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ORIGINAL ARTICLE

Outcome of Management of Splenic Injury in Aswan University Hospital

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ABSTRACT

Keywords: Blunt trauma, Evaluation, Management, Outcome, Splenic injury

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Background: Spleen is one of the most injured organs among blunt abdominal trauma. Spleen injuries were representing 45% of the total blunt abdominal injuries that threaten life. Non-operative management (NOM) proved to be one of the most secure techniques in the management of spleen injuries. O**bjectives:** To evaluate the outcome of operative and non-operative management of blunt abdominal trauma with splenic injury at Aswan University Hospital. **Patients and methods:** In this prospective non-randomized controlled study, 42 patients with blunt splenic injury were admitted to the emergency unit during the period from December 2020 to December 2021.**Result:** Our findings revealed that there was a non-significant difference between study groups regarding gender , age, mode of trauma and Total leukocyte count (TLC) (P >/= 0.05). but There was a statistically significant difference between study groups regarding imaging investigations in ultrasound (U/S) and complete blood count in hematocrit and hemoglobin (P <0.05) and CT with a contrast among Grades 1, 2,3, and 4 of spleen injuries, systolic and diastolic blood pressure, and Pulse rate (P < 0.001). **Conclusion:** For spleen injuries, non-surgical management is the most secure because of fewer complications, preserving spleen functions, and reducing blood transfusion compared to surgical management.

INTRODUCTION: Trauma is the fourth cause of death in the overall population and the first one in individuals below the age of 40 in Western countries.[1] Abdominal trauma can be classified as blunt or penetrating according to the agent and its mechanism of action.[2] The spleen is the most frequently injured organ in abdominal blunt trauma, mainly because of its highly vascularized

parenchyma and its anatomic location. Spleen is the only structure involved in almost 46% of blunt trauma (BT). On the other hand, the liver (41.7%), kidneys (16.4%), mesentery (15.1%), small and large bowel (10.1% and 6.3%, respectively), pancreas (5%), and omentum may concur with splenic injuries in the remaining part of BT.[3]

Globally, the treatment of spleen injuries has evolved significantly from surgical treatment to an increasingly selective non-surgical approach, advances in endovascular and cross-sectional imaging options.[4] Technological advances over the past decade have increased the importance of computed tomography (CT) in diagnosing damage of spleen trauma and identifying patients who may need an operative or non-operative management.[5]

NOM of blunt injury to the spleen has become standard of care in hemodynamically stable patients with an estimated success rate of greater than 80-90%.[6] It has been described as a safe procedure when experienced surgeons, modern imaging techniques, intensive care units, and other supportive services are available. Splenic artery embolization is an important adjunct to the nonsurgical treatment of splenic trauma, particularly when treating high-grade injuries.[7]

A significant number of splenic complications, which can be life-threatening, occur with surgical treatment of spleen injuries, such as hemorrhage, splenic artery pseudoaneurysm, embolization and splenic abscess. [8] Non-operative management (NOM) has several advantages over operative management (OM), including a reduction in complications, lower mortality rate, and preservation of the immune function of the spleen.[9]

The purpose of the study is to evaluate outcome of operative and non operative management of blunt abdominal trauma with splenic injury at Aswan University Hospital.

PATIENTS AND METHODS

Study design: A prospective non-randomized controlled study was conducted at Aswan University Hospital on 42 patients with blunt abdominal trauma with splenic injury admitted to the emergency unit during the period from December 2020 to December 2021.

Ethical Consent: Aswan university's institutional review board approved the study if all participants signed informed consent forms and submitted them to Aswan University by the code (R.11.04.1675). We adhered to the Helsinki Declaration, the ethical guideline of the world health organization for human trials.

Inclusion criteria:

- Patients from 4 years-old and not more than 55 years-old.
- Blunt abdominal trauma with splenic injury.

Exclusion criteria

- Patients more than 55 years-old and less than 4 years.
- Patients with penetrating trauma.
- Patients with multiple organ injuries.

Evaluation of patients at time of arrival to emergency department

When the patients arrived at the emergency department, they were divided into two main groups based on their hemodynamic status, according to the Advanced Trauma Life Support (ATLS) protocols.

- Hemodynamic stability is defined as systolic pressure > 90 mmHg with normal heart rate, while; hemodynamic instability is defined as systolic pressure < 90 mmHg and heart rate > 100 bpm.

- Laboratory investigation including; complete blood count, prothrombin time, activated partial thromboplastin clotting time, blood urea nitrogen and creatinine level.

- Imaging investigations including; x-rays, abdominal ultrasound, and computed tomography (CT).

The following data were collected: Complete medical history and demographics data including; age, sex, occupation, location

- Mechanism of blunt trauma (fall from a height, automobile accident, or physical injury), and medical status.

- Presentation, the time between periods of injury and the occurrence of an emergency

Then examination of the patient was performed

- Clinical examination were applied for all the enrolled patients; including chest, heart, head and neck, upper and lower extremities were examined after a systemic examination.

- Abdominal examination were applied for all the enrolled patients; to detect visible bruising or bruising, palpation (to detect tenderness or stiffness), and percussion (to detect varying degrees of opacity or dullness in the abdomen, creating the appearance of a mass).

Management Techniques

Non-operative management (NOM): Hemodynamically stable patients were selected for nonsurgical management, including serial physical examinations and careful monitoring of the patient's hematocrit. Conditioned erythrocytes were administered when the hemoglobin level was below 8 g/l. Heart rate, blood pressure, respiratory rate and urine output are closely monitored. Coagulopathy was corrected based on prothrombin time (PT) and activated partial thromboplastin time (APTT) results. Based on these results, blood products including fresh frozen plasma and platelets were administered intravenously.

Operative management: Surgery is indicated in hemodynamically unstable patients despite adequate resuscitation and unsuccessful non-operative-management.

Statistical analysis: Data analysis was performed using a statistical social science program version 20 (SPSS Inc., Chicago, IL, USA). Quantitative and qualitative variables were defined as mean and

standard deviation, p-value < 0.05 is considered significant. P-value > 0.05 is considered non significant. P-value < 0.0001 is considered highly significant.

RESULTS

In this prospective non-randomized controlled study was carried out at Aswan University Hospital from December 2020 till December 2021 conducted on 42 patient with blunt abdominal trauma with splenic injury admitted to emergency unit.

There was non statistically significant difference between study groups regarding; gender and age, Mode of trauma and presentation and Complete blood count in Total leukocytes count (TLC) (P >/= 0.05). There was statistically significant difference between study groups regarding; imaging examination in Ultrasound investigations and Complete blood count in Hematocrit and hemoglobin (P <0.05). There was highly statistically significant difference between study groups regarding; imaging examination in CT with contrast among Grade 1, 2,3 and 4 of spleen injury, systolic and diastolic blood pressure and Pulse rate (P < 0.001).

DISCUSSION

Spleen injuries represent 45% of the total blunt abdominal injuries. NOM proved to be one of the most secure techniques in the management of spleen injuries, with highly efficient outcomes in contrast to OM.[5] Splenectomy is considered as the operative management for spleen injury but with higher complications. however, it represents the only optional management in the failure of non-operative management of spleen injury.[10]

In a study examining the management and outcomes of spleen lesions in the Netherlands, **Grootenhaar *et al. (2021)*** [12] stated that the study population had an average age of 12 years, predominantly men (63.1%). Older age in the operated group than in the non-operated group. p=0.009). Male dominance due to the fact that men are more active and dangerous. In this study, there was non statistically significant difference between study groups regarding; Complete blood count in Total leukocytes count (TLC) and statistically significant difference between study groups regarding; Complete blood count in Hematocrit and hemoglobin. In addition to, similar findings as our study findings **Koren *et al. (2013)*** [13] stated that outcomes after blunt trauma to the spleen were treated with conservative or surgical treatment. Also, the difference between the surgical groups and observed hemoglobin (g/dl) was less than the half of each group (p<0.001), however; TLC was non statistically difference between conservative group and surgical group (p>0.05)

Our study stated that there was non statistically significant difference between study groups regarding; mode of trauma and presentation, the highest percentage was fall from height in conserve and splenectomy group.

Furthermore; **Gad *et al. (2018)*** [14] found in a study comparing surgical and conservative treatment of splenic trauma in patients that the most common injury mechanism was a traffic accident (55%), followed by a fall from height (35%) and finally Animal Kick (10%) in conservatively treated patients. In surgically treated patients, the most common trauma mechanisms were road traffic accident (60%), fall from height (30%), animal kicks (5%), and falling heavy

objects (5%), with no significant difference between the two groups in terms of type of trauma as our findings.

In addition to; **Osifo *et al. (2007)*** [15] road traffic accident was the traumatic mechanism in 50% of patients and fall from height was the second most common mechanism. However, this is in contrast to **Kristoffersen and Mooney (2007)** [16] where the main traumatic mechanism was fall from height.

Ultrasound was used to detect accumulations in the abdomen to identify the type of splenic injury and was also used to monitor the patient, but the degree of splenic injury cannot be determined, so nonsurgical cases require an additional CT scan .

Our study obtained that; there was statistically significant difference between study groups regarding; imaging examination in Ultrasound investigations and highly statistically significant difference between study groups regarding; imaging examination in CT with contrast among Grade 1, 2,3 and 4 of spleen injury. As reported before, **Ibrahim *et al. (2020)*** [17] found a very significant difference between the conservative group and the surgical group with respect to vital signs determined by CT scan and ultrasound investigation that influence the physician's decision regarding the choice of surgical treatment.

Our study showed that there was statistically significant difference between study groups regarding; Complete blood count in Hematocrit and hemoglobin ($p<0.05$) and there was highly statistically significant difference between study groups regarding; systolic and diastolic blood pressure and Pulse rate ($p<0.001$). In consistent with our study outcomes **Zabolotny *et al. (2002)*** [18] stated that (10%) non-operated patients received blood transfusions and all operated patients received blood transfusions. The increased need for blood transfusions associated with high grade splenic lesions, multiple splenic lesions and surgical treatment. Upon examining our hands, we found that there was a statistically significant difference between the two study groups in systolic blood pressure, diastolic blood pressure, and heart rate.

Splenectomy is not exempt from intra-operative and post-operative complications, such as thrombocytosis, post-splenectomy infections, abdominal abscess and OPSI For these reasons, surgeons have prefered avoiding splenectomy. Nevertheless, the main risk of NOM is the possibility of sudden delayed hemorrhage that could be immediately fatal, before emergency surgery can be performed. In addition, **Duchesne *et al.* (2008)** [19] in NOM, the higher amounts of blood transfusion that are often required, thus increasing the risk of blood borne disease, such as hepatitis and the increased risk of not detecting other intraabdominal lesions, have to be considered with respect to operation management.

CONCLUSION

For acute spleen injuries, non surgical management observed as the most secured management due to low complications, preserve spleen-functions and reduce blood-transfusion in contrast to surgical management.

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Tables and figures

Table (1): Comparison between the two studied groups according to demographic data

Demographic data	Total (n = 42)		Outcome				Test of Sig.	P value
			Conserve (n = 36)		Splenectomy (n = 6)			
	No.	%	No.	%	No.	%		
Sex								
Male	33	78.6	27	75.0	6	100.0	χ^2= 1.909	0.312
Female	9	21.4	9	25.0	0	0.0		
Age								
Min. – Max.	4.0 – 48.0		4.0 - 48.0		12.0 - 36.0			
Mean ± SD.	21.60 ± 12.59		20.39 ± 12.82		28.83 ± 8.68		U=61.00	0.095
Median (IQR)	19.50 (12.0-31.0)		18.50 (9.50-30.0)		30.0 (30.0- 35.0)			

SD: Standard deviation IQR: Inter quartile range t: test of significance

U: Mann Whitney test χ^2: Chi square test

Table (2): Comparison between the two studied groups according to mode of trauma and presentation

	Total (n = 42)		Outcome				t	P value
			Conserve (n = 36)		Splenectomy (n = 6)			
	o.		o.		o.			
Mode of trauma								
MCA	6	8.1	4	8.9		3.3		
Fall from height	8	2.9	7	7.2		6.7	5.395	0.132
Poly traumatized pt.		.4		.8		.0		
Dirct blunt trauma		6.7		1.1		0.0		
Presentation								
Diffuse abdominal pain	4	7.1	9	2.8		3.3		
LT hypochondrail pain	3	1.0	2	3.3		6.7	1.411	0.450
LAX abdomen		1.9		3.9		.0		

p: p value for comparing between the studied groups

t: test of significance %: percentage

Table (3): Comparison between the two studied groups according to ultrasound

Ultrasound	Total (n = 42)		Outcome				t	p
			Conserve (n = 36)		Splenectomy (n = 6)			
	o.		o.		o.			
Minimal	3	9.0	3	2.2		.0	19.694*	<0.001*
Mild		4.8		3.9		.0		
Mild and moderated at fellow up		.4		.0		6.7		
Moderate		9.0		3.9		0.0		
Marked		.8		.0		3.3		

p: p value for comparing between the studied groups

***: Statistically significant at p ≤ 0.05**

t: test of significance %: percentage

Table (4): Comparison between the two studied groups according to Ct with contrast

Ct with contrast	Total (n = 42)		Outcome				t	p
			Conserve (n = 36)		Splenectomy (n = 6)			
	o.		o.		o.			
Grade 1 spleen		.5		1.1		.0		
Grade 2 spleen	6	8.1	6	4.4		.0		
Grade 3 spleen	2	8.6	1	0.6		6.7	14.985*	0.001*
Grade 4 spleen		6.7		3.9		3.3		
Just ultrasound		.1		.0		0.0		

p: p value for comparing between the studied groups *: Statistically significant at $p \leq 0.05$ **t: test of significance %: percentage**

Table (5): Comparison between the two studied groups according to CBC

CBC	Total (n = 42)	Outcome		t	p
		Conserve (n = 36)	Splenectomy (n = 6)		
Hg					
Min. – Max.	8.50 – 15.0	8.90 – 15.0	8.50 – 11.0	2.734*	
Mean ± SD.	10.76 ± 1.41	10.98 ± 1.36	9.40 ± 0.97		0.009*
Median (IQR)	10.55 (9.8- 12.0)	10.75(10.0 -12.0)	9.20 (8.50- 10.0)		
HCT					
Min. – Max.	22.0 – 44.0	23.0 – 44.0	22.0 – 33.0		
Mean ± SD.	31.43 ± 4.86	32.17 ± 4.52	27.0 ± 4.86	2.568*	0.014*
Median (IQR)	32.0 (29.0- 35.0)	32.0(29.50-35.50)	25.50 (23.0- 33.0)		
TLC					
Min. – Max.	4.0 – 25.0	4.0 – 25.0	12.0 – 18.0		
Mean ± SD.	13.83 ± 3.97	13.53 ± 4.08	15.67 ± 2.88	1.229	0.226
Median (IQR)	14.0 (12.0- 16.0)	13.50(11.25- 15.0)	17.0 (12.0- 18.0)		

IQR: Inter quartile range SD: Standard deviation t: Student t-test

p: p value for comparing between the studied groups

***: Statistically significant at p ≤ 0.05**

Table (6): Comparison between the two studied groups according to haemodynamic stability

Haemodynamic stability	Total (n = 42)	Outcome		t	p
		Conserve (n = 36)	Splenectomy (n = 6)		
Blood Pressure					
Systolic					
Min. – Max.	70.0 – 130.0	90.0 – 130.0	70.0 – 110.0		
Mean ± SD.	105.48 ± 15.49	109.58 ± 11.30	80.83 ± 14.97	5.515*	<0.001*
Median (IQR)	110.0(100.0-120.0)	110.0(100.0-120.0)	77.50(70.0- 80.0)		
Dystonic					
Min. – Max.	40.0 – 90.0	60.0 – 90.0	40.0 – 60.0		
Mean ± SD.	65.12 ± 9.40	67.36 ± 7.70	51.67 ± 7.53	4.636*	<0.001*
Median (IQR)	62.50 (60.0- 70.0)	70.0 (60.0- 70.0)	50.0 (50.0- 60.0)		

Pulse					
Min. – Max.	75.0 – 130.0	75.0 – 120.0	90.0 – 130.0		
Mean ± SD.	100.81 ± 14.04	97.75 ± 11.34	119.17 ± 15.63	4.062*	<0.001*
Median (IQR)	100.0(90.0- 110.0)	98.50(89.0- 110.0)	125.0(115.0-130.0)		

IQR: Inter quartile range SD: Standard deviation t: Student t-test

p: p value for comparing between the studied groups

***: Statistically significant at p ≤ 0.05**

Figures

Figure (1): Comparison between the total studied groups according to sex

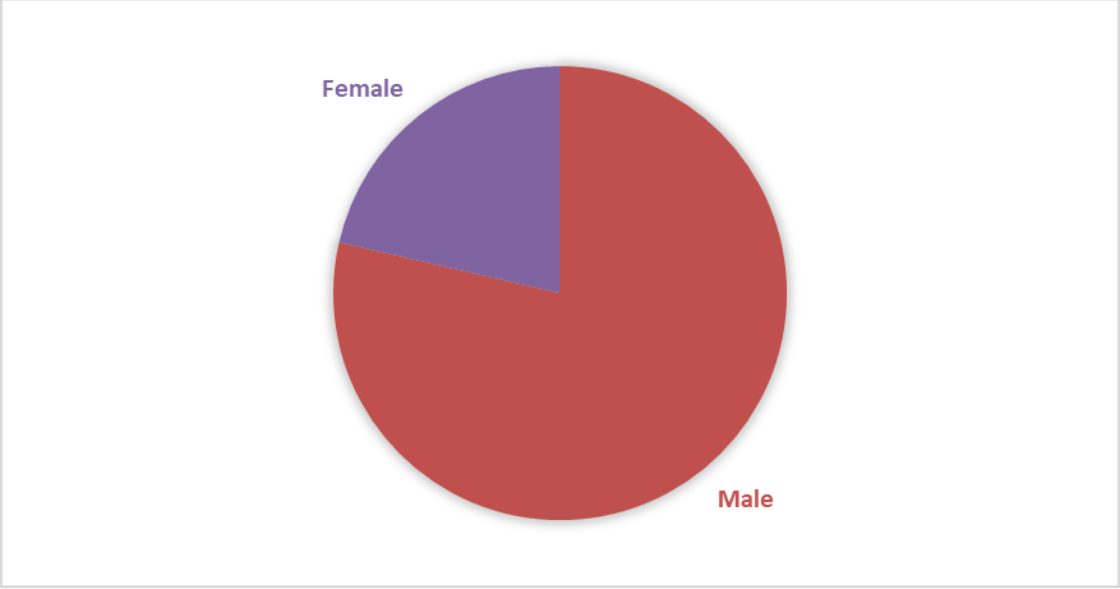


Figure (2): Percentage of Mode of Trauma among Conserve group and Splenectomy group.

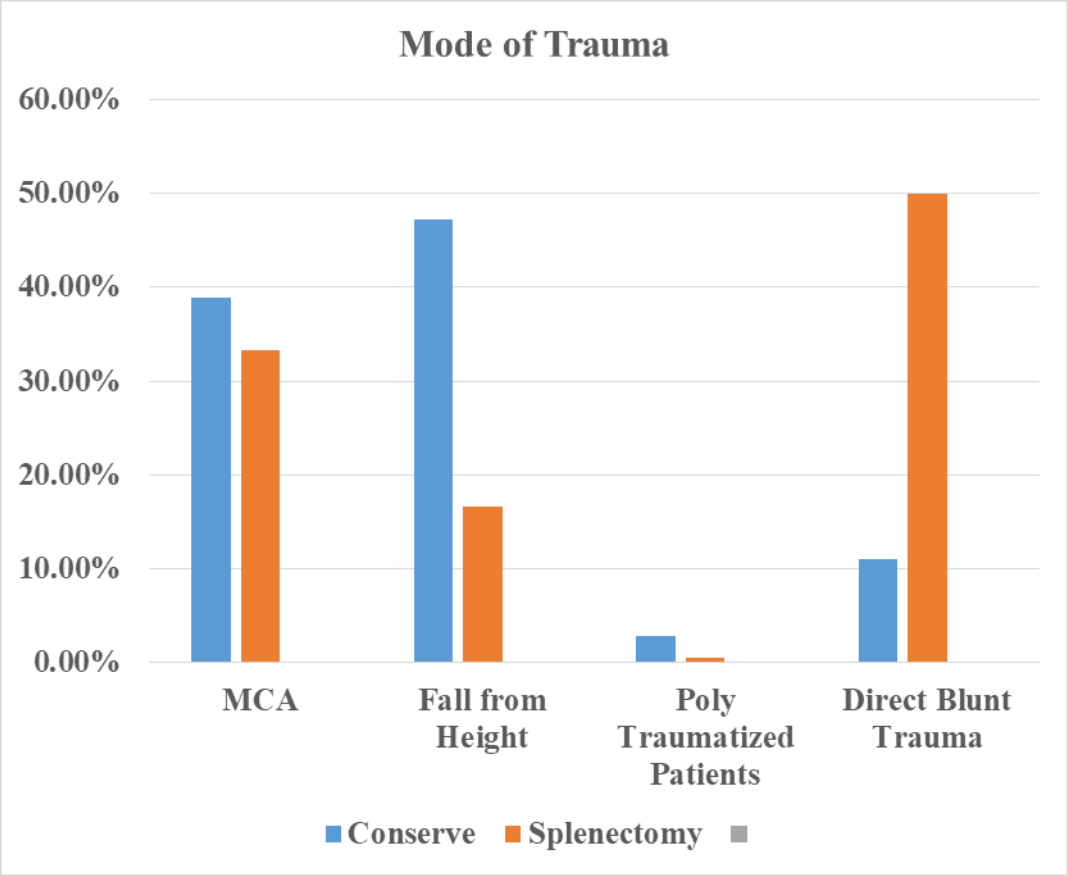
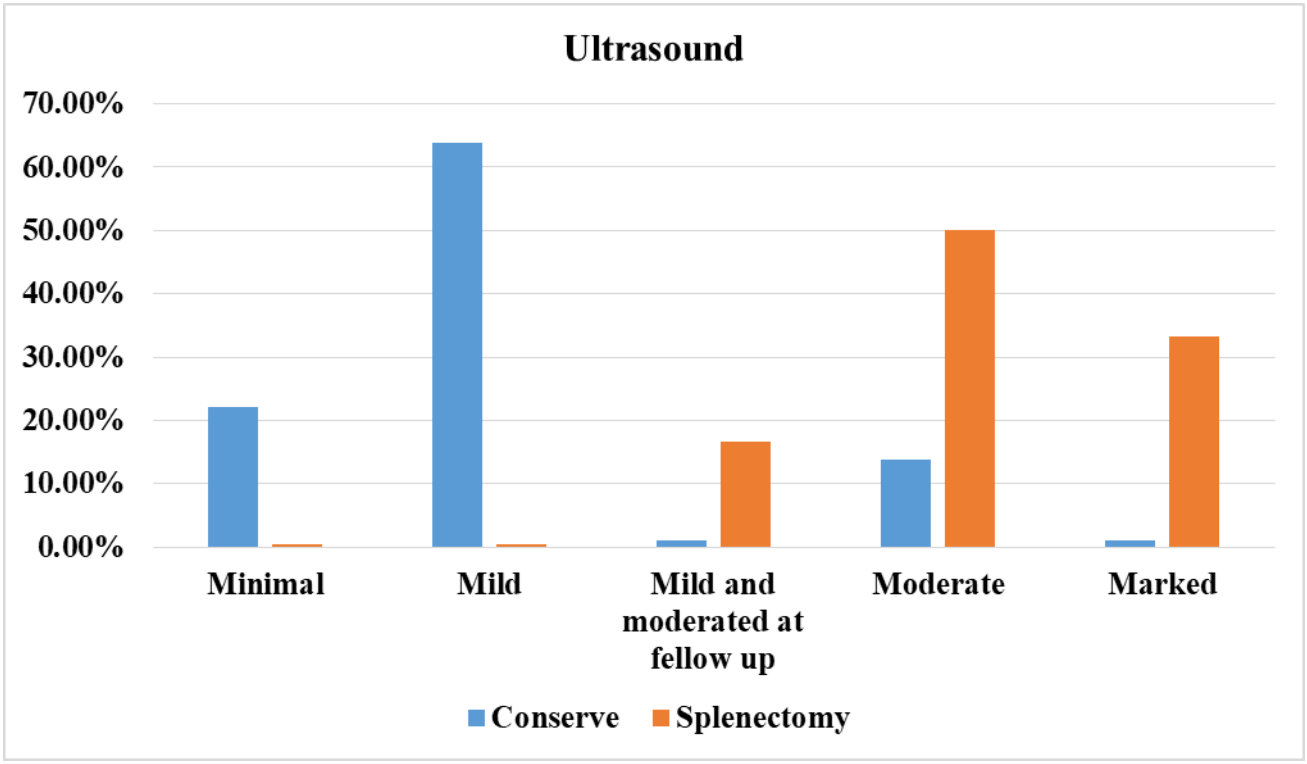

Mode of Trauma
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
MCA
Fall from Height
Poly Traumatized Patients
Direct Blunt Trauma
Conserve
Splenectomy

Figure (3): Percentage of Mode of Trauma among Conserve group and Splenectomy group.



grade 1 = subcapsular-haematoma <10% of surface area and parenchymal laceration <1 cm depth

grade 2 = subcapsular-haematoma 10-50% of surface area and parenchymal laceration 1-3 cm in depth

grade 3 = subcapsular-haematoma >50% of surface area and parenchymal laceration >3 cm in depth

grade 4 = splenic vascular injury and parenchymal laceration involving segmental vessels producing >25% devascularization