
SPLenic INJURIES IN MOSUL PROVINCE

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Summary

This is retrospective study of splenic trauma managed at Al-Zahrawi Teaching Hospital and Saddam General Hospital in Mosul Province. The data of 108 patients during the study between the first of January 1993 and the 13th of June 1997; have been analyzed. Males were three times affected more than females. The mean age was 24 years, and the highest incidence was encountered in those below the age of 10 years (39.8%). Blunt splenic trauma was much more common than penetrating injury (73% vs 27%). Road traffic accidents (41.7%) and fall from height (25%) were the most common causes. Splenic injuries were graded in severity from one to five. Twelve percent were grade I injuries, 13% grade II, 14% grade III, 16% grade IV, 27% grade V, and 19% of unknown grade. Associated injuries were frequent, occurred in 63% of patients. The majority of the patients (94.4%) were treated by splenectomy whereas only (5.6%) had splenorraphy performed. Delayed rupture of the spleen was present in two patients (1.9%) who required splenectomy more than 48 hours post-injury. Postoperative complications were common, occurred in 47 patients (34.5%). Pulmonary infection had the higher incidence and occurred in (20.4%) of the patients. Wound infection was present in 8 patients (7.4%) and peritonitis in 7 patients (6.4%). However, complications were more frequent in those severely injured with multiple associated injuries. The overall mortality was (25%). Sixteen patients (15%) with blunt splenic injury and 11 patients with penetrating injury died. Death generally occurred in those with severe associated injuries like head injuries. The two most common causes of death were exsanguination (8.3%) and septicemia.

Introduction

The spleen remains the most common injured organ in patients who sustained blunt abdominal trauma. Such injuries to the spleen represent approximately one quarter of all blunt and penetrating thoraco-abdominal injuries. Most studies of splenic injuries

have found that penetrating and blunt trauma were about equal in etiology of splenic rupture^{1,2}.

For decades, splenectomy was considered the safest approach to the injured spleen, extirpation of the spleen eliminated the risk of post-operative hemorrhage, and was believed to be without detriment to the patient^{3,4}. Recently the understanding of the important immunologic functions of this organ and that asplenic patients are at an

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increased risk from a number of postoperative complications such as pulmonary and wound infections, thromboembolic sequelae, overwhelming post-splenectomy sepsis, and possible fatal coronary artery disease have led to unprecedented efforts to preserve this organ in instances of injury, and techniques of splenic preservation have been introduced to avoid these potential problems^{5,6}.

The aim of this study was to highlight the magnitude of splenic injury in Mosul province and to evaluate the grades of splenic injury, the treatment modalities to which the patients subjected to and to discuss the postoperative complications.

Patients and Methods

The clinical records of all patients who underwent operation for splenic injury, from the 1st of January 1993 until the 13th of June 1997 at Al-Zahrawi Teaching Hospital and Saddam General Hospital, were reviewed and assessed. One hundred and eight patients were included in this study. Data were collected concerning age, sex, management and type of operation, postoperative complications, mortality and cause of death.

All patients with penetrating abdominal wounds underwent laparotomy after resuscitation. Patients with blunt abdominal trauma were operated upon depending on the presence of hypotension, signs of intraabdominal hemorrhage, peritoneal irritation, or peritonitis. In the majority of the patients, the diagnosis was confirmed at laparotomy. Six patients, all with blunt abdominal injury, had splenic trauma diagnosed by ultrasound, and 13 patients of the blunt splenic injury had positive abdominal tap. The patients were operated upon either by consultants or by surgeons experienced in performing laparotomies.

The severity of splenic injuries were graded retrospectively using the system

developed by Shackfold et al. and modified by Feliciano et al.⁷. Patients with iatrogenic splenic injury were excluded in this study.

Results

Patients' age ranged from 1.5 years to 80 years, with a mean age of 24 years. Forty three patients (39.8%) were under the age of 10 years (Table I).

Table I. Age incidence of splenic injured patients.

Age groups	No. of patients	%
< 10 years	43	39.8
11-20 yrs	27	25.0
21-30 yrs	20	18.5
31-40 yrs.	10	9.3
41-50 yrs.	2	1.8
> 50 yrs.	6	5.6
Total	108	100

Splenic trauma occurred more commonly in males. There were 82 male patients (75.9%) and 26 female patients (24.1%) with male to female ratio 3:1 (Table II).

Table II. Sex incidence of splenic injured patients

Sex	No. of patients	%
Male	82	75.9
Female	26	24.1
Total	108	100

Seventy-nine patients (73.2%) had injuries resulted from blunt trauma, whereas 29 patients (26.8%) sustained penetrating splenic injuries as shown in Table III.

The splenic injury was graded retrospectively and showed that 29 patients (26.9%) had grade V and about 20 patients (18.5%) with unknown grading (Table IV).

Table III. Causes of splenic injury

Cause	No. of patients	%
Blunt		
<i>F.F.H</i>	27	25
<i>R.T.A.s</i>	45	41.7
<i>Assault & Others</i>	7	6.5
Total	79	73.2
Penetrating		
<i>Gunshot wounds</i>	25	23.1
<i>Stab wounds</i>	4	3.7
Total	29	26.8

F.F.H.: fall from height

R.T.A.s.: road traffic

Table IV. Grading of splenic injury

Grade	No. of patients	%
I	13	12
II	14	13
III	15	13.9
IV	17	15.7
V	29	26.9
Unknown	20	18.5
Total	108	100

There were significant associated injuries in 45 patients (57%) of 79 patients with blunt trauma, and in 23 patients (79.3%) of 29 patients with penetrating injury (Table V).

Table V. Type of injury in relation to mechanism

Type of injury	Blunt inj.		Penetrating inj.		Total	
	No.	%	No.	%	No.	%
Isolated splenic inj.	34	43	6	20.7	40	37
Associated splenic inj.	45	57	23	79.3	68	63
Total	79	100	29	100	108	100

Inj.: injury

The patients with blunt injury had a high incidence of extraabdominal injuries (long bones fractures, chest and head injuries were the most frequent), while patients with penetrating injury had a high incidence of intra-abdominal and diaphragmatic injuries (Table VI).

Table VI. Associated injuries in splenic injured patients.

	Blunt inj.	Penetrating inj.	Total
	No. of inj.	No. of inj.	No. of inj.
Abdominal			
<i>Liver</i>	14	6	21
<i>Small intestine</i>	4	9	13
<i>Stomach</i>	1	13	14
<i>Kidney</i>	4	3	7
<i>Pancreas</i>	4	6	10
<i>Large bowel</i>	-	7	7
Total	27	44	72
Extra-abdominal			
<i>Head</i>	12	-	12
<i>Chest</i>	5	3	8
<i>Ribs fracture</i>	8	2	10
<i>Long bones fracture</i>	14	1	15
<i>Pelvis fracture</i>	4	-	4
<i>Diaphragm</i>	2	10	12
<i>Spinal cord</i>	-	2	2
Total	45	18	63

Splenectomy was the most commonly performed operation for splenic injury. One hundred and two patients (94.4%) were treated by splenectomy.

Splenorrhaphy was performed in 6 patients with splenic injury (Table VII).

The grades of splenic injury in those patients who had been treated by splenorrhaphy were ranged between grade I (four patients) and grade II (two patients).

Table VII. Mechanism of the injury versus the treatment

	Splenectomy		Splenorrhaphy	
	No.	%	No.	%
Penetrating	26	89.7	3	10.3
Blunt	76	96.2	3	3.8
Total	102	94.4	6	5.6

Forty seven patients (43.5%) developed postoperative complications. Chest complications occurred in more than half of them (22 patients), followed by wound infection (Table VIII).

Table VIII. Postoperative complications

	Type of complication	No.	%
Chest comp.	Infection	4	3.7
	Pneumonia	6	5.6
	Atelectasis	8	7.4
	Pulmonary embolism	3	2.8
	Respiratory failure	1	0.9
		22	20.4
Wound comp.	Wound infection	8	7.4
	Burst abdomen	2	1.9
		10	9.3
Abd comp.	Subphrenic abscess	4	3.7
	Intestinal obstruction	2	1.9
	Peritonitis	7	6.5
		13	12.1
Urinary tract comp.	Infection	2	1.9
Total		47	43.5

Comp.: complication

Discussion

Patients' age ranged from 1.5-80 years. The peak incidence of splenic injury was in those under the age of 10 years (39.8%) followed by the age group 11-20 years of age (25%) (Table I). This is understandable since these age groups are more liable to be the victims of fall from height or road traffic accidents. Neglect and lack of supervision by the parents is the likely explanation for the high incidence of fall from height as a cause of splenic injury in young children, whereas older children and adolescent are also more prone to be the victims of road traffic accidents. This may be due to increase activity of these age groups and they are usually involved in outdoor activity and unprotected by their parents and so more liable to struck by motor vehicles.

The other age groups with high incidence of splenic injury was 21-30 years of age (18.5%) (Table I), gunshot wounds was the most common cause of splenic injury in this age group, because of the increasing use of firearms in our society.

In this series blunt trauma as a cause of splenic injury was much more common than penetrating injury (73.2% vs 26.8%), which is comparable to other rates reported in the literature^{8,9,10}. Other authors reported about equal incidence in injury blunt and penetrating trauma^{1,2}. The majority of the patients were victims of road traffic accidents (whether motor vehicle accidents or motor vehicle versus pedestrians) accounted for splenic injury in 45/108 patients (41.7%), whereas falls accounted for (25%) and gunshot wounds (23%) of the injuries. Stabbing of the abdomen and / or the chest assaults and other causes accounted for the reminder (Table III).

In a study published by Steel and Lim showed that road traffic accidents accounted for (48%) of cases¹⁰. Moore et al. reported (50%) of splenic injury caused by road traffic accidents⁹, whereas Chadwick et al. reported (35%)¹¹.

In the present study, fall from height was much more frequent than assaults (25% versus 6.5%) whereas Chadwick et al. showed that assaults were much more common than falls (17.3% versus 6.3% falls)¹¹. Steele and Lim in their study showed that assaults accounted for (15.7%) of splenic injuries, whereas falls accounted for (12%) of cases¹⁰.

Of penetrating splenic injury, gunshot wounds were more frequent than stab wounds, and were the cause of splenic injury in 25 patients (23.1%) versus 4 patients (3.7%) with stab wounds. This is contradictory to other series which reported about equal incidence of gunshot wounds and stab wounds as a penetrating cause of splenic injury. Pachter et al.¹² and Steele and Lim¹⁰ showed (12%) incidence for each gunshot and stab wounds as a cause of splenic injuries. Millikan et al.⁸ and Moore et al.¹⁵ showed (16%) for each gunshot and stab wounds, while a study published by Chadwick et al. described stab wounds occurred much more

frequent than gunshot wounds (33.8% versus 1.5%)¹¹ (Table III).

Forty patients (37%) had isolated splenic injury, whereas 68 patients (63%) had associated injuries. Forty five patients (57%) of 79 patients with blunt trauma and 23 patients (79.3%) with penetrating injury had associated injuries (Table V).

Extra-abdominal injuries were more common in patients with blunt injury. Long bones fractures were the most common associated injury followed by chest injuries and head injuries. Of the abdominal associated injuries in patients with blunt trauma, the liver was the most commonly injured organ in association with the spleen, (Table VI).

Patients with penetrating injury had higher incidence of abdominal associated injuries of which the stomach ranked the top of the list, followed by the diaphragm as an extra-abdominal associated injury.

This is understandable since patients with blunt trauma had road traffic accidents or fall from height as a cause of splenic injury, and so they are more prone to have long bones fractures or other extra-abdominal injuries, while patients with penetrating abdominal or thoraco-abdominal injuries prove to have their spleen injured this usually is associated with injury to the adjacent structures such as stomach and diaphragm.

These findings seem comparable to a study performed by Steel and Lim, which showed overall associated injuries of (65.1%, 63%) of the patients associated injuries¹⁰. Also, their study showed higher incidence of extra-abdominal injuries in patients with blunt splenic rupture, and higher incidence of abdominal associated injuries in patients with penetrating injuries.

In this series, splenectomy was the most commonly performed operation, 94.4% of patients had their spleen removed as a management of their

splenic injury. Also, splenectomy was performed in about equal percentage in those patients who had blunt splenic injury and those who sustained penetrating injury (96.2% and 89.7% respectively).

Most authors reported that splenectomy for splenic injury is no more the standard therapy and the safest approach in all patients. It is now used in approximately less than 60% of splenic injuries in most centres^{3,7,11,12}.

In this review, 2 patients (1.9%) underwent splenectomy more than 48 hours post-injury. Both of them had isolated blunt splenic injury. This may represent delayed rupture of the spleen. The incidence of this clinical entity has been reported in texts to be approximately (10-15%) of splenic injury^{13,14}. This concept has been challenged by Oslen and Polly¹⁵ and by Benjamin and associates¹⁶. These authors reported a rate of delayed rupture of the spleen of less than 1% in over 600 patients by the use of new diagnostic modalities. They suggested that the 15% incidence reported in older papers actually represents a delay in diagnosis. In a recently published series the authors concluded, from their review of literature, that many case reports on the modern literature are misleading because the diagnosis of delayed rupture spleen was based on clinical grounds in patients who did not have CT scan at the time of initial examination. They stated that the true clinical entity of delayed splenic rupture occurs in patients sustaining blunt trauma who experience no hemodynamic instability of more than 48 hours after the initial injury. These patients should have a CT scan documented normal spleen at the time of the initial evaluation¹⁷.

In this study, splenorraphy was performed in 6/108 patients (5.6%). Three patients (10.3%) of the 29 patients with penetrating injury and 3/79 patients (3.8%) with blunt splenic injury had

their spleen repaired. The severity of splenic injury in those with reversed spleen ranged between grade I (4/13 patients, 30.8%) and grade II (2/14 patients, 14.3%).

In a recent study performed in Greece showed that 27/29 patients sustained closed injuries of the spleen, were treated successfully by suture repair with figure-of-eight, chromic catgut with the application of topical hemostatic agent¹⁸. Another series published recently by Mustafa pointed out that suture repair of the spleen was successful in (62.2%), whereas splenectomy was performed in (37.8%) of patients with splenic injury¹⁹.

Another study performed in Northampton General Hospital, UK, for a period of about 5 years. There were 15% grade I injury, 33% grade II, 25% grade III, 21% grade IV, and only 6% grade V (Table V). Splenectomy was required in 76% of injured spleens, 12% had splenorraphy performed and 12% were conservatively treated. In 50% of grade I, 29% grade II and 23% of grade III injuries, the spleen was preserved²⁰.

One of the major concern about splenorraphy is the risk of postoperative rebleeding from the repaired spleen. No one of the 6 patients required reoperation for rebleeding. However, Feliciano et al. described in their review of a 9 year experience with splenorraphy that reoperation for rebleeding was required in 20/997 patients (2%)²¹.

Complications were frequent, occurring in 47 patients (43.5%). This seems comparable to a study conducted by Steele and Lim which showed a 45% complication rate¹⁰, whereas Fabri et al. reported 29% complications rate²².

Pulmonary infection (chest infection and pneumonia) as the most frequent complication occurred in 9.2% of patients, followed by atelectasis in 7.4% of the patients. One patient had res-

piratory failure and required intubation for 3 days.

Pulmonary embolism occurred in 3/108 patients 2.8%. This figure seems favorable to a study of Steel and Lim which reported an incidence of pulmonary embolism of 4% after splenectomy for trauma¹⁰. However, in this series all patients with pulmonary embolism had either pelvic bones or long bones fractures, in association with splenic injury.

The overall rate of respiratory complications in this study was 20.4%, which is favorable to that reported by Steele and Lim¹⁰ and Giuliano and Lim²³ of 26%.

Wound infection occurred in 8/108 patients (7.4%). This figure seems comparable to the study of Steele and Lim which showed incidence of wound infection of 6%¹⁰, whereas Chadwick et al. series showed 9.4% incidence of wound infection¹¹.

In our series, 4 patients (3.7%) suffered subphrenic abscess. This observation is consistent with those of other authors^{10,11,24}.

In this study, peritonitis and intra-abdominal abscess occurred in 7/108 patients (6.5%). All of the seven patients died due to septicemia and multiple organ failure. However, five out of the seven patients had concomitant gastrointestinal injuries.

In this series, the overall mortality was 25%, whereas Naylor and associates reported an overall mortality rate of 11.2%¹, and Steele and Lim reported a 11.7% mortality rate¹⁰. Chadwick and his colleagues reported a mortality rate following splenic injury of 16.5%¹¹. Exsanguination and septicemia with multiple organ failure, ranked the top of the causes of death, followed by head injury. Pulmonary embolism was the cause of death in 3 patients (2.8%).

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