# Different Modalities in Management of Splenic Trauma

**Ahmad M. Atiya MD and Emad M. El Sageer MD**
Department of General Surgery, El-Minia Faculty of Medicine

## Abstract
**Aim:** The aim of this study is to evaluate the predictors of outcome of both operative and non-operative splenic conservation in blunt abdominal trauma. **Patients and methods:** ٢٠ patients with splenic trauma from December ٢٠١٤ to November ٢٠١٥. Patients were classified into two groups either Non – operative (conservative), or Operative (surgical).Informed consent was taken from all patients. **Results:** Twenty patients were included in this study and were classified according to the modalities of treatment into ٢ main groups: conservative (non- operative) group were ١٤ cases and surgical (operative) group were ٦ cases. Conservative group include ٩ male and ٥ female, while surgical group include ٤ male and ٢ female. In the conservative group, postoperative peri-splenic abscess was detected in two cases in which sonar guided drainage was successful. While in the surgical group, left sub-phrenic abscess was detected in one case in which sonar guided drainage was successful. And seroma of the exploratory wound was detected in one case in which antibiotics& repeated dressings was successful. ١cases died in surgical group intra operative due to massive haemorrage while no mortality in conservative group. **Conclusion:** Non operative management for blunt splenic trauma in hemodynamically stable patients is safe, effective and associated with, low morbidity and no mortality especially in grade I-II and III with inferior results in grade V. However, non-operative management should be practiced in hospitals where an efficient ICU is available.
**Key Words:** Management, Spleen, Trauma

---

## Introduction
Blunt abdominal trauma is more frequently encountered in the emergency department than penetrating one; usually result from motor vehicle collision [١]. Blunt trauma to the abdomen can cause severe injury especially to solid abdominal organs [٢]. The spleen and liver is the most commonly injured organs after blunt abdominal trauma and its management has been a topic for discussion over the past decade , small and large intestines are the next most injured[٣].

Motor vehicle accidents are the leading cause of injury to the spleen with pedestrian or bicycle accidents, falls and blunt trauma induced by physical assaults or sports [eg; boxing] as additional common causes. The anatomy of the spleen plays an important role in its pattern of injury, attached in place by its suspensory ligaments and partially protected by the lower costal margin, the spleen is susceptible to decelerating injury in motor vehicle accidents, puncture or laceration injury when lower ribs are fractured. In motor vehicle accidents, lateral impact seems to be an additional risk factor for splenic involvement, with the person seated closer to the side of collision placed at greater risk[٤].

Complications of post-splenectomy, especially intra-abdominal hemorrhage can be fatal, with delayed or inadequate treatment having a high mortality rate and the recognition of the fundamental role of the spleen in the immune response has led to greater efforts to preserve the spleen after injury[٥].

Until recently, the accepted treatment for splenic trauma, even for minor injuries, used to be splenectomy. This aggressive approach was based on the belief that, in adulthood, the spleen does not contribute any major function and conservative treatment was associated with potential life-threatening hemorrhage. With increasing recognition of the spleen's role in immunological function and awareness of overwhelming post-splenectomy sepsis (OPSI), non-operative management of hemodynamically stable patients with blunt

splenic injury has become the standard of care in pediatric and adult populations . Successful outcome following NOM is reported as up to ٩٧٪ of patients regardless of the grade of splenic injury[٦].

However, this changed policy towards splenic conservation requires careful risk–benefit analysis in the face of potentially life-threatening hemorrhage from delayed splenic rupture and the possibility of transfusion-induced viral Infections.

Furthermore, the increasing availability of reliable and good quality radiological imaging including ultrasound, computerized tomography (CT) scanning, and magnetic resonance imaging (MRI) have greatly improved the information available with regard to the nature of the splenic injury and this may well help to identify the suitable patients for conservative management but at the expense of patient radiation[٧].

In order for Nonoperative treatment (NOT) of splenic injuries to be the standard goal of therapy in hemodynamically stable patients, it is necessary to have an accurate knowledge of patient selection criteria for Nonoperative management, as well as a precise assessment of the factors precluding conservative therapy. This becomes tangible due to diagnostic and therapeutic angiography addition[٨].

Knowing all these factors set the trend in splenectomy-conservative therapy debate (non-operative management, conservative surgery, and spleen auto transplant); it is currently considered that traumatic splenic injury is no longer an absolute indication for splenectomy, thus a proper reviewing of indications for emergency surgery in traumatic hemoperitoneum is needed[٩].

Controversy exists about how to appropriately select patients for non-operative treatment since bleeding from splenic injuries can incur significant morbidity and mortality[١٠].

## Patients and Methods

This study was conducted at the casuality Unit of Minia University Hospital, and included ٢٠ patients with splenic trauma from December ٢٠١٤ to November ٢٠١٥.All patients were subjected to the primary survey provides the initial opportunity for evaluating and stabilizing a trauma patient. During the survey, the ABCDEs of trauma care are addressed. Secondary survey the patient is assessed systematically. Investigations were done as Plain X-ray (chest and abdomen), Abdominal u/s which is the routine investigation for all cases, to detect heamoperitonium, Computerized tomography (C.T) in certain selected heamodynamically stable cases to determine heamoperitonium, site & grading of splenic trauma according to AAST criteria for splenic Injury Scale. Laboratory investigations were done as Hb and serial hematocrite value, Prothrombin time &concentration, TLC and other investigations according to the presence of any associated co morbidity or as medical consultation needed.

We classified our patients into two groups either Non – operative (conservative), or Operative (surgical).The criteria for conservative management were heamodynamically stable patient or with correct response to plasma volume expansion, absence of signs of diffuse peritonitis on physical examination, transfusion requirements related to splenic injuries of less than ٢-٣ units of red blood cell concentrates (packed RBCs) and No suspicion of associated abdominal injuries and grade I, II& III splenic injury on imaging tests.

Criteria for discontinuing non operative management were Increasing abdominal pain, tenderness, and onset of diffuse peritonitis, more than ٢–٤ units packed RBC transfusion in the first ٢٤–٤٨ hours of observation, especially in the absence of orthopedic injuries, expansion of sub capsular splenic hematoma on a follow up CT and development of a symptomatic perisplenic fluid collection or hematoma on a follow up sonar.

Criteria for immediate operation were haemodynamic instability on admission.( All patients with systolic arterial blood

pressure (SAP) lower than ٩٠mmHg on admission in the emergency department and were unresponsive to fast infusion of ٢ liters of crystalloid solution and those who, after initial stabilization, developed low SAP lower than ٩٠mmHg were considered to be in a haemodynamically unstable condition), recurrence of instability after stabilization, peritoneal signs on physical examination.

Patients who planned for Conservative measures were put onabsolute bed rest for ٤٨– ٧٢ hrs in ICU, monitoring (every١/٢hr in first ٤hr,every ١hr in ٢nd ٨hr and ٢hr for the resting ٢٤hr) for Pulse, blood pressure, respiratory rate and temperature chart, Serial physical examinations are man-datory to detect changes in tenderness or the onset of new peritoneal signs in patients who are awake and alert, hemodynamic monitoring (serial hemo-globin, heamatocrite value and prothro-mbin concentration) every ١٢hr in first ٢٤hr and every day in the period of hospital stay, Serial follow up U/S every ٢hr in first ١٢hr, every ٤hr in the ٢nd ١٢hr and every day in the period of hospital stay and abdominal C.T in the next day after being stable (excludes associated abdo-minal injuries& detects site, extent & grade of splenic injury according to AAST splenic Injury Scale).

Follow up in our clinic for ٤-٦ weeks to detect any complication.

Assessment of the injury was done for patients who were subjected to surgery; If the injury is superficial (II and III) suture splenorraphy was done as fig (١), If the injury is deep or there is an avulsed part of the spleen (IV and V) splenectomy was done as fig (٢). Tubal drains were put in the splenic bed and in the pelvis.

Patients were admitted to ICU post-operatively until stabilization of their general condition then transferred to the surgical ward.

Post-operative follow up include close monitoring of Pulse, blood pressure, respiratory rate and temperature chart every ١/٢hr in the first of ٤hr, every ١hr in ٢nd ٨hr and every ٢hr in the resting ٢٤hr, drains: every ١hr in first ٨hr then every ٢hr in the resting ٢٤hr if there is blood collected >١٠٠cc per hr-----the abdomen was re-explored. Laboratory investigation including: coagulation profile, renal function, CBC, blood glucose level and electrolytes. Imaging investigation includ-ding: postoperative U/S.

Follow up after discharge in outpatient clinic was by imaging (U/S) For ٤ weeks to detect any complication as abscess formation, delayed rupture spleen after ٢ weeks or wound problems.

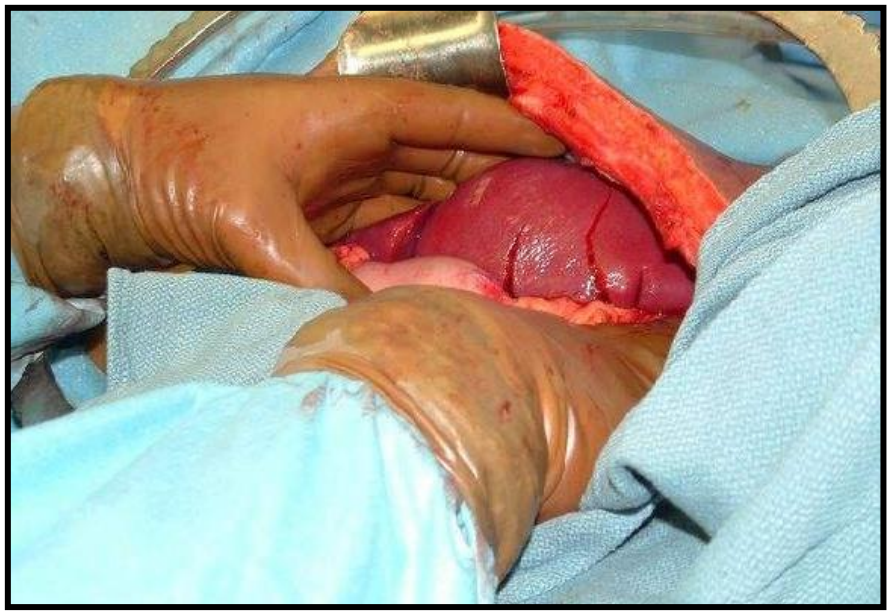


**Figure ١: Exploration reveals small superficial tear in spleen. Suture splenorraphy was done.**

**Figure ٢: Exploration reveals ruptured sub capsular splenic heamatoma. Splenectomy was done.**

## Results

Twenty patients were included in this study and were classified according to the modalities of treatment into ٢ main groups: conservative (non- operative) group were ١٤ cases and surgical (operative) group were ٦ cases. Conservative group include ٩ male and ٥ female, while surgical group include ٤ male and ٢ female.

**Age distribution of patients included in the study.**

| | ٠-١٠ys | ١١-٣٠ys | ٣١-٤٥ys | ٤٦-٦٠ys |
|---|---|---|---|---|
| **Conservative** | ٢ | ٧ | ٣ | ٢ |
| **Surgical** | ٢ | ٣ | ١ | ٠ |

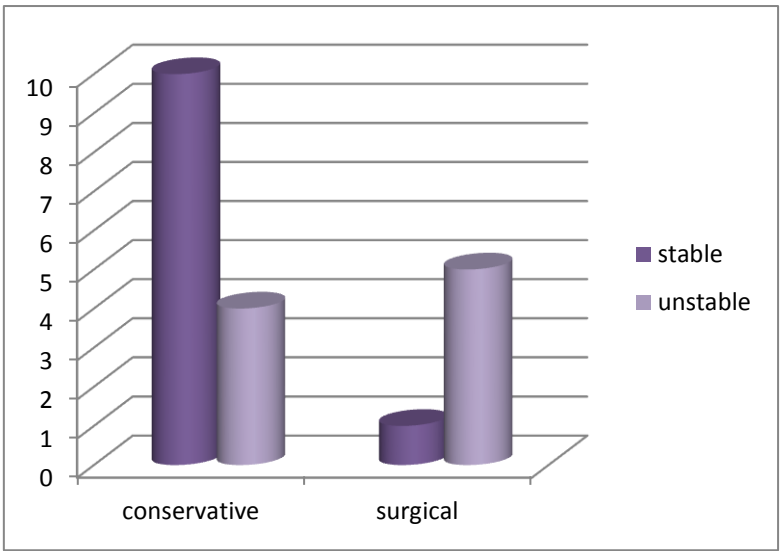
According to the type of trauma we had in the Conservative group the mechanism of blunt trauma in ١٤ cases that include fall from height (FFH) in ٣, striking hard objects (SHO) in ٤ & motor vehicle accident (MVA) in ٧ cases. While in the Surgical group the mechanism of blunt trauma in ٦ cases that include fall from height in ١, striking hard objects in ٢ & motor vehicle accident in ٣ cases.

**Type of trauma of patients included in the study.**

| | FFH | SHO | MVA |
|---|---|---|---|
| **Conservative** | ٣ | ٤ | ٧ |
| **Surgical** | ١ | ٢ | ٣ |

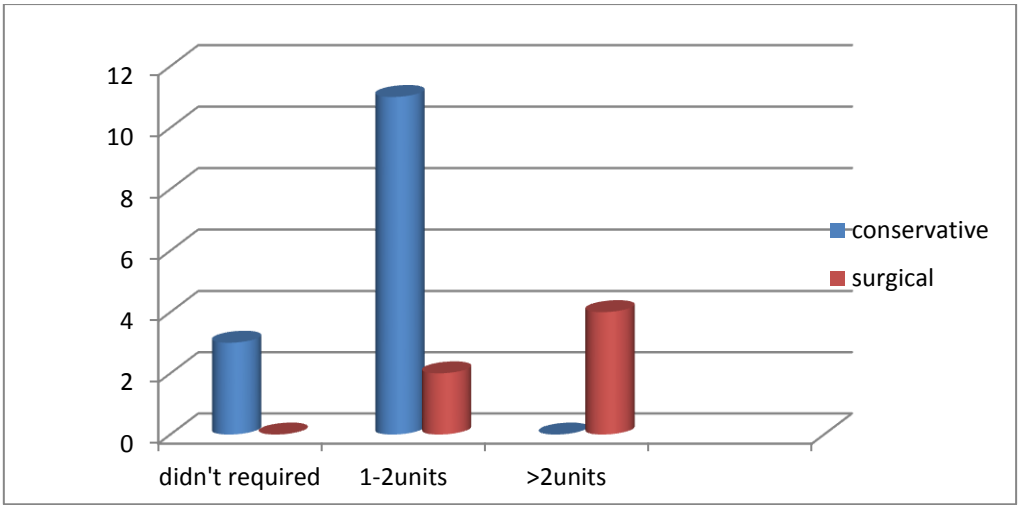
There was ٢ cases in conservative group diabetic and hypertensive and in surgical group only one case which was hypertensive.

On admission ١١ patients were haemo-dynamically stable (١٠ were treated conservatively , and ١ treated surgically), The other ٩ patients were haemo-dynamically un- stable (٤ cases respond to resuscitation and treated conservatively, while ٥ cases did not respond to resuscitation and required urgent exploration).




**Hemodynamic stability of patients included in the study.**

In the conservative group ٣ cases didn't require blood transfusion while the other ١١ cases (٧ cases required ١ unit of blood and other ٤ cases required ٢ units of blood).While in the Surgical group ٢ cases required ٢ units of blood and other ٤ cases required ٣ units of blood.




**Blood units distribution of patients included in the study.**

Ultrasonography was done in all cases of the study (١٤ cases were treated conservatively and ٦ cases needed abdominal exploration), while Computerized tomography was done in ١٦cases only (١٣ cases were treated conservatively and ٣ cases required exploration).

**Distribution of amount of collection in U/S of patients included in the study.**

| | No collection | minimal | Mild | moderate | Marked |
|---|---|---|---|---|---|
| **Conservative** | ٠ | ٤ | ٧ | ٣ | ٠ |
| **Surgical** | ٠ | ١ | ١ | ١ | ٣ |

According to AAST after imaging by U/S & CT; in the conservative group١ case were grade I, ٣cases were grade II, ٥ cases were grade III & ٥ cases were grade IV. While in the surgical group ٠ cases were grade I, ٠ cases were grade II, ١ case were grade III, ١ case were grade IV & ٤cases were grade V.

**Distribution of grade of splenic injury of patients included in the study**

| | Grade I | Grade II | Grade III | Grade IV | Grade V |
|---|---|---|---|---|---|
| **Conservative** | ٠ | ٤ | ٥ | ٥ | ٠ |
| **Surgical** | ٠ | ٠ | ١ | ١ | ٤ |

**Associated extra-abdominal injuries distribution of patients included in the study**.

| | Conservative | NO | Ttt | Surgical | NO | ttt |
|---|---|---|---|---|---|---|
| **Neurological** | Brain edema | ١ | Medical | Brain edema | ٠ | Non |
| | Extra Dural hematoma | ٢ | surgical | Hemorrhagic contusion | ١ | treated Conservatively (brain dehydrating measures+ stimulants) |
| | | | | Scalp injury | ١ | Suture |
| **Cardiothoracic** | Haemothorax | ٢ | ICT | Haemothorax | ١ | ICT |
| | pneumothorax | ٢ | ICT | Pneumothorax | ١ | ICT |
| | Fracture ribs | ٣ | Binder | Fracture ribs | ٢ | ICT in one& binder in one |
| | Lung contusion | ٢ | Medical | Lung contusion | ٠ | Non |
| **Orthopedic** | Fracture femur | ١ | Surgical | | | |
| | Fracture tibia | ١ | Surgical | | | |

Suture splenorrhaphy with vicryl was done in ١ case, and splenectomy was done in ٥ cases.

In the conservative group, postoperative peri-splenic abscess was detected in two cases in which sonar guided drainage was successful. While in the surgical group, left subphrenic abscess was detected in one case in which sonar guided drainage was successful. And seroma of the exploratory wound was detected in one case in which antibiotics& repeated dressings was successful.

**Complications in patients included in the study.**

| | Conservative | Surgical |
|---|---|---|
| **Free** | ١٢ | ٣ |
| **Wound seroma** | ٠ | ١ |
| **Subphrenic abscess** | ٢ | ١ |

١ case died in surgical group intra operative due to massive haemorrage while no mortality in conservative group.

Admission in ICU was required for ٥ patients of the conservative group and ٣ patients of the surgical group.

In the conservative group; ٩ cases stay in hospital for less than one week (٥ cases stay ٦ days and ٤ cases stay ٤ days), while ٥ cases stay for ١-٢ week (٣ cases stay ١٣ days and ٢ cases stay ١٠ days). While in the surgical group ٤ cases stay for ٥ days, while ١ case stay for ١٠ days & ١ case died intra operative.

All patients were followed up in the outpatient clinic for ١ month by clinical examination & imaging (U/S), ٥ cases were followed up by C.T

In the Conservative group; ١٢ cases showed satisfactory progress and the other ٢ patients developed peri-splenic abscess that resolved by antibiotics. While in the surgical group ٣ cases showed satisfactory progress, while ٢ cases developed compli-cation as wound seroma in one patient which treated medically and subphrenic abscess in one patient which treated medically by antibiotics.

**Distribution of complications after discharge in patients included in the study.**

| | Conservative | Ttt | Surgical | ttt |
|---|---|---|---|---|
| **Free** | ١٢ | - | ٣ | - |
| **Abscess** | ٢ | Treated medically by antibiotics | ١ | Treated medically by antibiotics |
| **Seroma** | ٠ | _ | ١ | Medical ttt |

## Discussion

Until recently, the accepted treatment for splenic trauma, even for minor injuries, used to be splenectomy. This aggressive approach was based on the belief that, in adulthood, the spleen does not contribute any major function and conservative treatment was associated with potential life-threatening haemorrhage. With increasing recognition of the spleen's role in immune-logical function and awareness of overwhelming post-splenectomy sepsis (OPSI), there has been an increasing trend towards conservative treatment and splenic salvage procedure [١١].

However, this changed policy towards splenic conservation requires careful risk–benefit analysis in the face of potentially life-threatening haemorrhage from delayed splenic rupture and the possibility of transfusion-induced viral infections.

Furthermore, the increasing availability of reliable and good quality radiological imaging including ultrasound, compu-terized tomography (CT) scanning, and magnetic resonance imaging (MRI) have greatly improved the information available with regard to the nature of the splenic injury and this may well help to identify the suitable patients for conservative management [١٢].

We have reviewed the outcome of splenic injuries in our study with the main aim of examining the effect of this changed conservative policy on patients and its implications.

During our study period ٢٠ patients exposed to blunt abdominal trauma, of them ١٤ patients responded to conservative management, ٤ patients required splenic-tomy due to failure of conservative management a percentage of ٧٠٪ versus ٢٠٪ respectively.

In the study done by (R. Aseervatham, M. muller ٢٠٠١) eighty-five patients were identified. Non-operative management was used on ٣٩ patients, while ٤٦ patients were managed surgically a percentage of ٤٥.٨٨٪ versus ٥٤.١٢٪ [١٣].

In the study done by (Köksal N, Uzun MA, and Müftüoğlu T ٢٠٠٠) ٢٦ patients were identified. Non-operative management was used on ٢٠ patients, while ٦ patients were managed surgically a percentage of ٧٦.٩٪ versus ٢٣.١٪. These agree with our study [١٤].

This also agrees with the study done by (Lo A, Matheson AM, Adams, ٢٠٠٤) eighty patients were identified. Non-operative management was used on ٤٥ patients, while ٣٥ patients were managed surgically a percentage of ٥٦٪ versus ٦٥٪ [١٥].

In the study done by (A yaghoubi Notash, H Ahmadi Amoli, et al., ٢٠٠٧) ٣٢٠ patients were identified. Non-operative management was used on ١٣٢ patients, while ١٨٨ patients were managed surgically a percentage of ٤١.٢٪ versus ٥٨.٧٪ .this don't agree with our study [١٦].

- Regarding the age in our study, we noticed that there was a slight age difference between patients who failed conservative management, ٣٣.٣٪ for children and ٦٦.٧٪ for adults versus, for patients who completed the conservative

management successfully, ١٤.٢٪ for children and ٨٥.٨٪ for adults.

But in the study done by (S Sinha, SVV Raja, and MH Lewis ٢٠٠٨) ٢١patients were identified. The median patient age was ٢٦ years (range, ١٢–٨١ years). The median age of the operative and non-operative groups was not significantly different [١٧].

But in the study of (Douglas and Simpson ١٩٩١) described ٣٢ cases of children with clinical signs of splenic injury treated conservatively out of whom, ٢٥ children did not require surgical intervention. This study proved that the spleen has indeed the capability of healing itself with an excellent outcome in selected cases [١٨].

But in the study done by (George A Giannopoulos, Iraklis E Katsoulis, et al., ٢٠٠٩) non – operative management was initially applied in ٧٣.٣٪ (٢٢ patients) of all blunt abdominal injuries. No significant differences were observed between operative group and conservative group in relation with age[١٩].

- Regarding the grade of injury our study showed that:

a– ١ patients of ٢٠ (٥٪) were of grade I
-This patient was successfully treated none operatively (a percentage of ١٠٠٪ of grade I splenic injury).

b – ٤ patients (٢٠٪) were of grade II
-All of them were successfully treated none operatively (a percentage of ١٠٠٪ of grade II splenic injury).

c – ٦ patients (٣٠٪) were of grade III
- ٥ of them were successfully treated none operatively (a percentage of ٨٣.٣٪ of grade III splenic injury).
- The remaining one patient were needed operative Interference and splenorraphy was done (a percentage of ١٦.٦٪ of grade III splenic injury).

d - ٦ patients (٣٠٪) were of grade IV
- ٤ of them were successfully treated none operatively (a percentage of ٦٦.٦٪ of grade IV of splenic injury).
- The remaining ٢ patient needed operative Interference and splenectomy was done (a percentage of ٣٣.٣٪ of grade IV of splenic injury).

e– ٤ patients (٢٠٪) were of grade V
- All cases needed operative interference and and splenectomy was done (a percentage of ١٠٠٪ of grade V splenic injury).

These our results concluded that lower grades (I-III) have the highest rate of success. Included that class I, II and III can be treated safely and class IV can be treated with high prediction of failure and recommended that class V should be treated surgically.

- In the study done by (Köksal N, Uzun MA, Müftüoğlu T ٢٠٠٠) on ٢٦ patients concluded that The mean operative splenic injury grade was ٣ in the patients who underwent surgery, and the mean injury grade based on CT scan was ٢.٦ in the patients who were managed conservatively [١٤].

- In the study done by (S Sinha, SVV Raja, and MH Lewis ٢٠٠٨) ٢١ patients concluded that Using Buntain's CT grading, the majority of grades I and II splenic injuries were managed non-operatively and grades III and IV were managed operatively. These agree with our study [١٧].

- This also agree with the study done by (Lisa K. McIntyre, MD; Melissa et al., ٢٠٠٥) on ٢٢٤٣ patients concluded that Risk of failure increased with admission to a level III or IV trauma hospital compared with a level I trauma hospital [٢٠].

- In our study, the mean duration of hospital stay for patients who were treated conservatively was slightly higher than those who needed operative.

- This agree with the study done by (S Sinha, SVV Raja, and MH Lewis,٢٠٠٨) concluded that the non-operative group had a significantly longer hospital stay [١٧].

- This also agree with the study done by (Köksal N, Uzun MA, Müftüoğlu,٢٠٠٠) concluded that the mean duration of hospitalization in the patients with operative and non-operative management groups were ٧.٦ and ٨.٦ days, respectively [١٤].

- In the study done by (M Beuran, I Gheju, et al., ٢٠١٢) concluded that hospital stay varies between ٣ to ٧ days when no other injuries are present to elicit a prolonged stay[٢١].

- But in the the study done by (Margherita Cadeddu, Anna Garnett, et al., ٢٠٠٦) concluded that The median length of

stay in hospital was significantly higher in the operative group than in the Nonoperative group that don't agree with our study [٢٢].

- Regarding the blood transfusion in our study is the need for transfusion greater in patients managed surgically.

- In the study done by (Köksal N, Uzun MA, Müftüoğlu T,٢٠٠٠) concluded that The mean unit of blood transfusion in the patients with operative and non-operative management groups were ١.١ and ٠.٦.this don't agree with our study. These agree with our study [١٤].

- In the study done by (R. Aseervatham, M. Muller, ٢٠٠١) concluded that transfusion requirement were lower in non-operative group. This also agree with our study [١٣].

- In the study done by (S Sinha, SVV Raja, and MH Lewis ٢٠٠٨) concluded that Blood transfusion requirement was significantly higher among the operative group [١٧].

- In the study done by (Lo A, Matheson AM, Adams D ٢٠٠٤) concluded that transfusion requirement were lower in non-operative group than surgical group [١٣٢].

- Regarding the mortality rate in our study one patient only died in surgical group intra operative and no mortality in non-operative group.

- In the study done by (Köksal N, Uzun MA, Müftüoğlu T ٢٠٠٠) concluded that no mortality in surgical and conservative group[١٤].

- In the study done by (S Sinha, SVV Raja, and MH Lewis ٢٠٠٨) concluded that There were no deaths in the non-operative group. In the operative group, one patient who sustained polytrauma remained unstable, developed a systole and died in ICU on the first postoperative day[١٧].

- In the study done by (Margherita Cadeddu, Anna Garnett, et al., ٢٠٠٦) concluded that the mortality rate was similar between operative and Nonoperative groups (٩.٣٪ v. ٦.٨٪, p = ٠.٤٩)[٢٢].

- In the study done by (Yikun Qu, Shiyan Ren, Chunmin Li, et al., ٢٠١٣) concluded that Fourteen of ٦٠٤ patients (١.١٩٪) undergoing splenectomy had intra-peritoneal hemorrhage: reoperation was performed in ١٣ patients, and ٣ patients died after reoperation, giving the hospital a mortality rate of ٢١.٤٣٪; whereas, ٥٩٠ of ٦٠٤ patients (٩٨٪) had no hemorrhage following splenectomy, and the mortality rate (٠.٣٤٪) in this group was significantly lower (P < ٠.٠٠١) [٢٣].

- Regarding the hemodynamic in our study ١١ patients were hemo-dynamically stable and ٩ patients were hemodynamically un-stable. ١٤ patients treated conservatively, while ٦ patients treated surgically. Our study concluded that patients who are hemodynamically stable patients are safe, effective.

- In the study done by (J. Skattum, P. A. Naess, C. Gaarder ٢٠١١) concluded that non-operative management continues to be reported as a successful approach in hemodynamically stable patients without other indications for laparotomy, achieving high success rates in both children and adults. These agree with our study [٢٤].

- In the study done by (Lo A, Matheson AM, Adams D ٢٠٠٤) concluded that Patients with splenic injuries who are hemodynamically stable can be managed non-operatively with acceptable outcome. However, in the presence of concomitant trauma, there is an increasing trend towards operative management. This also agrees with our study [١٥].

- In the study done by (Köksal N, Uzun MA, Müftüoğlu T ٢٠٠٠) concluded that hemodynamic stability is the most important factor which could affect the selection of patients for non-operative management outcome regardless of the patient age and computed tomography scan grading of the injury. These also agree with our study [١٤].

So we can conclude that non operative management for blunt splenic trauma in hemodynamically stable patients is safe, effective and associated with, low morbidity and no mortality especially in grade I-II and III with inferior results in grade V.

However, non-operative management should be practiced in hospitals where an efficient ICU is available.

## References


١. Hoyt D.B, Coimbra R and Winchell RT (٢٠٠١): Management of acute trauma "Trauma of critical care " In Sabiston text book of surgery , the biological basis of modern surgical practice, ١٦ edition by Town Send CM . Section III Ch. ١٩, B ٣١١-٣٩٩.

٢. Hann JM, Bonchichlo GV, Kramer N and Sealea TM (٢٠٠٥): Non operative management of blunt abdominal splenic injury: as years' experience. J. trauma; Vole ٥٠: p ٤٢–٥١.

٣. Shafi S, Parks J, Ahn C, Gentilello LM, Nathens AB (٢٠١٠): More operations, more deaths? Relationship between operative intervention and risk-adjusted mortality at trauma centers. J Trauma; Vole ٦٩: p ٧٠–٧٧.

٤. Potenza B and Nolan J (٢٠٠٧): Mechanism and Epidemiology of Trauma in Trauma: Emergency Resuscitation Preoperative Anesthesia Surgical Management. Edited by: Wilson W, Grande C, Hoyt D. informa ١st edition; Vole (١): p ٢٥-٤٢.

٥. Yikun Qu, Shiyan Ren, Chunmin Li, Songyi Qian, and Peng Liu (٢٠١٣): Management of Postoperative Complications Following Splenectomy. Into Surge; Vole ٩٨, No ١, p ٥٥-٦٠.

٦. Bessoud B,Denys A,Calmes J-M,Madoff D, Qanadli S,Schnyder P,etal (٢٠١١): Nonoperative management of traumatic splenic injuries.Vole ١٣: p ١٤٥-١٥٣.

٧. Pachter HL, Guth AA, Hofstetter SR, Spencer FC (١٩٩٨): Changing patterns in the management of splenic trauma: The impact of non-operative management. Ann Surge; ٢٢٧: p ٧٠٨-٧١٩.

٨. Uranus S, Pfeifer J, (٢٠١٢): Non operative management of blunt splenic injury. World J.surg; Vole ٢٥: p ١٤٠٥-١٤٠٧.

٩. Skandalakis LJ, Colborn GL (٢٠١٢): Surgical History.Tribute to a Triad: History of Splenic Anatomy, Physiology, and Surgery- part٢.World Journal of surgery; Vole ٢٣: p ٥١٤-٥٢٦.

١٠. Harbrecht BG (٢٠٠٥): Is anything new in adult blunt splenic trauma? Am J Surge; Vole ١٩٠: p ٢٧٣-٢٨٢.

١١. Haller JP, Papa P, Drugas G, Colombani P (٢٠١٢): Nonoperative management of solid organ injuries in children. Is it safe. Is there a role for proximal splenic artery embolization? Ann Surg; Vole ٢١٩: p ٦٢٥-٦٣١.

١٢. Keramidas D, Buyukunal C, Senyuz O (١٩٩١): Splenic artery ligation: a ten-year experience in the treatment of selected cases of splenic injuries in children. Jpn J Surge;vole٢١:p١٧٢-١٧٧.

١٣. R. Aseervatham, M. muller (٢٠٠١): Blunt Trauma To The Spleen, Vole ٧٠, Issue ٥, P: ٣٣٣–٣٣٧.

١٤. Köksal N, Uzun MA, and Müftüoğlu T (٢٠٠٠): Hemodynamic stability is the most important factor in nonoperative management of blunt splenic trauma, Ulus Travma Derg; Vol (٤): p٢٧٥-٢٨٠.

١٥. Lo A, Matheson AM, Adams D (٢٠٠٤): Impact of concomitant trauma in the management of blunt splenic injuries. N Z Med J; Vol ١١٧(١٢٠١): p ١٠٥٢.

١٦. A Yaghoubi Notash١, H Ahmadi Amoli١, ANikandish٢, AYazdankhah Kenari١, F Jahangiri ٣, P Khashayar ٢ (٢٠٠٧): Non-operative management in blunt splenic trauma, Vole ٢٥, Issue ٤, P: ٢١٠–٢١٢.

١٧. S Sinha, SVV Raja, and MH Lewis (٢٠٠٨): Recent Changes in the Management of Blunt Splenic Injury: Effect on Splenic Trauma Patients and Hospital Implications, Ann R Coll Surg Engl; Vol ٩٠(٢): p ١٠٩–١١٢.

١٨. Douglas and Simpson (١٩٩١): The conservative management of splenic trauma. Vole ٦, Issue ٥, P ٥٦٥–٥٧٠.

١٩. George A Giannopoulos, Iraklis E Katsoulis, Nikolaos E Tzanakis, Panayotis A Patsaouras, and Michalis K Digalakis (٢٠٠٩): Non-operative management of blunt abdominal trauma. Is it safe and feasible in a district general hospital? Scand J Trauma Resusc Emerg Med; Vol ١٧: p ٢٢.

٢٠. Lisa K. McIntyre, MD; Melissa Schiff, MD, MPH; Gregory J. Jurkovich, MD (٢٠٠٥): Failure of Nonoperative Management of Splenic Injuries. Arch Surg; Vol ١٤٠(٦): p ٥٦٣-٥٦٩.

٢١. M Beuran, I Gheju, MD Venter, RC Marian, and R Smarandache (٢٠١٢):

Non-operative management of splenic trauma. J Med Life; Vol ٥(١): p ٤٧–٥٨.

٢٢. Margherita Cadeddu, Anna Garnett, Khaled Al-Anezi, and Forough Farrokhyar (٢٠٠٦): Management of spleen injuries in the adult trauma population: a ten-year experience. Can J Surg; Vol ٤٩(٦): p ٣٨٦–٣٩٠.

٢٣. Yikun Qu, Shiyan Ren, Chunmin Li, Songyi Qian, and Peng Liu (٢٠١٣): Management of Postoperative Complications Following Splenectomy. Int Surg; Vol ٩٨, No ١, p ٥٥-٦٠.

٢٤. J. Skattum, P. A. Naess, C. Gaarder (٢٠١١): Non-operative management and immune function after splenic injury. Vole ٩٩, Issue S١, p ٥٩–٦٥.