwent emergency operative treatment, which represents group I, 28.4% of patients (n= 38) were admitted for a conservative non-operative treatment. Non-operative treatment could be successfully applied in 76% of cases (N = 29) which represents group II, and in 24% of cases (N = 9), it was necessary to perform a secondary splenectomy and which represents group III. In total, 21.6% of patients had non-operative conservative treatment and 78% had a laparotomy immediately or after admission. The mechanism of injury was not significantly different between the 3 groups. Traffic accidents were the most common cause. The failure rate of conservative treatment gradually increases with the stage of splenic damage. Emergency management involved splenectomy in 92% and splenorrhaphy in 8%. In group III, there were 89% splenectomy and 11% splenorrhaphy. Postoperative complications were observed in 10.4% and 45.7% of the non-operative and operative groups, respectively (p=0,006). The mortality rate was 16.2% and 3.4% in the operative and non-operative groups (p = 0,021). **Conclusion:** The final decision for emergency laparotomy for blunt trauma to the spleen should be based on the clinical condition and hemodynamic situation of the patient. Above all, the contribution of the scanner allows correct triage of patients who could benefit from non-operative treatment.

Keywords Spleen, Trauma, Non-operative treatment, Splenectomy

1. Introduction

The spleen and liver are the organs most frequently injured in abdominal trauma [1]. Close trauma to the spleen, often secondary to road accidents, is a frequent reason for admission to visceral and digestive surgery emergencies. The advent of ultrasound and computed tomography (CT) has changed their management [2]. The American Association for the Surgery of Trauma (AAST) has classified splenic injuries from I to V [3], see Table 1. Over the past three decades, the management of splenic injuries has evolved toward a more conservative and non-operative approach. This attitude reduces the complications of splenectomy and laparotomy. The main condition for this choice is hemodynamic stability or a satisfactory response to initial resuscitation. However, computed tomography (CT) may underestimate the degree of injury compared to operative findings [4]. Numerous retrospective studies have shown that splenic injuries can be safely managed non-surgically through the selective use of arterial embolization [5]. Failure rates appear to vary from 8 to 38% [6–10]. Mortality linked to splenic trauma varies between 4 and 18% [11]. The aim of our study was to analyze and evaluate the results of non-operative treatment of blunt trauma to the spleen in adults.

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2. Material and Methods

This retrospective, single-center, prognostic study was conducted on patients hospitalized in the visceral and digestive surgery emergency department of the TiziOuzou University Hospital Center from 2016 to 2023 (8 years) and diagnosed with blunt splenic trauma. The database of the TiziOuzou hospital department and emergency department was used to identify eligible patients and the required information was extracted from the patients' medical records.

This information included demographic data, mechanism of injury, AAST scores of splenic injuries assessed and determined from the CT scan performed on admission, level of consciousness (based on the Glasgow Coma Scale), signs

of peritonitis on abdominal examination (tenderness and/or generalized abdominal contracture), and signs of shock on admission to the emergency department (systolic blood pressure less than 90 mm Hg, diastolic blood pressure less than 60 mm Hg or a heart rate greater than 100 beats per minute were considered hemodynamically unstable), initial laboratory results, therapeutic method, length of hospitalization, number of blood transfusions received, presence or occurrence of complications (hemorrhagic shock, intestinal obstruction, infectious complications including pneumonia, sepsis, wound infection, urinary tract infection, deep vein thrombosis, pulmonary embolism, liver or kidney dysfunction and abscess intra-abdominal). The medical history of patients, as well as failures of conservative treatment (patients requiring additional and delayed procedures, such as partial or total splenectomy, splenorrhaphy).

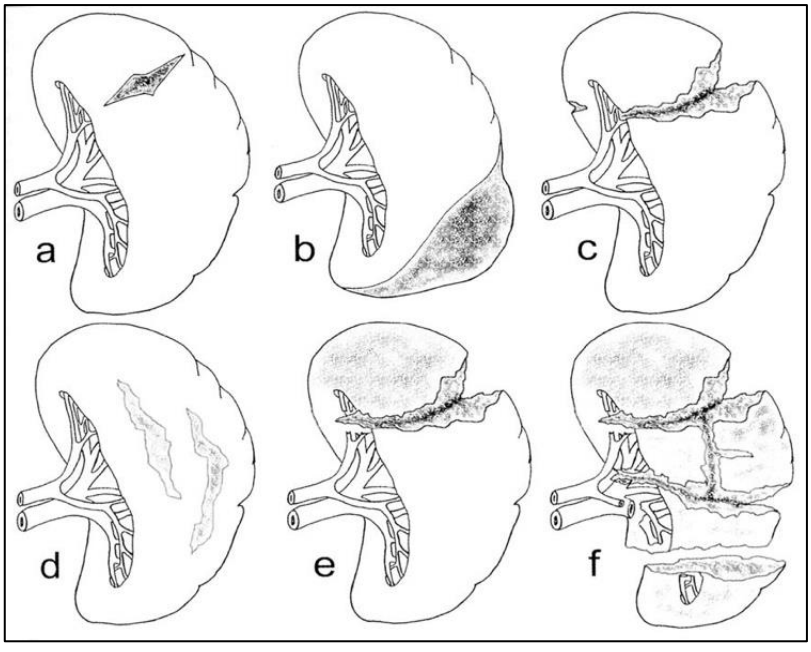
We adopted a defined protocol (Figure 2) for splenic preservation in patients with stable or stabilized hemodynamic status, after transfusion of less than 3 red blood cells, without suspicion of hollow organ perforation. An "armed" surveillance approach was based on clinical examination, with measurement of BP, pulse, conjunctival examination several times a day and abdominal examination once a day, blood count once a day, CT scan and/or ultrasound (hemoperitoneum control) on admission and then at 48 hours.

In case of failure of conservative treatment due to hemodynamic decompensation or the appearance of signs of peritonitis, we immediately performed a midline laparotomy. The laparoscopic approach was only performed 4 times.

The collected data were analyzed using SPSS software. Qualitative data were expressed as numbers and percentages. Quantitative data were presented as median and interquartile range (IQR). A p-value less than 0.05 was considered statistically significant.

Table 1. American Association for the surgery of Trauma grading system for splenic injuries

Grade	Injury type	Description of injury
I	Hematoma	Subcapsular < 10% surface area
	Laceration	Capsular tear < 1 cm parenchymal depth
II	Hematoma	Subcapsular 10 – 50% surface area
		intraparenchymal < 5 cm in diameter
	Laceration	Capsular tear 1- 3 cm parenchymal depth that does not involve a trabecular vessel
III	Hematoma	Subcapsular > 50% surface area or expanding; ruptured subcapsular or parenchymal hematoma
	Laceration	> 3 cm parenchymal depth or involving trabecular vessels
IV	Laceration	Laceration involving segmental or hilar vessels producing major devascularization
		(> 25% of spleen)
V	Laceration	Completely shattered spleen
	Vascular	Hilar vascular injury which devascularized spleen



a) Déchirure capsulaire superficielle, grade I.
b) Hématome sous capsulaire intéressant plus de dix mais moins de 50 % de la surface splénique, grade II.
c et d) Lacérations parenchymateuses profondes, transversales ou verticales, sans atteinte des vaisseaux segmentaires ou hilaires, grade III.
e) Déchirure intéressant les vaisseaux segmentaires et hilaires, produisant une dévascularisation polaire supérieure estimée à un tiers de la rate, grade IV.
f) Fragmentation splénique complexe, avec lésions vasculaires hilaires et dévascularisation totale de la rate, grade V.

Figure 1. Représentation schématique des lésions traumatiques de la rate, avec leurs grades selon la classification de l'American Association for the Surgery of Trauma.

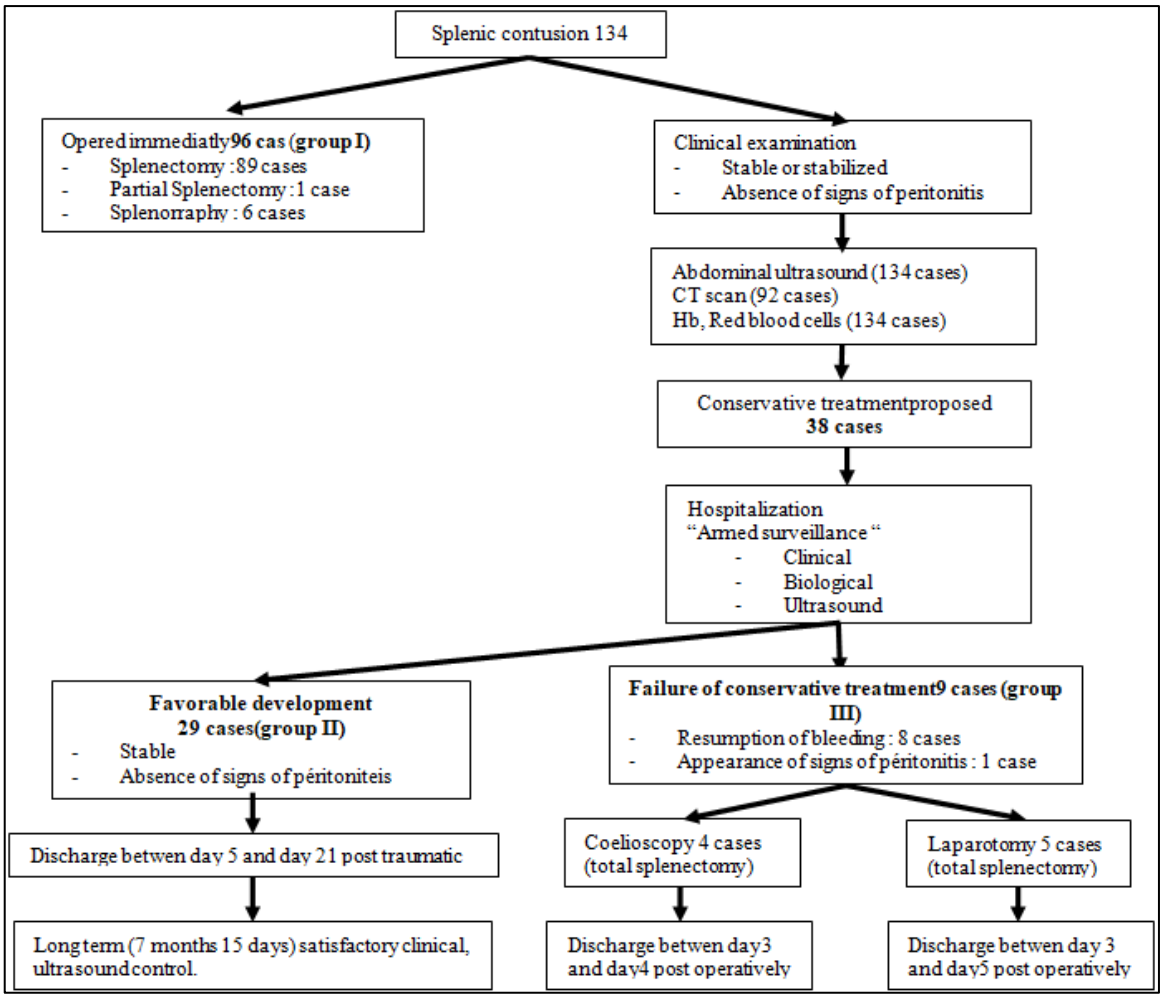


Figure 2. Patient management algorithm in the series

3. Results

Our study involved 440 patients with trauma (closed and open) of the abdomen, treated at the emergency department and the visceral and digestive surgery department of the TiziOuzou University Hospital Center for 8 years (from January 2016 to December 2023). Among them, 134 patients (30.5%) suffered from closed trauma of the spleen and 96 (71.6%) were operated on immediately, which represents group I. A total of 38 patients were proposed to non-operative treatment and studied. The failure rate of conservative treatment was 23.7% (9 cases), which represents group III. The evolution was favorable in 76.3% (29 cases), which represents group II. The average age was 36 years (17 to 72 years). The sex ratio was 3 men for one woman. The demographic characteristics of the patients, the clinical and morphological examination results (radiological, biological) as well as the therapeutic strategies are presented in Table 2.

Ninety-three (93) male patients were distributed differently between the two groups. There were more men in the surgical group than in the conservative treatment group 69 vs 24 ($p = 0.32$). Splenic injuries in the operated patients were more significant than those in the conservative treatment patients ($p < 0.001$). Patients who underwent surgery had significantly higher rates of splenic injuries ($p < 0.001$), unstable hemodynamic status ($p < 0.001$) and complications ($p = 0.006$). In addition, a higher proportion of surgically treated patients had moderate and severe loss of consciousness than the conservative group ($p = 0.01$). Mortality was higher in the surgical group ($p = 0.021$). Patients in the surgical group had more signs of peritonitis ($p < 0.001$). The proportion of traumatic mechanisms differed in a non-significant way between the two groups ($p = 0.032$). The most frequently found traumatic mechanisms in both operative and non-operative groups were car accidents (64.9%) followed by domestic accidents (20.9%). Comparing the average age, length of hospitalization and number of blood transfusions required between the two groups, it was observed that patients who underwent surgical treatment required larger amounts of blood transfusions, moreover, there was no significant difference between the two groups in terms of age and length of hospitalization.

Table 2. A comparison of patients managed operatively and non-operatively

Variables		**Total (N = 134)**	**Non-operative treatment (N= 29 + 9 = 38) Group II + III**	**Operative treatment (N= 96) Group I**	**P - value**
Sex	Male	93 (69,4%)	24 (63,2%)	69 (71,9%)	**0,32**
	Female	41 (30,6%)	14 (36,2%)	27 (28,1%)	
Mechanism of trauma					
	Car Accident	87 (64,9%)	18 (47,4%)	69 (71,9%)	**0,032**
	Domestic accident	28 (20,9%)	8 (21,1%)	20 (20,8%)	
	Accidental fall	7 (5,2%)	5 (13,2%)	2 (2,1%)	
	Sports	5 (3,7%)	4 (10,5%)	1 (1%)	
	Aggression	7 (5,2%)	3 (7,9%)	4 (4,2%)	
AAST Injury Score (according to admission CT scan		**(92 cas)**	**(38 cas)**	**(54 cas)**	**<0,001**
	1	16 (17,4%)	16 (42,1%)	0 (0)	
	2	13 (14,1%)	6 (15,8%)	7 (13%)	
	3	34 (36,9%)	10 (26,3%)	24 (44,4%)	
	4	21 (22,8%)	6 (15,9%)	15 (27,7%)	
	5	8 (8,7%)	0 (0%)	8 (14,8%)	
Correlated injury					
	No	30 (22,4%)	18 (47,4%)	12 (12,5%)	**<0,001**
	Yes	104 (77,6%)	11 (28,9%)	93 (96,9%)	
Unstable hemodynamics					
	No	37 (27,6%)	27 (71%)	10 (10,4%)	**<0,001**
	Yes	97 (72,4%)	11 (28,9%).	86 (89,6%)	
Peritonitis signs					
	Yes	62 (46,3%)	1 (2,6%)	61 (63,5%)	**<0,001**
	No	72 (53,7%)	37 (97,4%)	35 (36,6%)	
G C S					
	Mild (13 – 15)	88 (65,7%)	32 (84,2%)	56 (58,3%)	**0,01**
	Moderate (9 – 12)	29 (21,6%)	5 (13,2%)	24 (25%)	
	Severe (1 – 8)	17 (12,7%)	1 (2,6%)	16 (16,7%)	
Complications					
	No	89 (66,4%)	32 (84,2%)	57 (59,4%)	**0,006**
	Yes	45 (33,6%)	6 (15,6%)	39 (40,6%)	
Outcome					
	Recovery	116 (86,6%)	37 (97,4%)	79 (82,3%)	**0,021**
	Death	18 (13,4%)	1 (2,6%)	17 (17,7%)	
MCHC	Low	134 (100%)	38 (100%)	96 (100%)	-
WBC	Normal	134 (100%)	38 (100%)	96 (100%)	-
Age, Mean		32,8 +- 12,2	36.0 +- 14,5	29,6 +- 10,6	-
Hospitalization duration, Days, Mean		8.2 +- 2,2	8,1 +- 2,3	8,6 +- 2,2	-
Number of blood transfusions, Mean		3,1 +-1	2,4 +- 0,9	3,5 +- 0,9	-

AAST: American Association for the Surgery of Trauma; GCS: Glasgow Coma Scale; MCHC: mean corpuscular hemoglobin concentration; WBC: White blood cell.

The clinical examination data on admission are summarized in Table 3.

Table 3. Clinical data collected upon admission

Clinical examination on admission	N (%)	
Hemodynamic instability Instabilité	11 (28,9%)	
Abdominal pain	25 (65,8%)	
Defense of the left hypochondrium	9 (23,7%)	
Associated lesions (n = 25)		
- Skull	15	(73,7%)
- Chest	8	
- Locomotor system.	5	
Absence of clinical signs	2 (5,3%)	

Ultrasound performed in the 134 cases showed 108 splenic contusions and 26 subcapsular hematomas of the spleen. Elsewhere, it showed an association with hepatic contusion (n = 16), pancreatic contusion (n = 2), renal contusion (n = 4) and retroperitoneal hematoma (n = 8). Hemoperitoneum was noted in 72 cases; the abundance of which was judged to be low in 24 cases, medium in 36 cases and high in 12 cases.

Abdominal computed tomography (CT), performed in only 92 cases, showed, in addition to splenic contusion, hepatic contusion in 12 cases, renal contusion in 3 cases, pancreatic contusion in 1 case, and retroperitoneal hematoma in 4 cases.

On the therapeutic level, 29 of the 38 patients (76.3%) underwent successful non-operative treatment. They were monitored in the intensive care unit of the medical-surgical emergency department or the visceral and digestive surgery department of the hospital, which has this unit. Of these patients, eleven were stabilized after transfusion of an average quantity of 2 GC (i.e. 500 ml). Ultrasound was used to assess hemoperitoneum. These patients were also treated for other trauma (cranium, Locomotor system, in particular).

Of the 38 patients proposed for monitoring (Table 4), nine required secondary surgery with splenectomy, including 5 patients by laparotomy and 4 patients by laparoscopy. The clinical picture that led to surgery was hemodynamic decompensation 48 hours after hospitalization, requiring a transfusion of more than 3 GC in 8 cases and due to the appearance of signs of peritonitis, 24 hours after admission, in one case.

Table 4. Therapeutic management of splenic trauma

Non operative treatement	N (%)
Offered for admission	38
Maintained	29 (76,3%)
Hemodynamic stability	27 (71,1%)
Stability after transfusion of 3 red blood cells	11 (28,9%)
Exhaust (failure).	9 (23,7%)
Hemodynamic decompensation	8 (21,1%)
Suspected hollow organ injury	1 (2,6%)

Non-operated patients (n = 29) had a good outcome, with one complication in the form of a false pancreatic cyst, and one patient, with multiple trauma, died in surgical intensive care. Patients operated on after failure of conservative treatment (n = 9) had a good outcome in 4 cases. Furthermore, morbidity was limited to 3 cases of wall infection and 2 cases of splenic cavity collections. (Table 5).

Table 5. Patient evolution

Evolution	not opered (n = 29)	Opered (n = 9)
Good evolution	29	4
Mortality	1	0
Morbidity	1	5 (3 Wall infections, 2 collections of the splenic lodge)

For patients who had a non-operative attitude, the average length of hospitalization was 8.2 days (5 to 21 days). The discharge of non-operated patients was decided on a normal clinical examination and after an ultrasound check, showing stability of the lesions, at 48 hours and just before discharge. A four-week work stoppage was prescribed as well as a ban on all sporting activity for three months.

Long-term follow-up of non-operated patients was ensured for an average of 7.5 months with clinical and ultrasound monitoring in all cases. A CT scan was performed in 22 cases at the three-month follow-up. The progress was considered good.

4. Discussion

Road traffic accidents are the main cause of splenic contusions [2,12,13]. Young male subjects are most affected [13,14,15]. Splenic contusions are part of polytrauma in 2/3 of cases and the spleen is injured in 46% of polytrauma [2,16]. In our study, splenic trauma represents 30.5% of all traumatic injuries of the abdominal viscera during abdominal contusions.

Given the risk of infection (which is all the more serious when the subject is young) [17], the immunological role of the spleen, particularly in children [2], and the restrictive measures that the splenectomized person will have to undergo for life, non-operative treatment has gradually become established. In addition, splenectomy exposes the patient to the complications of any laparotomy (occlusion, postoperative eventration, scarring). Moog et al. [2] operated on a single case of splenic trauma in 88 children. The average success rate of non-operative treatment of the spleen is 90% in children [18,19]. On the other hand, in adults, surgical abstention was slow to become established and only concerned 25% to 30% of injured patients [20,21]. This was probably explained by more violent trauma and a greater frequency of associated intra-abdominal injuries. In our series of 134 splenic injuries treated between 2016 and 2023, there were 87 and 28 cases successively linked to traffic accidents and

domestic accidents, with successively performed 69 (79.3%) and 28 (71.4%) immediate splenectomies. Currently the abstention rate has increased to between 60 and 85%. During laparotomy, many splenic injuries stopped bleeding, an argument in favor of conservative treatment and the development of surgical abstention [22]. A French study [23] did not count any emergency splenectomies for 65 consecutive splenic injuries in children under 15 years of age. In adults, between 55% and 80% of patients with splenic trauma currently benefit from non-operative treatment [24]. The average success rate of abstentionist behavior is now 80 to 90% in adults [15,18,25-28].

This rate increases with the use of splenic arterial embolization [15,28-30]. In a series of 164 cases of splenic trauma, the authors were able to perform embolization treatment in 24 patients, in 3 cases after recurrent bleeding [29]. This resulted in a success rate of non-operative treatment of 98%. Also, in another published series of 317 cases, the authors were able to reduce the rate of patients operated on by 16% thanks to the use of embolization [30]. Finally, in the French multicenter series [28] the rate of spleen salvage after embolization was 91%. In our series, we only had a rate of 21% (18 cases) and 28.6% (8 cases) of spleen salvage in the 87 cases of traffic accidents and the 28 cases of domestic accidents. We did not use splenic arterial embolization at any time.

Despite the growing trend to favor conservative management over surgical management, determining the best treatment for each patient remains undecided because the wait-and-see option must meet strict conditions: hemodynamic stability, no suspicion of hollow organ lesions [31], "armed" and sustained clinical monitoring in a surgical intensive care setting and availability of morphological examinations.

The morphological examinations necessary to retain the conservative option are CT and ultrasound. CT is the reference examination. But its cost, the radiation generated and the difficulty of performing it in certain patients due to post-traumatic agitation limit its use. Ultrasound is the second examination allowing to monitor patients. In fact, a reassuring clinical examination and an ultrasound with normal renal Doppler are sufficient to opt for non-operative treatment [16]. Its use in adults is common practice with high sensitivity, and its effectiveness is accepted [19-22]. There is a growing trend (especially for American centers) to perform abdominal ultrasound (FAST ultrasound: Focused Assessment with Sonography for Trauma) systematically in the initial evaluation of all polytrauma patients regardless of hemodynamic stability. It is performed by the surgeon himself to highlight the hemoperitoneum [23-25]. In our series, we performed 92 CT scans and 134 ultrasound scans, which was sufficient to successfully monitor 38 patients.

Monitoring should be provided in a surgical department with an intensive care unit or in a surgical intensive care setting. In our series, all patients were monitored in the intensive care unit of the surgical emergency department and the visceral and digestive surgery department of the hospital. Monitoring was provided by the on-call teams.

Patients hospitalized in intensive care are transferred to the visceral and digestive surgery department as soon as the patients' general condition permits (level of consciousness, resumption of bowel movements). Ultrasound checks are performed every 3 to 4 days [2]. Some authors recommend a follow-up CT scan on day 7 of the injury [32]. In our series, in addition to clinical and ultrasound monitoring, all patients who underwent non-operative treatment underwent CT monitoring during hospitalization.

The total duration of hospitalization is short for the most recent series (8 days). This duration of hospitalization is further reduced in the case of splenic arterial embolization [15,27,29]. In our study, patients were hospitalized for an average of 8.2 days with extremes ranging from 5 to 28 days. The cessation of sports activities is prescribed for 6 to 7 weeks for non-contact sports, and for 3 months for more violent sports [33].

Complications of non-operative treatment are secondary hemorrhage which complicates 1 to 3% of monitored splenic traumas [34,27,35], splenic abscesses, pseudo-aneurysms of the splenic artery, unrecognized hollow organ injury [34,36], splenic pseudocyst in 0.44% of cases [14]. Other authors [37] have described fistulization of a large splenic subcapsular hematoma in the colon which was managed conservatively with good outcome. Delayed bleeding and unrecognized abdominal injuries correlated with multiple traumas can increase the mortality rate [31]. In our series, we have 8 recurrences of hemorrhage (21%) and one appearance of signs of peritonitis due to hollow organ injury (2.6%).

In case of failure of non-operative treatment, laparoscopy can be an alternative to laparotomy in a hemodynamically stable patient. This technique allows exploration of the entire abdominal cavity, evacuation of hemoperitoneum, identification of the source of bleeding, and assessment of the severity of lesions. It also allows the detection and treatment of possible perforations of hollow organs [37]. More recently, this technique has been used to perform total or partial splenectomies, or a hemostasis procedure allowing preservation of the entire spleen. In our series, only 4 out of 9 patients underwent secondary splenectomy by laparoscopic approach.

In the EAST multicenter retrospective study reporting the experience of 27 trauma centers in the USA [34], it was found that the more significant the splenic injuries, the less feasible non-operative treatment was (according to Moore grade I, II, III, IV and V injury, non-operative treatment was successfully performed in 75%, 70%, 49%, 17% and 1% of cases respectively). This conservative approach is not without risk: this same work shows a worrying number of avoidable deaths from hemorrhage; in fact, there were 6 avoidable deaths out of 10 deaths of patients in whom the non-operative option had been chosen [39]. The surgeon must therefore constantly keep in mind that the risk of infection underlying this conservative attitude is major in children under 5 years of age, significant in young people under 15 years of age but much lower in adults and that performing a total splenectomy for haemostasis remains a useful and current procedure.

The treatment method for splenic injury is determined by the patient's hemodynamic stability, intra- and extra-abdominal injuries, signs of peritonitis, active bleeding, and injury severity [40]. In the present study, the most common splenic injury score was grade 3 on the AAST splenic injury scale; 70.6% of these patients, 71.4% with grade 4, and all those with grade 5 injuries underwent surgical treatment.

5. Conclusions

Our study shows that non-operative treatment (NOT) for blunt splenic trauma is safe and effective. It should be routinely offered to both adults and children, in cases of hemodynamic stability, subject to reliable imaging and competent resuscitation.

Conflicts of Interest

None of the authors have any conflicts of interest (financial or otherwise) to disclose.

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