

**HEMODYNAMIC STABILITY IS THE MOST IMPORTANT FACTOR IN
NONOPERATIVE MANAGEMENT OF BLUNT SPLENIC TRAUMA****HEMODİNAMİK STABİLİTE KÜNT DALAK TRAVMASININ NONOPERATİF
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SUMMARY: Since January 1998, non-operative management of blunt splenic trauma has become the preferred method for the selected paediatric and adult patients in our clinic. Of the 26 patients who were admitted to our clinic because of blunt splenic trauma between January 1998 and May 2000, 20 were elected for non-operative management according to our protocol which was primarily based on hemodynamic status regardless of the age and grading of the injury. Diagnostic computed tomography (CT) was obtained in the patients with non-operative management. Non-operative management rate was 76.9% for patients with blunt splenic trauma (83.3% and 71.4% for the paediatric and adult patients, respectively). All of these cases were managed conservatively without any complication and no mortality was observed. Six patients required emergent surgical exploration based on preoperative evaluation. In all of these 6 cases, associated injuries were present. No significant differences were found with regard to the age of operative and non-operative management groups ($p=0.421$). The mean operative splenic injury grade was 3 in the patients who underwent surgery, and the mean injury grade based on CT scan was 2.6 in the patients who were managed conservatively ($p=0.572$). The mean duration of hospitalisation in the patients with operative and non-operative management groups were 7.6 and 8.6 days, respectively ($p=0.572$). The mean unit of blood transfusion in the patients with operative and non-operative management groups were 1.1 and 0.6, respectively ($p=0.453$). Our data revealed that hemodynamic stability is the most important factor which could effect the selection of patients for non-operative management outcome regardless of the patient age and computed tomography scan grading of the injury.

Key words: Splenic trauma, nonoperative management.

ÖZET: Ocak 1998'den itibaren kliniğimizde, künt dalak yaralanmalı seçilmiş çocuk ve erişkin olgularda non-operatif tedavi yöntemini tercih ediyoruz. Ocak 1998-Mayıs 2000 tarihleri arasında künt dalak yaralanması nedeniyle kliniğimize başvuran 26 olgudan 20'sine, yaralanma derecesi ve yaş sınırlaması dikkate alınmaksızın hemodinamik stabiliteyi esas alan non-operatif tedavi protokolümüzü uyguladık. Non-operatif tedavi uygulanan hastalara tamsal amaçlı bilgisayarlı tomografi (BT) çekildi. Künt dalak yaralanması olan hastalarımızdaki non-operatif tedavi oranı %76.9' dur (çocuk hastalarda; %83.3, erişkin hastalarda: %71.4). Non-operatif tedavi uygulanan olgularımızda komplikasyon ve mortalite gözlenmedi. Preoperatif değerlendirme sonucu acil cerrahi girişim uygulanan 6 hastada yandaş yaralanmalar mevcuttu. Operatif ve non-operatif tedavi uygulanan gruplar arasında yaş açısından anlamlı bir fark bulunmadı ($p=0.421$). Ameliyat edilen hastalardaki ortalama operatif dalak yaralanma derecesi 3 iken, non-operatif tedavi uygulanan hastalardaki BT ile değerlendirilen ortalama dalak yaralanma derecesi 2.6 idi ($p=0.572$). Hastanede kalış süresi operatif grupta 7.6, non-operatif grupta 8.6 gün idi ($p=0.572$). Operatif tedavi uygulanan hastalardaki ortalama kan transfüzyonu 1.1 ünite iken, non-operatif tedavi uygulanan hastalarda 0.6 ünite idi ($p=0.453$). Sonuçlarımıza göre, yaralanmanın bilgisayarlı tomografi ile derecelendirilmesi ve yaş sınırlaması dikkate alınmaksızın, non-operatif tedavi uygulanacak hastaların seçiminde hemodinamik stabilite esastır.

Anahtar kelimeler: Dalak travması, non-operatif tedavi.

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INTRODUCTION

Attempts for splenic salvage following splenic injury have increased due to a better understanding of the function and structure of the spleen and its important role in the immunological events of the human body as well. Nevertheless, splenectomy still remains the most commonly performed operation if surgical treatment for splenic injury is indicated, while splenorrhaphy and segmental resection are used less frequently (1). Since the early 1970's, successful non-operative management

of blunt splenic trauma in children has been practised; thereafter this approach has also been used in an increasing and safe manner for adult patients (2-7). Although the non-operative management of blunt splenic trauma has been increasingly preferred method of treatment, protocols are still controversial. We evaluated the results of our non-operative management protocol for conservative management of blunt splenic trauma in 20 consecutive patients.

METHODS

Between January 1998 and May 2000, 26 patients with blunt splenic injury were admitted to our clinic. Six of these patients underwent immediate surgical exploration due to either presence of concomitant cerebral injury precluding abdominal assessment (n=3) or hemodynamic instability despite appropriate resuscitation (n=3). Prior to surgical exploration, we performed diagnostic peritoneal lavage (DPL) in these 6 cases whom DPL was positive. The remaining 20 cases who were hemodynamically stable on hospital admission or could be stabilised with resuscitation were elected for non-operative management according to our protocol.

The non-operative treatment protocol included hemodynamic stability on hospital admission or after initial resuscitation, a diagnostic CT scan, absence of injury precluding abdominal assessment, absence of concomitant abdominal injury requiring exploration, close serial evaluation by the surgical team, initial intensive care monitoring, strict bed rest, and serial hematocrit (Hct) measurements. The patients were followed in the surgical intensive care unit by hemodynamic monitoring (blood pressure (BP), pulse rate (PR) and urine output every hour, central venous pressure when necessary), and serial Hct measurements every 4 hours during the first 24 or 48 hours according to CT grading of splenic injury. And then, patients were transported to service room, and during the following 48 hours BP and PR were evaluated for every 4 hours and Hct was measured for every 12 hours. Until discharge from the hospital, the patients were followed for a period of 7 to 10 days with the evaluation of BP and PR for every 6-8 hours and evaluation of Hct for every 24 hours. The period of strict bed rest was completed between 7 and 10 days and gradually reduced and, finally ended between the sixth and the eighth week. Acute changes or instability of the hemodynamic parameters or need for excessive blood transfusion were accepted as criteria for surgical exploration. The same protocol was applied for both paediatric and adult patients.

CT was obtained in all the patients who were mana-

ged non-operatively on hospital admission. With the exception of the patients with grade IV splenic injury, the following of splenic injuries were done with CT in the first 14 patients, but later, only ultrasound was used for follow up on patient discharge and at the end of first and third months.

Splenic injuries were graded by CT or operative findings according to the classification of the American Association for the Surgery of Trauma (table 1). The overall clinical status of each patient was evaluated by the Abbreviated Injury Scale categorisation. Trauma was scored by Paediatric Trauma Score (PTS) for paediatric patients and by Injury Severity Score (ISS) for adults.

Statistical analysis was performed with non-parametric Mann-Whitney and Fisher's exact test using GraphPad InStat tm, copyright 1990-1993 GraphPad Software V2.02. P values of <0.05 were considered statistically significant.

Table 1: Spleen injury scale.

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

*Advances one grade for multiple injuries, up to grade III.

RESULTS

Of the 26 patients, 12 (46.1%) were children, and 14 (53.9%) were adults. Demographic data of the patients are shown in table 2. No significant differences were found with regard to the age of operative and non-operative management groups (p=0.421). Non-operative mana-

gement rates were 83.3% and 71.4% for the paediatric and adult patients, respectively.

Table 2: Demographic characteristics of the patients.

	Children(n=12)		Adults(n=14)		Total(n=26)	
	OP	NOM	OP	NOM	OP	NOM
Mean Age±SD	7±1.4	6.7±3.4	35±19.6	36.4±17.1	25.6±20.9	21.5±19.4
(Range)	(6-8)	(4-14)	(18-52)	(18-75)	(6-52)	(4-75)
Sex (M/F)	2/0	7/3	2/2	6/4	4/2	13/7

OP:Operative management, NOM:Nonoperative Management.

The mean value of ISS for the adult group was 31.2±9.5 in the patients who underwent surgery, and 17.7±6.8 in the patients who were managed conservatively, and the difference was statistically significant (p=0.036). The detailed characteristics of the patients are shown in table 3.

Table 3: Comparative data of the patients in operative and non-operative management groups.

	Children(n=12)		Adults (n=14)		P Value#	Total (n=26)		P Value#
	OP	NOM	OP	NOM		OP	NOM	
Mean								
PTS/ISS±SD*	8±1.4	9.7±1	31.2±9.5	17.7±6.8	p=0.036	-	-	-
Mean Op./CT								
Grade±SD*	2.5	2.2±1	3.2±1.7	3±1.1	p=0.733	3±1.4	2.6±1.1	p=0.572
Mean Hospital Stay±SD (Day)	**	7.1±1.7	9.7±3.3	10.2±3	p=0.945	7.6±4.4	8.6±2.8	p=0.572
Mean Transfusion±SD (Unit)	-	0.2±0.3	1.5±0.5	1.1±1.1	p=0.453	1.1±0.7	0.6±0.9	p=0.122

OP: operative management, NOM: non-operative management; PTS: paediatric trauma score; ISS: injury severity score, Op.,Operative.

Due to the small number of paediatric patients, statistical analysis was performed in adults and total patients.

* Trauma was scored by PTS for children and by ISS for adults. = Splenic injuries were graded by CT in patients with NOM and by operative findings in patients with OP. **One patient died at the postoperative 2nd hours.

Four adult patients (28.6%) required emergent surgical exploration based on preoperative evaluation. Mean operative splenic injury grade was 3.2±1.7. Three of these patients underwent splenectomy, while non-therapeutic laparotomy was performed in the other one (table 4). This patient had additional cranial trauma and pelvic fracture. He was unconscious at hospital admission. Since DPL was positive, abdominal exploration was done. However, a retroperitoneal hematoma with grade I splenic injury was identified. In all of these 4 cases, associated injuries were present (table 5).

Ten (71.4%) patients in the adult group were managed non-operatively. The mean injury grade based on CT scan was 3±1.1. Additionally, in 9 patients (90%) associated injuries were present (table 5). All of these cases were managed conservatively without any complication.

Table 4: Treatment methods and outcomes in patients.

	Children		Adults		Total	
	No	%	No	%	No	%
Patients in 1998-2000(n=26)						
NOM	10	83.3	10	71.4	20	76.9
NOM Success	10/10	100	10/10	100	20/20	100
OP	2	16.7	4	28.6	6	23.1
Splenectomy	0	3	21.4	3	11.5	
Splenorrhaphy	2	16.7	0	0	2	7.8
Nontherapeutic laparotomy	0	0	1	7.1	1	3.8
Operative Death	1/2	50	0	0	1/6	16.6
Patients in 1994-1997(n=41)						
NOM	2	11.1	3	13	5	12.2
NOM Success	2/2	100	3/3	100	5/5	100
OP	16	88.9	20	87	36	87.8
Splenectomy	11	61.2	13	56.5	24	58.5
Splenorrhaphy	3	16.7	4	17.5	7	17.1
Segmental resection	1	5.5	2	8.7	3	7.3
Nontherapeutic laparotomy	1	5.5	1	4.3	2	4.9
Operative Death	2/16	12.5	3/20	15	5/36	13.8

NOM: non-operative management OP: operative management.

Table 5: Associated Injuries in patients.

Associated Injuries	Children		Adults		Total	
	OP (n=2)	NOM (n=10)	OP (n=4)	NO (n=10)	OP (n=6)	NO (n=20)
Chest*	-	3	2	5	2	8
Cranial/Cerebral	1	2	2	-	3	2
Pelvic Fractures-	1	1	1	1	2	
Extremities						
Fractures	1	1	2	2	3	3
Face	-	-	1	1	1	1
Liver	-	3	-	1	-	4
Kidney	-	-	-	3	-	3

* Including rib fractures, hemo-pneumothorax and parenchymal injury.

No mortality was observed in adult groups. The mean duration of hospitalisation in the adult patients with operative and non-operative management groups were 9.7±3.3, and 10.2±3 days, respectively (p=0.945). The mean unit of blood transfusion in the adult patients with operative and non-operative management groups were 1.5±0.5 and 1.1±1.1 (p=0.453).

In the paediatric group, two patients underwent emergency exploration and splenorrhaphy (table 4). One of them had associated cranial trauma and unconsciousness. Additionally, his DPL was found to be positive. During the exploration, grade II splenic injury was

identified. Nonetheless, he died of associated cranial trauma. The other patient underwent surgical exploration due to hemodynamic instability and he had grade III splenic injury concomitant with extremities fracture. The characteristics of the remaining 10 children (83.3%) managed non-operatively were shown in table 3.

Retrospective analysis of the management of the patients with blunt splenic trauma in our clinic, prior to introduction of this protocol, between 1994 and 1997 was shown in table 6. The results indicate remarkable decrease of the surgery rate after the introduction of the protocol (p=0.0001 for children, p=0.0008 for adult, p<0.0001 for all patients). No significant difference was not found in patients between 1994-1997 and 1998-2000 according to age (p=0.846), sex (p=0.412), PTS/ISS (p=0.798/p=0.826), splenic injury grading (p=0.157), hospital stay (p=0.861), and blood transfusion (p=0.281).

Table 6: Data of the patients with blunt splenic injury between 1994-1997.

	Children (n=18)		Adults (n=23)		Total (n=41)	
	OP	NO	OP	ON	OP	NOM
No (%)	16 (88.9)	2 (11.1)	20 (87)	3 (13)	36 (88.7.8)	5 (12.2)
Mean Age±SD (Range)	5.6±3.2 (1-14)	14±1.4 (13-15)	31.6±14 (17-61)	34.6±10.2 (26-46)	20±16.8 (1-61)	26.4±13.4 (13-46)
Sex (M/F)	11/5	2/-	16/4	2/1	27/9	4/1
Mean PTS/ISS±SD*	8.9±2.2	11	24.1±15	17.6±5.8	-	-
Mean Op./CT Grade±SD*	3.4±0.8	2±1.4	3.2±0.9	2.6±0.5	3.3±0.8	2.4±0.8
Mean Hospital Stay±SD (Day)	7±2.2	9	9.3±6.9	17±9.8	8.3±5.4	13.8±8.2
Mean Transfusion±SD (Unit)	1.06±1.3	-	1.3±1.4	1.6±1.5	1.2±1.3	1±1.4
NOM Success		2/2		3/3		5/5

OP: operative management, NOM: non-operative management; PTS: paediatric trauma score; ISS: injury severity score.
 * Trauma was scored by PTS for children and by ISS for adults. = Splenic injuries were graded by CT in patients with NOM and by operative findings in patients with OP.

DISCUSSION

Splenectomy may lead to sepsis particularly due to encapsulated micro-organisms as previously reported in both children and adults (8- 11). Therefore, splenic salvage procedures like splenorrhaphy, segmental resection, and autotrasplantation have gained more popularity (12, 13). Non-operative management is currently the most common salvage procedure for the blunt splenic injuries. Since 1998, we have applied non-operative management protocol primarily based on hemodynamic stability for blunt splenic injuries and the results of our first 26 consecutive patients were assessed in this study. Introduction of our protocol resulted in a remar-

kable decrease in operation rate of both adults and children when compared to the previous patients of the same institution. However, the types of surgery were similar to the groups treated between 1994 and 1997, this confirms the results of Thomas et al.(1) who reported splenectomy is the most frequently performed surgery for blunt splenic trauma. High splenectomy rate was attributed to easiness of the operation, rapid control of bleeding, surgeon familiarity, no need for full postoperative monitorization, and early recovery.

Expectedly, both adults and children operated on for blunt splenic trauma had higher ISS or PTS scores and DPL positiveness as well. However, it should be emphasised that positive DPL does not necessarily mean surgical exploration in every patient. Our series had two patients with positive DPL, but they had uneventful convalescence with non-operative treatment.

Adult patients over 50-55 years have been reported to be more prone to management failure (2, 5) and higher complication rates(14). Contrary, Wasvary et al.(6) reported that there was no significant difference between operative and non-operative groups in terms of both mean age and failure rate. We used to prefer surgery in the patients over 50 years of age before January 1998, however, non-operative management protocol showed that age does not effect the outcome in our 2 patients over 50. Although, these findings in our very limited number of patients encourage us to include the patients over 50, it should be considered that age-related diseases or debility may effect the outcome in elderly patients who tend to do so.

The success of CT for reliable grading of splenic trauma has been widely reported (15-18). However, Becker et al.(19) reported over or underestimation with CT in comparison with the operative grades. Among the 14 patients evaluated, CT and operative grading were identical only in four. Therefore, they suggested that patient selection should not be solely based on CT grading, clinical findings should also be taken into consideration. We did not consider high CT grade as an absolute indication for operation in the absence of supporting clinical evidence (table 7).

The first 14 patients in the non-operative management group had follow-up CT's, whereas there was no any change which could effect the management (figure 1). This is in accordance with the reports of Lawson et al.(20) and Thaemert et al.(21) who found routine follow-up of blunt splenic trauma by CT scan had no value. Likewise, we do not recommend routine follow-up CT in hemodynamically stabile patients.

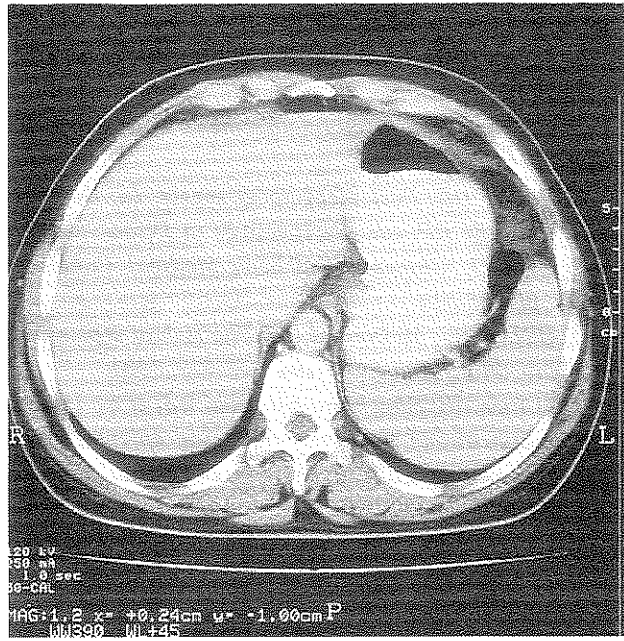
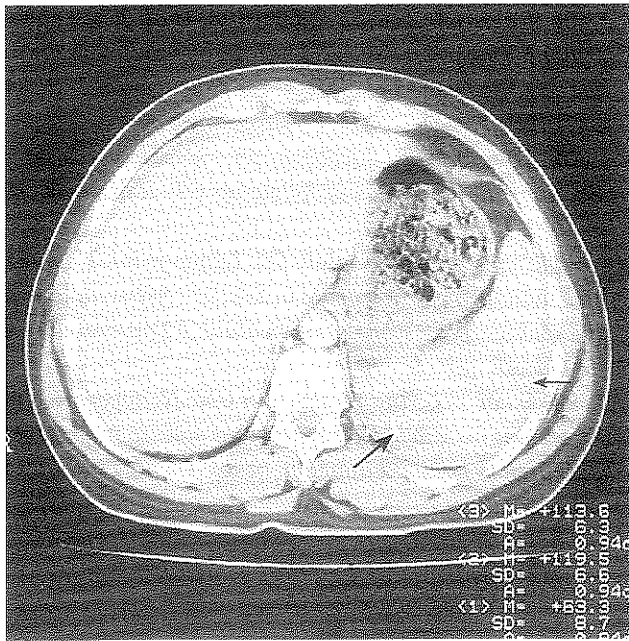
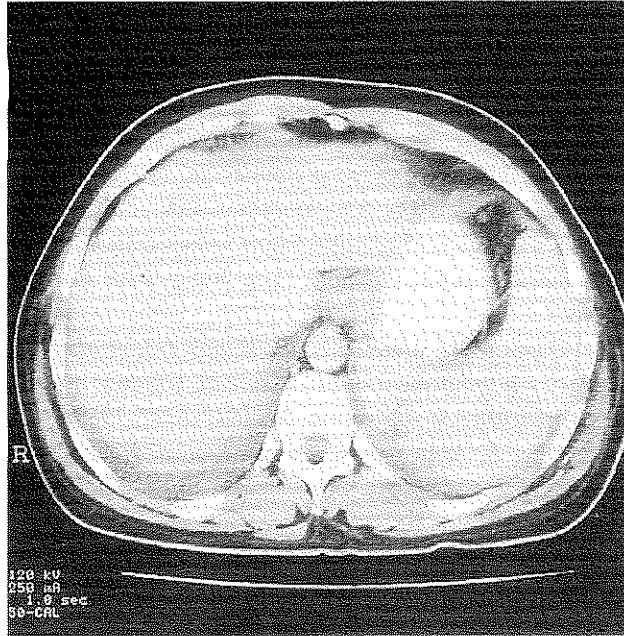
Table 7: Operative and CT grading in patients.

	Children(n=12)		Adults(n=14)		Total(n=26)	
	OP	NOM	OP	NOM	OP	NOM
Grade I	-	3	1	1	1	4
Grade II	1	3	-	3	1	6
Grade III	1	3	1	1	2	4
Grade IV	-	1	1	5	1	6
Grade V	-	-	1	-	1	-

OP: operative management, NOM: non-operative management;
 *Splenic injuries were graded by CT in patients with NOM and by operative findings in patients with OP.

Most reports suggest operative management for splenic injury over than grade III (3,5) as we used to do between 1994 and 1997. Our recent data showed that non-operative management can be successful even in grade 4 splenic injuries. These findings confirm the reports which found non-operative management is safe in grade 4 splenic injuries (6, 22).

Figure 1: CT scan views in a patient with non-operative management for grade IV spleen injury. (a- on admission (small arrow indicates laceration; big arrow indicates hematoma), b-ten days later, c-six weeks later)



In conclusion; hemodynamic stability is the key factor for non-operative management. CT grading is also helpful but not decisive alone, age of the patient should be considered individually. Utilisation of this protocol reduce the numbers of operations, thereby splenectomies in blunt splenic trauma.

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