ORIGINAL ARTICLE

Clinical outcomes of splenic arterial embolization for blunt splenic injury in pediatric and adolescent patients

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ABSTRACT

BACKGROUND: Splenic arterial embolization (SAE) is an effective intervention for the management of arterial hemorrhage associated with blunt splenic injury. However, its role and clinical outcomes in pediatric and adolescent patients are unclear. The aim of this study is to assess the role and the clinical outcomes of SAE for blunt splenic injuries in pediatric and adolescent trauma patients.

METHODS: A retrospective cohort study was performed in patients aged ≤17 years with blunt splenic injury transferred to a regional trauma center in a tertiary referral hospital between November 01, 2015, and September 30, 2020. The final study population consisted of 40 pediatric and adolescent patients with blunt splenic injuries. The patient demographics, mechanisms of injury, details of injuries, angiographic findings, embolization techniques, and technical and clinical outcomes, including spleen salvage rates and procedure-related complications, were examined.

RESULTS: Of the 40 pediatric and adolescent patients with blunt splenic injury, 17 underwent SAE (42.53%). The clinical success rate was 88.2% (15/17). No cases of embolization-related complications or clinical failure were observed. Spleen salvage after SAE was achieved in all patients. In addition, no statistically significant differences were observed in clinical outcomes (clinical success and spleen salvage rates) between low-grade (World Society of Emergency Surgery [WSES] spleen trauma classification I or II) and high-grade (WSES classification III or IV) splenic injury groups.

CONCLUSION: SAE is a safe and feasible procedure, and is effective for successful spleen salvage of blunt splenic injuries in pediatric and adolescent patients.

Keywords: Adolescent; multiple trauma; pediatric; spleen; therapeutic embolization.

INTRODUCTION

Significant developments have emerged in the management of blunt trauma to the spleen over the past several decades. Sacrifice of the spleen was once common, but improved knowledge about the risk of developing an overwhelming post-splenectomy infection, especially in the pediatric population, has led to more emphasis on attempting splenic salvage.[1-3] Because the spleen in pediatric patients generally has a thicker capsule and firmer parenchyma than in adults, non-operative management (NOM) has generally been employed in hemodynamically stable children and adolescents with operative splenic salvage being widely employed in cases of pediatric trauma.

Splenic artery embolization (SAE) is a useful adjunct in the NOM of blunt splenic injury in hemodynamically stable patients. Its primary objective is to control bleeding and preserve the function of the spleen by avoiding splenectomy. SAE in adults has been used as an adjuvant to NOM, allowing

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for control of ongoing hemorrhage and organ preservation.[4,5] However, only a few reports have been published on the application of this technique in the control of ongoing hemorrhage due to splenic injuries in pediatric and adolescent patients.[6-10]

Here, we reviewed data from a 5-year period from a single institution with blunt splenic injuries in pediatric and adolescent patients. The present study was performed to assess the role and the clinical outcomes of SAE for blunt splenic injuries in pediatric and adolescent trauma patients.

MATERIALS AND METHODS

Study Setting

A retrospective cohort study was performed in a regional trauma center between November 1, 2015, and September 30, 2020. Patients were identified using the hospital inpatient inquiry system. We retrospectively reviewed data from the medical records and included a total of 10,881 patients with traumatic injuries who were admitted to our trauma center. This study was approved by the Institutional Review Board of Busan National University Hospital (No. H-2010-015-096). Signed informed consent from the patients was not required.

All patients with blunt splenic injuries were included in the study. Exclusion criteria were ≥18 years old, discharge/transfer from the emergency room, unclear medical records, or patients without splenic injury. The final study population consisted of 40 pediatric and adolescent patients with splenic injuries (Fig. 1). In total, 34 patients underwent NOM and 6 underwent operative management (OM). Of the 34 patients with NOM, 17 underwent angiography/embolization and 17 underwent only conservative management without any additional procedures. The patient demographics, mechanisms of injury, and details of injuries were recorded. Available data included age, sex, mechanisms of injury, vital signs on arrival, packed red blood cell (pRBC), transfusion, Injury Severity Score (ISS), clinical features of splenic injury, methods of management, Abbreviated Injury Scale (AIS) score for splenic injury, World Society of Emergency Surgery (WSES) spleen trauma classification (Table 1), length of hospital stay, intensive care unit (ICU) length of stay (LOS), and survival status. All abdominal computed tomography (CT) scans were reviewed by the interventional radiologist, the emergency physician, and the trauma surgeon to determine the American Association for the Surgery of Trauma (AAST) Organ Injury Scale (OIS) grade of blunt spleen injury.[11] Patients were also stratified according to the 2017 WSES classification (Table 1).

Interventional Procedures

Indications for SAE were (1) contrast media extravasation or expanding perisplenic hematoma in contrast-enhanced abdominal CT or (2) persistent hemodynamic instability associated with splenic injury without another significant source of bleeding. Contraindications for SAE included patients who did not respond to the initial fluid resuscitation and had signs of persistent inadequate tissue perfusion and oxygenation. Patients with blunt splenic injuries requiring emergency treatment were treated according to the spleen injury management algorithm (Fig. 2).

All procedures were conducted by one of three interventional radiologists with 21, 7, and 5 years of experience, respectively.

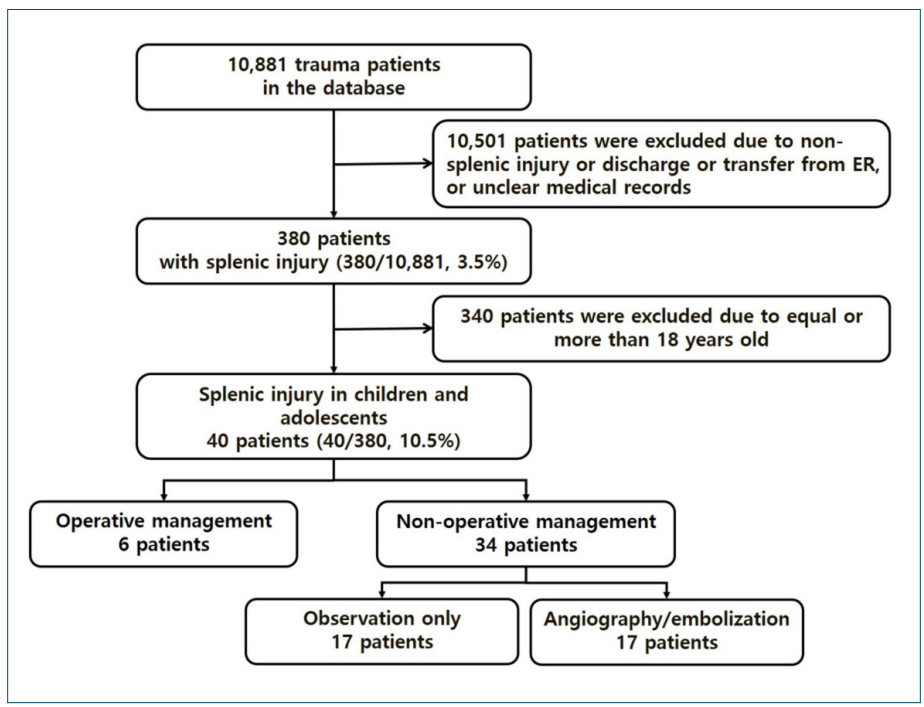

Figure 1. Study flowchart.

Table 1. World Society of Emergency Surgery spleen trauma classification for pediatric patients

	WSES class	AAST	Hemodynamic status	First-line treatment in children
Minor	WSES I	I-II	Stable	NOM + consider angio
Moderate	WSES II	III	Stable	NOM + consider angio
-				
WSES III	IV-V	Stable	NOM + consider angio	
Severe	WSES IV	I-V	Unstablea	OM

aHI was defined as SBP <70 mmHg plus twice the patientency Surgery s; WSES: World Society of Emergency Surgery; AAST: American Association for the Surgery of Trauma; Angio: Angiography/angioembolization; OM: Operative management; HI: Hemodynamic instability; SBP: Systolic blood pressure; NOM: Non-OM.

All patients underwent transfemoral transarterial catheterization with a 4-Fr or 5-Fr sheath (Radifocus Introducer II; Terumo Medical Corporation, Tokyo, Japan). Selective cannulation of the celiac trunk and splenic artery was performed to identify the bleeding sites on a uniplanar angiography suite (Infinix-i; Canon Medical Systems, Tochigi, Japan) using a 4-Fr (Terumo Medical Corporation) or 5-Fr Cobra (Cook Medical Technologies, Bloomington, IN) catheter at a flow rate of 1–4 mL/s during injection for 5 s and a rate of 3 frames per second at the anteroposterior position. Microcatheters with a 2.0-Fr (Progreat; Terumo Medical Corporation) or 1.7-Fr (Veloute; Asahi Intecc, Aichi, Japan) or 1.68-Fr (Radio Star; TaeWoong Medical Co., Gimpo, Korea) tip were also inserted. The following indicators of ongoing bleeding were identified: petechial hemorrhage, pseudoaneurysm, contrast extravasation, and cutoff sign. All bleeding splenic arterial branches were superselectively embolized. The choice of n-butyl-2-cyanoacrylate (NBCA) (Histoacryl; B. Braun, Melsungen, Germany), fiber-coated microcoils (Tornado; Cook Medical Technologies), detachable microcoils (Concerto; Medtronic, Minneapolis, Minnesota; or Interlock; Boston Scientific, Natick, Massachusetts), and/or gelatin sponge particles (Cutanplast; Mascia Brunelli, Viale Monza, Italy; or EG-gel; Engain, Seongnam, Korea) was not regimented but was randomly determined at the attending interventional radiologist's discretion. Completion of splenic arteriography was performed in all patients after embolization to ensure the cessation of hemorrhage and total occlusion of the target arteries.[12]

Definitions and Outcome Measures

Patients <18 years were defined as pediatric and adolescent patients. The shock index was defined as heart rate (beats/min)/systolic blood pressure (SBP; mmHg). Hemodynamic instability [HI] was defined as SBP <70 mmHg plus twice the patient's age in years.[13] Clinical success after SAE was defined as successful NOM with SAE without splenectomy and rebleeding. Follow-up CT was performed at 3, 7, and 30 days after SAE. Two authors retrospectively reviewed the follow-up CT scans to evaluate the scope for splenic salvage, defined as the presence of viable splenic parenchyma on follow-up CT.

The primary objectives were the assessment of the role and clinical outcomes of SAE for blunt splenic injuries in pediatric

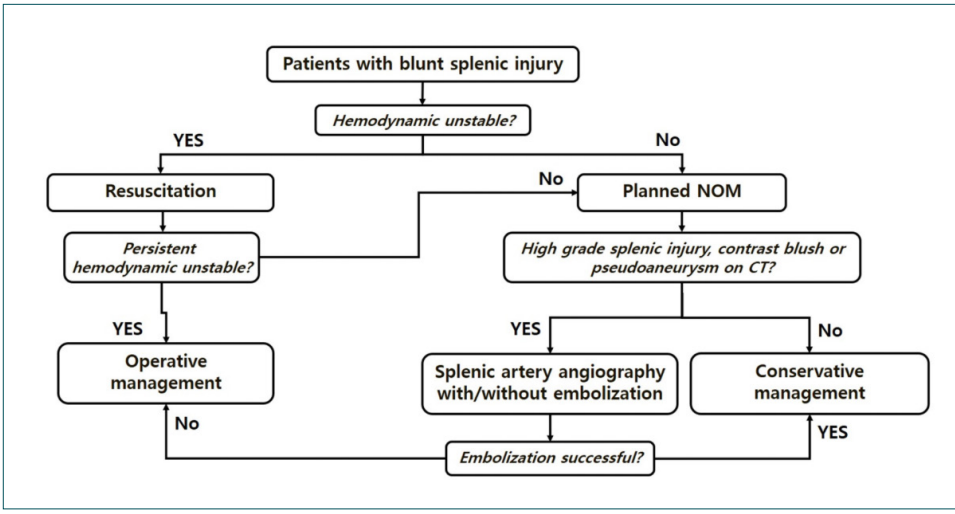

Figure 2. Treatment algorithm for patients with blunt splenic injury. Contrast blush and pseudoaneurysm imply splenic arterial injury. NOM: Non-operative management.

Table 2. Demographics and clinical features of patients (n=40)

Characteristics	NOM (n=34), n (%)	OM (n=6), n (%)	p
Age (years), median (IQR)	11 (7–15)	17 (16–17)	0.031
Male	22 (64.7)	3 (50.0)	0.654
Origin of admission			
Scene	8 (23.5)	1 (16.7)	1.000
Transfer	26 (76.5)	5 (83.3)	
Cause of injury			
Traffic accident	12 (35.3)	5 (83.3)	0.231
Fall	10 (29.4)	1 (16.7)	
Entrapment	9 (26.5)	0	
Other	3 (8.8)	0	
Physiology at admission			
SBP (mmHg), median (IQR)	110 (97–120)	95 (70–100)	0.044
Heart rate (beats/min), median (IQR)	110 (85–135)	126 (124–150)	0.069
Shock index, median (IQR)	0.99 (0.74–1.31)	1.75 (1.26–2.14)	0.009
HIa	6 (17.6)	5 (83.3)	0.004
ISS, median (IQR)	14 (9–22)	27 (21–41)	0.011
GCS, median (IQR)	15 (15–15)	15 (3–15)	0.411
RTS, median (IQR)	7.84 (7.55–7.84)	7.84 (7.55–7.84)	0.929
Initial laboratory findings			
Hemoglobin (g/dL), median (IQR)	11.9 (11.2–13.3)	11.2 (10.0–12.5)	0.255
Lactic acid (mmol/L), median (IQR)	1.7 (0.9–2.9)	4.3 (2.7–5.9)	0.024
Base excess (mmol/L), median (IQR)	−0.5 (−3.1–1.9)	−7.4 (−10.3–−1.2)	0.038
Spleen AIS			0.722
2	15 (44.1)	2 (33.3)	
3	13 (38.2)	2 (33.3)	
4	6 (17.7)	2 (33.3)	
WSES classification			0.005
I	12 (35.3)	0	
II	10 (29.4)	0	
III	6 (17.6)	1 (16.7)	
IV	6 (17.6)	5 (83.3)	
Outcome			
pRBC transfusion (units), median (IQR)	0 (0–2)	7 (2–11)	0.011
Hospital stay (days), median (IQR)	9 (7–13)	21 (17–24)	0.020
ICU LOS (days), median (IQR)	1 (1–2)	6 (5–10)	0.009
Mortality	0	1 (6.0)	0.150

aHI was defined as SBP <70 mmHg plus twice the patientts age in years. OM: Operative management, NOM: Non-OM, IQR: Interquartile range, SBP: Systolic blood pressure, ISS: Injury severity score, GCS: Glasgow Coma Scale, RTS: Revised trauma score, AIS: Abbreviated Injury Scale, WSES: World Society of Emergency Surgery, pRBC: Packed red blood cell, ICU: Intensive care unit, LOS: Length of stay, HI: Hemodynamic instability.

and adolescent patients. The secondary objective was the assessment of relevant clinical findings of pediatric and adolescent patients undergoing OM and NOM for blunt splenic injuries.

Statistical Analysis

Several subgroup analyses were also performed to evaluate the heterogeneity of the treatment effect of SAE. One of the subgroups selected included patients with high-grade splenic

Table 3. Clinical findings of patients undergoing transarterial splenic embolization and conservative management (n=34)

Characteristics	Conservative (n=17), n (%)	SAE (n=17), n (%)	p
Age (years), median (IQR)	8 (5–16)	12 (7–14)	0.835
Male	12 (70.6)	10 (58.8)	0.721
Physiology at admission			
SBP (mmHg), median (IQR)	110 (90–120)	110 (100–120)	0.600
Heart rate, beats/min, median (IQR)	118 (84–140)	106 (90–119)	0.428
Shock index, median (IQR)	1.05 (0.76–1.32)	0.96 (0.73–1.19)	0.642
HIa	4 (23.5)	2 (11.8)	0.656
ISS, median (IQR)	9 (8–17)	16 (9–24)	0.274
GCS, median (IQR)	15 (14–15)	15 (15–15)	0.487
RTS, median (IQR)	7.84 (6.61–7.84)	7.84 (7.84–7.84)	0.237
Initial laboratory findings			
Hemoglobin (g/dL), median (IQR)	12.0 (11.3–13.3)	11.8 (11.0–13.1)	0.756
Lactic acid (mmol/L), median (IQR)	0.9 (0.8–4.7)	1.9 (1.1–2.9)	0.482
Base excess (mmol/L), median (IQR)	−2.2 (−7.9–1.6)	0 (2 (−–2.4)	0.132
Spleen AIS			0.010
2	12 (76.6)	3 (17.6)	
3	4 (23.5)	9 (52.9)	
4	1 (5.9)	5 (29.4)	
WSES classification			0.006
I	10 (58.8)	2 (11.8)	
II	2 (11.8)	8 (47.1)	
III	1 (5.9)	5 (29.4)	
IV	4 (23.5)	2 (11.8)	
Outcome			
pRBC transfusion (units), median (IQR)	0 (0–1)	0 (0–2)	0.594
Hospital stay (days) median (IQR)	8 (6–15)	9 (8–12)	0.457
ICU LOS (days), median (IQR)	1 (0–2)	2 (1–2)	0.560

aHI was defined as SBP<70 mmHg plus twice the patientansarterial sple SAE: Splenic artery embolization, IQR: Interquartile range, SBP: Systolic blood pressure, ISS: Injury Severity Score, GCS: Glasgow Coma Scale, RTS: Revised trauma score, AIS: Abbreviated Injury Scale; WSES: World Society of Emergency Surgery, pRBC: Packed red blood cell, ICU: Intensive care unit, LOS: Length of stay, HI: Hemodynamic instability.

injury, defined as WSES classification ≥3. Low-grade splenic injury was defined as WSES classification <3. Primary and secondary outcomes were compared between the low-grade and high-grade injury groups.

Summary statistics are reported as the median and interquartile range (IQR) as appropriate. Categorical variables are expressed as numbers and percentages. Fisher's exact test was used to compare the frequencies of categorical variables between groups. Stata (Version 14.2; Stata Corp., College Station, TX) was used for data analysis. In all analyses, P<0.05 was taken to indicate statistical significance.

RESULTS

Patient Characteristics and Clinical Features

The overall incidence of splenic injuries was 3.5% (380/10,881) (Fig. 1). Splenic injuries in children and adolescents accounted for 10.5% of all splenic injuries (40/380). The median age of the pediatric patients was 12 years (IQR, 7–16) and 62.5% were male. Traffic accidents were the most common cause of injury (42.5%). The median SBP upon arrival was 104 mmHg (IQR, 92–120) and 27.5% of patients had HI. The median ISS was 16 (IQR 9–25) and splenic injuries with AIS ≥3 were observed in 23 of 40 patients (57.5%). In addition, 22 patients were classified as WSES I or II (55.0%), while 18 were classified as WSES III or IV (45.0%).

In total, 34 patients (85.0%) were treated with NOM, while the remainder were treated with OM (n=6, 15.0%). NOM consisted of splenic artery angiography/embolization or conservative management only.

The median length of hospital stay and ICU LOS was 10 (IQR, 7–19) and 2 days (IQR, 1–6), respectively. The mortality rate was 2.5%. Table 2 lists detailed demographic characteristics of pediatric and adolescent patients with blunt splenic injuries.

Relevant Clinical Findings of Patients Undergoing Operative Management with Blunt Splenic Injuries

Table 2 lists the clinical features of patients with NOM and OM. HI was more common in patients with OM than in patients with NOM (83.3% vs. 17.6%, respectively, p=0.004). In comparison to the NOM group, patients treated with OM were older (p=0.031) and had lower SBP upon arrival (p=0.044), higher shock index (p=0.009), higher ISS (p=0.011), higher initial lactic acid level (p=0.024), lower base excess (p=0.038), higher WSES classification (p=0.005), greater pRBC transfusion requirement (p=0.011), longer hospital stay (p=0.020), and longer ICU LOS (p=0.009). However, sex, cause of injury, heart rate upon arrival, Glasgow Coma Scale, Revised Trauma Score, and initial hemoglobin level did not differ significantly between OM and NOM groups. No differences were observed in AAST-OIS spleen injury grade or mortality between the two groups.

Comparison of Clinical Features of Patients Undergoing SAE and Conservative Management Only

Table 3 lists the clinical features of patients undergoing splenic artery angiography/embolization and conservative management only. Comparison of SAE and conservative management groups revealed that patients undergoing angiography had higher AIS for the spleen (p=0.010) and higher WSES classification (p=0.006). However, no definitive associations were observed between NOM modalities and any other clinical findings.

Clinical Outcomes of Patients Undergoing SAE and Spleen Salvage

Table 4 lists the clinical findings of patients undergoing SAE. The clinical success rate was 88.2% (15/17), in which successful hemostasis and symptom improvement were achieved by embolization. Two patients underwent secondary embolization due to rebleeding on follow-up CT at 3, 5, and 8 days after primary embolization. On secondary embolization, one patient developed petechial hemorrhage and was treated with gelatin sponge particles. Another patient had a pseudoaneurysm and was treated with NBCA. These patients had successful hemostasis at the completion of angiography in addition to symptom improvement after secondary embolization.

No cases involved embolization-related complications or clinical failure, defined as post-embolization splenectomy or death due to embolization-related complications. Spleen salvage after SAE was archived in all patients (100%). The rates of clinical success (p=0.790) and spleen salvage (p=1.000) did not differ significantly between patients with low- and high--grade grade splenic injury (Table 4). No statistically significant differences were observed in other clinical outcomes (pRBC transfusion requirement, hospital stay, and ICU LOS) between groups.

DISCUSSION

This was the first study to assess clinical outcomes and the role of SAE for blunt splenic injuries in pediatric and adolescent patients in a large contemporary cohort in South Korea.

Table 4. Clinical findings of patients undergoing splenic artery embolization (n=17)

Characteristics	Low-grade injurya (n=10)	High-grade injuryb (n=7)	p
Age (years), median (IQR)	12 (7y– 14)	10 (6–15)	0.624
Male	6 (60.0)	4 (57.1)	1.000
ISS, median (IQR)	10 (9–13)	19 (16–33)	0.016
Clinical successc	9 (90.0)	6 (85.7)	0.709
Spleen salvage	10 (100)	7 (100)	1.000
Outcome			
pRBC transfusion (units), median (IQR)	1 (0–2)	0 (0–0)	0.090
Hospital stay (days), median (IQR)	9 (7–10)	10 (8–13)	0.403
ICU LOS (days), median (IQR)	1 (0–2)	2 (2–6)	0.057

aHigh-grade splenic injury was defined as WSES classification ≥3; bLow-grade splenic injury was defined as WSES classification <3; cClinical success was defined as successful NOM with splenic artery embolization without splenectomy and rebleeding; WSES: World Society of Emergency Surgery; IQR: Interquartile range; ISS: Injury Severity Score; pRBC: Packed red blood cell; ICU: Intensive care unit; LOS: Length of stay; NOM: Non-operative management.

SAE led to high rates of technical success and efficacy and may be a valuable adjunct in pediatric and adolescent patients with blunt splenic injury, especially in cases of high-grade injury.

In our study, patients with blunt splenic injuries requiring emergency treatment were treated according to the spleen injury management algorithm (Figure 2). Indication for OM was persistent HI in spite of adequate resuscitation. We did not consider the patient's age as an indicative factor for surgical management. Interestingly, in comparison to the NOM group, patients treated with OM were older (11 vs. 17 years; p=0.031) (Table 2).

NOM is considered the standard of care in children with blunt solid organ injury who are in a hemodynamically stable condition, with success rates exceeding 90%.[14] In adults, transarterial splenic embolization is an established minimally invasive approach to achieve rapid hemorrhage control in acute blunt splenic injury.[15-17] However, the evidence in children is sparse and largely confined to small series or case reports. In addition, the role of SAE in pediatric blunt splenic injury is controversial. Some reports have indicated that SAE should be limited to children in whom NOM is failing.[18-20] Swendiman et al.[19] reported no improvement in splenic salvage after angiography for high-grade injuries. In contrast, several studies have demonstrated that SAE for bleeding and organ preservation has important therapeutic roles in the management of splenic injury in pediatric patients.[10,21-23] Skattum et al.[10] reported that 22 of 66 NOM pediatric patients undergoing SAE (33.3%) and 98% successful NOM rates. Mayglothling et al.[21] reported a spleen salvage rate of 87% in the SAE group. In the present study, the rate of effective hemorrhage control by SAE was 88.2% in pediatric and adolescent patients. No cases involved major embolization-related complications or mortality. Spleen salvage after SAE was achieved in all patients. No statistically significant differences were observed in clinical outcomes (clinical success rates and spleen salvage rates) between the low-grade (WSES I or II) and high-grade splenic injury groups (WSES III or IV). These results indicate that SAE was effective in controlling hemorrhage and enabled organ preservation in pediatric and adolescent patients, even those with high-grade blunt splenic injury.

The present study differs from previous studies suggesting that SAE may be useful in pediatric and adolescent patients in two main ways. First, our trauma center is equipped with a trauma bay, a 42-bed dedicated trauma ICU, and a trauma angiography suite. Three interventional radiologists and the equipment required for angiography/embolization are available 24 h a day, 7 days a week.[12,24] Therefore, the time from arrival to angiography/embolization can be <2 h. At our center, angiography was performed when the expanding hematoma was visible or if there was high-grade splenic injury. Our interventional radiologists and the equipment required for angioembolization are available, with the attending doctor being responsible for providing the indication for angioembolization (Fig. 2). This is the reason for the reliability of the data presented here. Second, to our knowledge, this is the first study to evaluate the role and clinical outcomes of SAE in pediatric and adolescent patients in South Korea. Our data indicate that SAE was performed with high technical success and efficacy.

However, this study had several limitations. First, it was confined to patients at a single center, and our study population may be specific to a certain region. Our patients also only represented the population presenting to a regional trauma center. As such, the severity and frequency of injuries seen at our institution likely differ significantly from those seen in a community emergency department. Second, because this was a non-randomized and retrospective analysis with a limited number of cases, the results are not conclusive and lack sufficient statistical power to detect significant differences. Additional prospective studies with larger sample sizes are necessary to confirm our findings.

Conclusion

This was a 5-year single-institution cohort study involving pediatric patients with blunt splenic injury. SAE is an effective intervention for treating blunt splenic injury in pediatric and adolescent patients. The procedure is safe and feasible and effective for successful spleen salvage.

Ethics Committee Approval: This study was approved by the Pusan National University Hospital Clinical Research Ethics Committee (Date: 30.06.2022).

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: C.Y.P.; Design: H.K., C.Y.P.; Supervision: C.Y.P.; Materials: H.K.; Data: H.K., C.H.J.; Analysis: H.K., C.H.J.; Literature search: H.K., C.Y.P.; Writing: H.K., C.Y.P.; Critical revision: H.K., C.Y.P., C.H.J.

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ORİJİNAL ÇALIŞMA - *ÖZ*

Çocuk ve ergen hastalarda künt dalak yaralanması için splenik arter embolizasyonunun klinik sonuçları

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AMAÇ: Splenik arteriyel embolizasyon (SAE), künt dalak yaralanması ile ilişkili arteriyel kanamanın yönetimi için etkili bir müdahaledir. Bununla birlikte, çocuk ve ergen hastalardaki rolü ve klinik sonuçları belirsizdir. Bu çalışmanın amacı, çocuk ve ergen hastalarda künt dalak yaralanmalarında SAE'nun rolünü ve klinik sonuçlarını değerlendirmektir.

GEREÇ VE YÖNTEM: 1 Kasım 2015 ile 30 Eylül 2020 tarihleri arasında üçüncü basamak bir referans hastanesindeki bölgesel bir travma merkezine nakledilen künt dalak yaralanması olan ≤17 yaşındaki hastalarda retrospektif bir kohort çalışması gerçekleştirildi. Nihai çalışma popülasyonu, künt dalak yaralanması olan 40 çocuk ve ergen hastadan oluşmaktaydı. Hasta demografik bilgileri, yaralanma mekanizmaları, yaralanmaların ayrıntıları, anjiyografik bulgular, embolizasyon teknikleri ve dalak kurtarılma oranları ve prosedürle ilgili komplikasyonlar dahil olmak üzere teknik ve klinik sonuçlar incelendi.

BULGULAR: Künt dalak yaralanması olan 40 çocuk ve ergen hastanın 17'sine SAE (%42,53) uygulandı. Klinik başarı oranı %88,2 (15/17) idi. Embolizasyonla ilişkili komplikasyon veya klinik başarısızlık vakası gözlenmedi. Tüm hastalarda SAE sonrası dalak kurtarımı sağlandı. Ek olarak, düşük dereceli (Dünya Acil Cerrahi Derneği [WSES] dalak travması sınıflandırması I veya II) ve yüksek dereceli (WSES sınıflandırması III veya IV) dalak yaralanma grupları arasında klinik sonuçlarda (klinik başarı ve dalak kurtarma oranları) istatistiksel olarak anlamlı bir fark gözlenmedi.

TARTIŞMA: Splenik arteriyel embolizasyon (SAE) güvenli ve uygulanabilir bir prosedürdür ve çocuk ve ergen hastalarda künt dalak yaralanmalarının başarılı dalak kurtarılmasında etkilidir.

Anahtar sözcükler: Çocuk; dalak; ergen; multi travma; terapötik embolizasyon.

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