COMPARAÇÃO DE ABORDAGENS CIRÚRGICAS E NÃO CIRÚRGICAS AO TRAUMA ESPLÊNICO**COMPARISON OF SURGICAL AND NON-SURGICAL APPROACHES TO SPLENIC TRAUMA**

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RESUMO

A perda do baço acarreta em aumento do risco de sepse, pielonefrite, pneumonia e embolia pulmonar ao longo da vida de pacientes com trauma esplênico. Com relação à sensibilidade do baço e à importância de terapias apropriadas para trauma espástico, este estudo teve como objetivo determinar as consequências do trauma raquimedular com base em diferentes métodos terapêuticos. Este estudo de coorte retrospectivo foi realizado em pacientes com trauma esplênico que foram encaminhados ao Hospital Rasool Akram em Teerã, Irã, durante 2011-2017. Todos os registros médicos de 133 pacientes com trauma esplênico foram coletados entre 2011 e 2017. Os dados foram coletados relacionados à ultrassonografia e tomografia computadorizada ou a outros métodos de diagnóstico dos pacientes admitidos na enfermaria cirúrgica. Finalmente, pacientes com trauma esplênico com abordagem cirúrgica foram comparados com indivíduos com abordagem não cirúrgica. As abordagens cirúrgicas e não cirúrgicas foram realizadas em 80% (n = 104) e 20% (n = 26) dos indivíduos, respectivamente. Houve diferença significativa entre os dois grupos em relação ao tempo de permanência na unidade de terapia intensiva e duração total da internação. A comparação entre os dois grupos mostrou que não houve diferença significativa em termos dos efeitos colaterais relacionados ($P > 0,05$). No geral, 80,8% (n = 84) e 96,4% (n = 27) dos pacientes receberam alta nos grupos cirúrgico e não cirúrgico, respectivamente. Além disso, 19,2% (n = 20) e 3,6% (n = 1) dos casos morreram em grupos cirúrgicos e não cirúrgicos. A comparação dos pacientes sobreviventes mostrou que houve uma diferença significativa entre os grupos ($P = 0,045$). Este estudo mostrou que não houve diferença em relação às consequências de abordagens cirúrgicas e não cirúrgicas nos pacientes com trauma esplênico. O tempo de internação hospitalar foi menor no grupo não cirúrgico, comparado ao grupo cirúrgico. A causa mais comum de trauma nos dois grupos foi acidente de carro. O hematoma retroperitoneal foi o trauma intra-abdominal mais comum. A taxa de mortalidade foi maior no grupo cirúrgico em comparação com o grupo não cirúrgico.

Palavras-chave: *Trauma abdominal contuso, Tratamento não cirúrgico, Esplenectomia esplênica, Trauma esplênico.*

ABSTRACT

The spleen loss leads to increase the risk of sepsis, pyelonephritis, pneumonia, and pulmonary embolism throughout the lifetime of patients with splenic trauma. Regarding the sensitivity of the spleen and the importance of appropriate therapies for spastic trauma, this study aimed to determine the consequences of spinal trauma based on different therapeutic methods. This retrospective cohort study was conducted on the splenic trauma patients who were referred to Rasool Akram Hospital in Tehran, Iran, during 2011-2017. All medical records of 133 splenic trauma patients were gathered from 2011-2017. The data were gathered related to ultrasound, and computed tomography scan or other diagnostic methods of the patients admitted in the surgical ward. Finally, splenic trauma patients with a surgical approach were compared to the subjects with a non-surgical approach. Surgical and non-surgical approaches were performed on 80% (n=104) and 20% (n=26) of the subjects, respectively. There was a significant difference between the two groups regarding the length of intensive care unit stay and total hospitalization duration. The comparison between the two groups showed that there was no significant difference in term of the related side effects ($P > 0.05$). Overall, 80.8% (n=84) and 96.4% (n=27) of the

patients were discharged in surgical and non-surgical groups, respectively. In addition, 19.2% (n=20) and 3.6% (n=1) of the cases died in surgical and non-surgical groups. The comparison of survived patients showed that there was a significant difference between the groups ($P=0.045$). This study showed that there was no difference regarding the consequences of surgical and non-surgical approaches in patients with splenic trauma. The length of hospital stay was shorter in the non-surgical group, compared to that of the surgical group. The most common cause of trauma in both groups was car accidents. Retroperitoneal hematoma was the most common intra-abdominal trauma. The mortality rate was higher in the surgical group in comparison to that of the non-surgical group.

Keywords: *Blunt abdominal trauma, Non-surgical management, Splenectomy, Splenic, Splenic Trauma*

1. INTRODUCTION:

Trauma has some type resulting in superficial and deep injuries that can threaten the lives of people of all ages (Khazaei *et al.*, 2016). The most common blunt abdominal trauma is splenic trauma. The spleen loss leads to increase the risk of sepsis, pyelonephritis, pneumonia, and pulmonary embolism throughout the lifetime of these patients. Spinal injury is observed in more than 3% of all the cases referring to trauma centers and 40% of laparotomies are performed due to blunt abdominal trauma, which occurs with unknown causes. Previously, splenorrhaphy was the dominant technique of spleen preservation (Hoefnagel, 1956). Despite the uncommon infection after splenectomy (0.5-3.2%), the mortality rate of the patients with postoperative infection is reported between 50% and 75% indicating an increase in the complications of this approach utilization (Bisharat *et al.*, 2001). The risk of sepsis, pneumonia pyelonephritis, pulmonary pneumonia, and pulmonary embolism throughout the patient's lifetime increased in the patients without the spleen, compared to that in the general population (Renzulli *et al.*, 2009).

Regarding the advancements in imaging and increasing use of computed tomography (CT) scan in trauma cases, surgical treatment has been introduced as an applicable technique in patients with spleen trauma. First, this approach was used in the treatment of children and then for adults since the early 1990s (El Khoury *et al.*, 2011). In cases with unstable hemodynamic condition and the use of diagnostic techniques, such as ultrasound, splenectomy is considered as an option. However, in patients with stable vital symptoms, if there is a doubt about the abdominal visceral injury, CT scan is the best diagnostic method. With the detection of spleen injuries in a patient's CT scan, the surgeon deals with the issue of surgical intervention or the use of non-surgical treatment (Oyo-Ita *et al.*, 2015).

The sensitivity of the spleen organs, choosing appropriate therapies for trauma patients

to prevent complications, such as bleeding, infections, and deaths and the existence of some controversial information considering the choice of surgical and non-surgical procedures are essential issues in this regard. With this background in mind and the inadequate number of studies about this issue in Iran, the present study aimed to determine the consequences of splenic trauma based on different therapeutic methods in Iranian population.

2. MATERIALS AND METHODS:

This retrospective cohort study was conducted on the splenic trauma patients, who were referred to the Rasool Akram Hospital in Tehran, Iran, 2011-2017. All medical records of 143 splenic trauma patients were gathered from 2011-2017. The inclusion criteria were trauma diagnosis, surgical or non-surgical treatment, and the availability of patients' records. First, the data of 143 splenic trauma patients admitted in the surgical ward were gathered related to ultrasound and CT scan or other diagnostic methods. Then, some cases were excluded from the study due to incomplete information, and 133 patients remained. The Data, including age, gender, trauma grade, the type of treatment intervention, duration of hospitalization, re-referral to the hospital, number of times and volume of blood transfusion, and rate of postoperative mortality were gathered and then entered into a researcher-made questionnaire. Finally, splenic trauma patients with a surgical approach were compared to the cases with a non-surgical procedure.

2.1. Statistical analysis

All the data were analyzed in SPSS software (version 24) using Chi-square test, t-test, and Mann-Whitney U test. P-value less than 0.05 was considered statistically significant.

2.2 Ethical considerations

The Ethics Committee approved this study of the Iran University of Medical Sciences

(IR.IUMS.FMD.REC.1398.101). All procedures performed in studies involving human participants following the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments. All participants provided written and informed consent.

3. RESULTS AND DISCUSSION:

The mean age of the subjects was reported as 25.6 ± 11.26 years within the range of 2-63 years. In total, 113 (85%) and 20 (15%) subjects were male and female, respectively. Table 1 tabulates other demographic and diagnostic data. The mean scores of systolic blood pressure, diastolic blood pressure, respiratory rate, body temperature, and heart rate were 108.62 ± 18.261 mmHg, 69.54 ± 11.9 mmHg, 18.27 ± 5.57 breaths/min, $39.63 \pm 29.31^\circ$, and 98.51 ± 20.57 beat/min, respectively. Moreover, the mean scores of length of intensive care unit (ICU) stay and ward hospitalization were 5.78 ± 9.11 and 10.64 ± 11.7 days, respectively. Also, the mean score of the Glasgow Coma Scale was calculated as 13.45 ± 3.105 . Surgical and non-surgical approaches were used in 80% (n=104) and 20% (n=26) of the patients, respectively. Table 2 demonstrates the distribution of concurrent Intra- and extra-abdominal traumas based on surgical and non-surgical approaches.

There was no significant difference between intra- and extra-abdominal injuries ($P=0.006$). Moreover, Table 3 tabulates the mean scores of basic information according to surgical and non-surgical approaches. Based on the obtained results, there was a significant difference between the two groups in terms of length of ICU stay and total hospitalization duration. The comparison of disease grade between the two groups showed that there was no significant difference between surgical and non-surgical approaches ($P=0.21$). The related side effects were observed in 26% and 11.5% of the patients in the surgical and non-surgical groups, respectively. No significant difference was observed between the two groups in terms of the side effect ($P>0.05$).

Table 4 presents different side effects based on surgical and non-surgical approaches. Overall, 30.8%, 61.5%, and 7.7% of the subjects were in Grade 1, Grade 2, and Grade 3, respectively. The frequency of disease grade based on surgical and non-surgical approaches is presented in Table 5. The CT scan was performed in 53.5% (n=53) and 82.1% (n=23) of the cases in

surgical and non-surgical groups, respectively. According to the conduction of CT scan, no significant difference was observed between surgical and non-surgical approaches ($P=0.006$).

Penetrating trauma, blunt trauma, car accident, fight, and fall were the causes of trauma in 5.8%, 1%, 48.1%, 3.8%, and 41.3% of the cases in the surgical group, respectively. In the non-surgical group, 5.3%, 1.5%, 50%, 3%, and 40.2% of the patients were injured due to penetrating trauma, blunt trauma, car accident, fight, and fall, respectively. Finally, 80.8% (n=84) and 96.4% (n=27) of the subjects were discharged in surgical and non-surgical groups, respectively. In addition, 19.2% (n=20) and 3.6% (n=1) of the cases died in surgical and non-surgical groups. The comparison of survived patients demonstrated a significant difference between the two groups ($P=0.045$).

Based on the obtained results of this study, there was no significant difference between intra- and extra-abdominal traumas in surgical and non-surgical approaches. The length of ICU stay and total hospitalization duration were shorter in the non-surgical group, compared to those of the surgical group. Car accidents were the most common cause of trauma in both groups. Retroperitoneal hematoma was the most common intra-abdominal trauma and the most common extra-abdominal trauma was related to organs in both groups. The rate of mortality was higher in the surgical group.

The non-surgical approach in patients with splenic trauma is a controversial issue. This approach has some benefits; however, the careful selection of cases is difficult due to level I scientific evidence. The leading cause of this approach failure is the errors in the clinical assessment. In some instances, with acute spastic trauma, the patient is transferred to the operating room without a CT scan. The advancements in imaging approaches leads to the use of non-surgical technique in recent years.

Similar to the findings of the present study, in a study carried out by Lyas *et al.*, it was shown that non-surgical approach was successful and there was no difference between the prognosis of patients in surgical and non-surgical groups (Lyass *et al.*, 2001). Future studies should be conducted regarding the role of CT scan in the patients with the non-surgical approach. More effective outcomes and higher success rates have been reported in the comparison of surgical and non-surgical techniques for patients with Grade III and IV injuries (Tugnoli *et al.*, 2015).

However, the risk of non-surgical

management failure even after artery embolization increased in large lesions, which probably leads to worse parenchymal injury. On the other hand, according to the development of splenic abscess due to splenic ischemia and necrosis, the splenic trauma patients may need splenectomy. Artery embolization is associated with the increasing risk of non-surgical management failure rate; therefore, its use should be extensive (DuBose *et al.*, 2014). Based on a study conducted by Cinquantini *et al.*, the clinical success rate was reported as 95% for non-surgical management. Similar to the present study, in the study mentioned above, non-surgical management and splenic surgical management in dealing with hemodynamically stable patients with splenic injuries were compared and the results revealed no significant difference between them (Cinquantini *et al.*, 2018).

In the present study, the patients in the surgical group were similar to those in the non-surgical group in term of the lesion severity, while in a study performed by Cinquantini *et al.*, the patients in the surgical group had remarkable higher severity, compared to those in the non-surgical group. The surgical approach treated all cases with Grade IV with a clinical success rate of 100%. In a study carried out by Cinquantini *et al.*, it was suggested that a high chance of success is achieved by embolization that is confirmed by other reports (Rajani *et al.*, 2006; Davis *et al.*, 1998; Dent *et al.*, 2004).

According to the literature, the success rate of non-surgical management is estimated between 85–94% (Requarth *et al.*, 2018). However, a higher percentage of non-surgical approach is likely to be related to the treatment of patients with lower grades using these approaches. In fact, the majority of cases treated with embolization were in Grade III (Cinquantini *et al.*, 2018). Based on the results of the present study, no difference was observed between non-surgical and surgical approaches in terms of disease grade. Nonetheless, Banerjee *et al.* suggested the surgical procedure for the patients with Grade III (Banerjee *et al.*, 2013).

In a study conducted by Brillianto *et al.*, it was indicated that the success rates of patients with surgical and non-surgical approaches were reported as 91.6% and 95.4%, respectively, that was not different between the patients with various Grades. This finding confirmed by Bhullar *et al.* study (Bhullar *et al.*, 2012) showed that non-invasive measures for patients with high or low trauma grades under the standard protocol could be very safe and successful (Brillantino *et al.*,

2016). The management of Grade III lesions is very controversial. Although some studies supported the surgical approach (Banerjee *et al.*, 2015; Bhullar *et al.*, 2012; Brilliantino *et al.*, 2016; Miller *et al.*, 2014), some of them reported no remarkable advantages in this regard (Stassen *et al.*, 2012; Crichton *et al.*, 2017).

Some studies suggested the surgical approach associated with non-surgical management to increase the clinical success rate (Rajani *et al.*, 2006; Dent *et al.*, 2004). However, no improvement in splenic salvage rate was reported in other studies (Harbrecht *et al.*, 2007; Duchesne *et al.*, 2008; Smith *et al.*, 2006). In some studies, proximal and distal splenic embolization is compared (Bessoud *et al.*, 2006; Frandon *et al.*, 2014; Schnüriger *et al.*, 2011); however, due to different conditions of using these approaches, the comparison is misleading. Technically, distal embolization leads to safer hemostasis; therefore, with the observation of one or two target lesions in angiography, it should be preferred. Since there is a limited number of studies regarding the combined embolization (Rong *et al.*, 2017), it is recommended to carry out future studies in this regard.

In a retrospective registry review, 926 patients with splenic injury were assessed. Similar to the results of the present study, the study as mentioned earlier, indicated the same distribution of splenic injury grade between two groups. An improvement was observed in non-operative management by the increasing use of angiography and embolization. An aggressive utilization of splenic embolization in patients with appropriate indications will result in low rates of failure and mortality (Rosati *et al.*, 2015). Some advantages have been observed regarding the non-surgical approach. In the present study, total hospitalization duration was shorter in the non-surgical group, compared to that of the surgical group. Shorter hospitalization time was confirmed by another similar study (Tugnoli *et al.*, 2015), leading to a decrease in the risk of hospital infections, costs, and missed working days for each patient.

Moreover, there was no need for blood transfusion, platelet count, fresh frozen plasma, and Ringer's serum in the non-surgical approach that results in decreasing the risk of hospital infections and faster treatment. The survival of patients is the main goal of therapy focused on the traumatic patients; however, the mortality rate in cases with non-surgical management is not specified in the literature (Peitzman *et al.*, 2016). A primary concern in the case of patients with

splenic injuries is the possibility of a delayed rupture after discharge. Based on the evidence, it was concluded that there is no difference between the survival rate in splenic trauma patients with surgical and non-surgical approaches (Rialon *et al.*, 2016).

The present study demonstrated that 80.8% and 96.4% of the subjects in surgical and non-surgical approaches survived, respectively indicating no difference between the two in terms of survival. The survival rate was higher in the non-surgical group than that of the surgical group and the difference was not statistically significant. Therefore, both techniques are useful in the treatment of the patients. In this regard, the proper selection of cases for each type of treatment (surgical or non-surgical) is essential. In another retrospective study carried out by Kaufman *et al.* on 2587 patients, it was indicated that there is no relationship between the survival rate and use of ICU equipment (Kaufman *et al.*, 2016). According to the results of a retrospective study conducted by Alamri *et al.* on 238 patients, the mortality rate was higher among the patients older than 46 years, compared to that of the younger ones. The findings of the study as mentioned above showed that the splenectomy rate decreased; therefore, radiation therapy has been a successful method for the treatment of patients with high grades (Kaufman *et al.*, 2017), consistent with the results of some other studies (Robinette *et al.*, 1977; Ein *et al.*, 1977; HALLER, 2018; Aksnes *et al.*, 1995; Neuwirth *et al.*, 2016; Lolle *et al.*, 2016).

Based on the findings of a study carried out by Girard *et al.*, the non-surgical approach is the first-line treatment for splenic trauma patients with stable hemodynamic condition (Girard *et al.*, 2016). This result was confirmed by another review study conducted by Maboutly *et al.* that showed the increase of non-surgical approach in traumatic patients with stable hemodynamic condition. However, the use of non-surgical techniques in patients with high Grades may lead to an increase in the risk of failure, prolonged hospitalization, risk of delayed bleeding, and transfusion-related infections. Therefore, an appropriate therapeutic approach should be performed based on the patient's clinical condition, radiological findings, and surgeon's experience (El-Matbouly *et al.*, 2016).

Qu *et al.* assessed the postoperative consequences in patients who underwent splenectomy. According to the findings of the study above, it was revealed that 1.1% of the subjects who experienced splenectomy had intra-abdominal hemorrhage 21.43% of whom died.

Besides, a significant relationship was observed between the post-operative bleeding and mortality rate. According to the result as mentioned earlier, abdominal bleeding as the leading risk factor should be a matter of concern in patients with splenic trauma (Qu *et al.*, 2013), consistent with the results of some other studies (Krausz *et al.*, 2003; Solomonov *et al.*, 2000; Pusateri *et al.*, 2003).

In a study conducted by Ochsner, the stable hemodynamic conditions, absence of peritoneal damage signs in CT scan, and absence of significant peritoneal symptoms in abdominal examinations were introduced as the main criteria regarding the use of non-surgical approach in patients with splenic trauma (Ochsner *et al.*, 2001), consistent with the results of some other studies (Federle *et al.*, 1998; Notash *et al.*, 2008; Upadhyaya *et al.*, 2003; Sharma *et al.*, 2005; Krause *et al.*, 2000; Sclafani *et al.*, 1991). The present study provided more information considering non-surgical management in patients with splenic trauma and more details on the consequences of splenic trauma. Because the present study was a retrospective observational study; therefore, the obtained results cannot be generalized to other populations. The small sample size was considered another limitation of this study. It is suggested to carry out further studies to assess the value of ultrasound and CT scan in non-operative management of blunt splenic injuries.

4. CONCLUSIONS:

The obtained results of this study showed that there was no significant difference in the consequences of patients with splenic trauma between the surgical and non-surgical approaches. The length of hospitalization stay was shorter in the non-surgical group, compared to that of the surgical group. The most common cause of trauma in both groups was car accidents. Retroperitoneal hematoma was the most common intra-abdominal trauma. Furthermore, the mortality rate was higher in the surgical group, compared to that of the non-surgical group.

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Table 1. Demographic and diagnostic data of splenic trauma patients

Variable		n	%	Variable		n	%
Education	Below high school	40	43.0	Occupation	Self-employed	35	40.7
	High school	32	34.4		Employed	7	8.1
	Associate Degree	9	9.7		Housewife	3	3.5
	Bachelor	9	9.7		Student	41	47.7
	Master or higher	3	3.2	Cause of trauma	Penetrating trauma	7	5.3
Diagnosis	Computed tomography scan	43	34.1		Blunt trauma	2	1.5
	Ultrasound	63	50.0		Accident	66	50.0
	Other	7	5.6		Fight	4	3.0
	Both	13	10.3		Fall	53	40.2

Table 2. Distribution and comparison of concurrent intra- and extra-abdominal traumas based on surgical and non-surgical approaches

Intra-abdominal trauma		n	%	n	%	Extra-abdominal trauma		n	%	n	%
Intestine	Surgical	3	2.9	4	3.1	Chest	Surgical	10	9.6	12	9.2
	Non-surgical	1	3.8				Non-surgical	2	7.7		
Liver	Surgical	7	6.7	11	8.5	Head	Surgical	5	4.8	7	5.4
	Non-surgical	4	15.4				Non-surgical	2	7.7		
Diaphragm	Surgical	3	2.9	3	2.3	Limb	Surgical	17	16.3	24	18.5
	Non-surgical	0	0				Non-surgical	7	26.9		
None	Surgical	60	57.7	79	60.8	Pelvis	Surgical	4	3.8	4	3.1
	Non-surgical	19	73.1				Non-surgical	0	0		
Kidney	Surgical	4	3.8	4	3.1	None	Surgical	31	29.8	40	30.8
	Non-surgical	0	0				Non-surgical	9	34.6		
Retroperitoneal hematoma	Surgical	11	10.6	11	8.5	Spine	Surgical	7	6.7	9	6.9
	Non-surgical	0	0				Non-surgical	2	7.7		
Stomach	Surgical	2	1.9	2	1.5	Limb, head, and neck	Surgical	17	16.3	20	15.4
	Non-surgical	0	0				Non-surgical	3	11.5		
Pancreas	Surgical	1	1.0	1	0.8	Limb and chest	Surgical	9	8.7	10	7.7
	Non-surgical	0	0				Non-surgical	1	3.8		
Intestine and liver	Surgical	1	1.0	1	0.8	Chest, limb, and head	Surgical	1	1.0	1	0.8
	Non-surgical	0	0				Non-surgical	0	0		
Intestine and retroperitoneal hematoma	Surgical	2	1.9	2	1.5	Head and pelvic	Surgical	1	1.0	1	0.8
	Non-surgical	0	0				Non-surgical	0	0		
Liver and kidney	Surgical	4	3.8	6	4.6	Pelvic and spine	Surgical	2	1.9	2	1.5
	Non-surgical	2	7.7				Non-surgical	0	0		
Liver and retroperitoneal	Surgical	4	3.8	4	3.1	Kidney, intestine,	Surgical	2	1.9	2	1.5
	Non-surgical	0	0				Non-surgical	0	0		

neal hematoma						and retroperiton eal hematoma					
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Table 3. Mean score of basic information according to surgical and non-surgical approaches

Variables	Treatment approach	n	Mean	Standard deviation	P-value
Systolic blood pressure	Surgical	104	108.16	19.18	0.57
	Non-surgical	26	110.42	14.15	
Diastolic blood pressure	Surgical	104	69.62	12.20	0.88
	Non-surgical	26	69.23	10.83	
Respiratory rate	Surgical	102	18.49	6.05	0.36
	Non-surgical	25	17.36	2.76	
Body temperature	Surgical	103	40.301	32.80	0.61
	Non-surgical	26	37.01	0.25	
Heart rate	Surgical	103	100.02	21.1	0.09
	Non-surgical	26	92.54	17.41	
Length of intensive care unit stay (day)	Surgical	101	6.40	10.08	0.01
	Non-surgical	28	3.57	3.27	
Total hospitalization duration (day)	Surgical	104	11.40	12.9	0.02
	Non-surgical	28	7.82	4.42	
Blood loss in operating room (cc)	Surgical	102	1430.39	1416.78	0.000
	Non-surgical	26	0	0	
Whole blood transfusion (cc)	Surgical	103	86.41	458.26	0.35
	Non-surgical	28	5.36	28.34	
Packed red blood cells transfusion in operating room (cc)	Surgical	103	434.99	549.96	0.000
	Non-surgical	26	0	0	
Packed red blood cells transfusion except in operating room (cc)	Surgical	102	133.33	273.34	0.03
	Non-surgical	26	40.38	162.49	
Fresh frozen plasma transfusion in operating room (cc)	Surgical	102	288.24	443.72	0.000
	Non-surgical	26	0	0	
Fresh frozen plasma transfusion except in operating room (cc)	Surgical	103	159.22	436.88	0.01
	Non-surgical	26	30.77	156.89	
Platelet transfusion in operating room (cc)	Surgical	103	14.08	82.37	0.000
	Non-surgical	26	.00	.000	
Platelet transfusion except in operating room (cc)	Surgical	103	8.74	56.63	0.43
	Non-surgical	26	0	0	
Normal saline injection in operating room (cc)	Surgical	103	2107.28	1584.25	0.000
	Non-surgical	26	0	0	
Normal saline injection except in operating room (cc)	Surgical	103	441.75	1015.32	0.002
	Non-surgical	26	76.92	306.34	
Urine output in operating room (cc)	Surgical	103	703.40	607.561	0.000
	Non-surgical	26	0	0	
Ringer's lactate solution injection in	Surgical	103	924.76	972.108	0.000

operating room (cc)	Non-surgical	26	0	0	
Ringer's lactate solution injection except in operating room (cc)	Surgical	103	53.40	312.42	0.387
	Non-surgical	26	0	0	
Ringer's serum injection in operating room (cc)	Surgical	103	1316.5	998.73	0.000
	Non-surgical	26	0	0	
Ringer's serum injection except in operating room (cc)	Surgical	103	33.98	175.205	0.91
	Non-surgical	26	38.46	196.11	
Number of computed tomography scans	Surgical	98	0.67	0.75	0.03
	Non-surgical	28	0.96	0.57	
Number of ultrasounds	Surgical	99	1.23	0.71	0.31
	Non-surgical	26	1.08	0.62	

Table 4. Different side effects based on surgical and non-surgical approaches

Variables	Treatment approach	n	%	Total	
				n	%
Infection and fever	Surgical	15	14.4	17	13.1
	Non-surgical	2	7.7		
Bleeding	Surgical	3	2.9	3	2.3
	Non-surgical	0	0		
No splenic embolization	Surgical	77	74.0	100	76.9
	Non-surgical	23	88.5		
Seizure	Surgical	3	2.9	4	3.1
	Non-surgical	1	3.8		
Perforation	Surgical	2	1.9	2	1.5
	Non-surgical	0	0		
Tachycardia and tachypnea	Surgical	1	1.0	1	0.8
	Non-surgical	0	0		
Bronchiectasis	Surgical	1	1.0	1	0.8
	Non-surgical	0	0		
Infection and bleeding	Surgical	2	1.9	2	1.5
	Non-surgical	0	0		

Table 5. Grades of lesions based on surgical and non-surgical approaches

Treatment approach		Grade			Total
		2	3	4	
Surgical	n	1	6	1	8
	%	12.5	75.0	12.5	100
Non-surgical	n	3	2	0	5
	%	60.0	40.0	0.0	100
Total	n	4	8	1	13
	%	30.8	61.5	7.7	100