Case Report

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Transcatheter Arterial Embolization for Blunt Hepatic Trauma in a Preschooler

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Published reports regarding the use of transcatheter arterial embolization (TAE) for blunt hepatic trauma in young children, especially preschoolers (3–5 years old), are still scarce. We present a case report of a 4-year-old girl who was involved in a motor vehicle accident while sitting in the passenger seat without wearing a seatbelt. Focused Assessment with Sonography for Trauma and contrast-enhanced computed tomography scan showed severe liver injury with signs of active intraabdominal bleeding. Selective hepatic artery embolization was performed to control arterial hemorrhage. No procedure-related complications occurred, and she was discharged on foot on day 14. TAE is a safe and effective treatment for hemostasis in blunt hepatic trauma, and it should be strongly considered as a treatment option not only in adults but in young children as well.

Keywords: *Non-Operative Management; Blunt Hepatic Trauma; Pediatric Trauma; Transcatheter Arterial Embolization*

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INTRODUCTION

Transcatheter arterial embolization (TAE) is widely used as a safe and effective treatment for hemostasis in blunt hepatic trauma in adults [1]. However, published reports in the pediatric population, especially preschoolers (3–5 years old), are still extremely scarce. We report a case of severe liver injury in a 4-year-old who was successfully treated with TAE.

CASE REPORT

A 4-year-old girl with no history of illness was involved in a motor vehicle accident while sitting in the passenger seat without wearing a seatbelt. Primary survey findings were as follows: airway intact, respiratory rate of 22 breaths/min, SpO_2 of 100% (O_2 10 L/min with reservoir mask), heart rate of 126 b.p.m., blood pressure of 143/72 mmHg, no active bleeding on the body surface, Glasgow Coma Scale score 15 (E4V5M6), pupils equal and reactive at 4 mm, no hemiplegia. Focused Assessment with Sonography for Trauma (FAST) was positive with echo free space in Morrison's pouch and in the pouch of Douglas; chest X-ray and pelvic X-ray showed no abnormalities. Contrast-enhanced computed tomography scan (CE-CT) showed severe liver injury (American Association for the Surgery of Trauma (AAST) grade IV) with disruption of the liver capsule, extensive hemoperitoneum and contrast extravasation (Figure 1). Laboratory data showed elevated liver enzymes: asparate aminotransferase (AST) 484 U/L, alanine aminotransaminase (ALT) 288 U/L, total bilirubin 0.37 mg/dL, and lactate dehydrogenase (LDH) 956 U/L.

Besides being slightly tachycardic for her age, considering the fact that she was excited and crying throughout the physical examination, there were no specific vital sign abnormalities or physical findings suggesting that she was hemodynamically unstable due to hemorrhagic shock. However, repeat FAST after CE-CT

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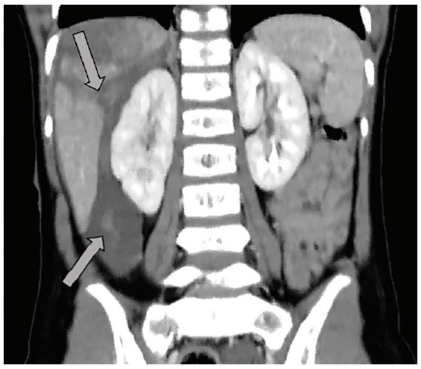

Figure 1 CE-CT on day 1. The coronal view shows the injury was mainly focused on the right posterior segment with disruption of the liver capsule, extensive hemoperitoneum, and contrast extravasation (arrows).

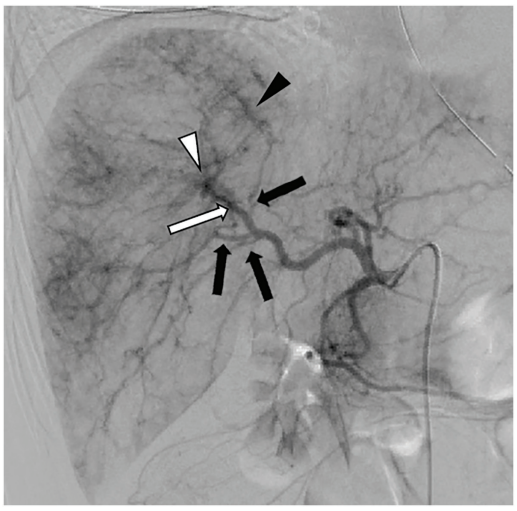

Figure 2 Common hepatic arteriography on day 1. Contrast extravasation (black arrowhead) and arterio-portal shunt (white arrowhead) visualized. Posterior segment branches (black arrows) were tightly embolized, and the anterior segment branch (white arrow) was modestly embolized.

showed enlargement of the echo free space and abdominal tenderness persisted, suggesting the duration of active intraabdominal bleeding.

We decided to take the strategy of non-operative management (NOM) with selective hepatic artery embolization to achieve hemostasis. Common hepatic arteriography showed contrast extravasation and arterio-portal shunt in the anterior and posterior segment branches of the right hepatic artery (Figure 2). No collateral circulation was visualized, and selective TAE was performed using a gelatin sponge cut into 1 mm pieces. From the CE-CT findings, we considered that the arterial hemorrhage was mainly from the posterior segment, so the posterior segment branches were tightly embolized, while the anterior segment branch was modestly embolized, just enough to decrease the peripheral flow of the artery.

After selective TAE, we confirmed the disappearance of contrast extravasation and arterio-portal shunt with right hepatic arteriography. No signs of hepatic vein or portal vein injury became apparent with venography and portography following celiac arteriography, denying the need for further intervention with laparotomy.

We used a 3 Fr system to minimize any risk of leg ischemia. The devices used for the procedure were as follows: XEMEX Introducer Set™ (3 Fr/30 cm, Zeon Medical Inc, Tokyo, Japan), CX Catheter-AII™ (Shepherd-Hook/3 Fr/60 cm, Gadelius Medical, Tokyo, Japan), Radifocus™ Guidewire M (0.025 inch/260 cm/Angled, Terumo Corporation, Tokyo, Japan), Carnelian MARVEL™ (Non-tapered, 1.9 Fr/1.9 Fr, Tokai Medical Products, Aichi, Japan), ASAHI CHIKAI™ black (0.014 inch/200 cm, ASAHI INTECC Co., Aichi, Japan). Considering the small diameter of the aorta, the tip of the CX Catheter-AII™ was slightly steam-shaped to improve the selectivity of the celiac artery.

No procedure-related complications occurred. She showed no signs of rebleeding after the procedure, elevated liver enzyme values normalized and was discharged on foot on day 14. Prior to discharge, we confirmed minor biloma formation at the site of the injury with follow-up CE-CT on day 12. We decided no intervention was necessary and continued outpatient follow-up with abdominal echography (Figure 3*a–d*).

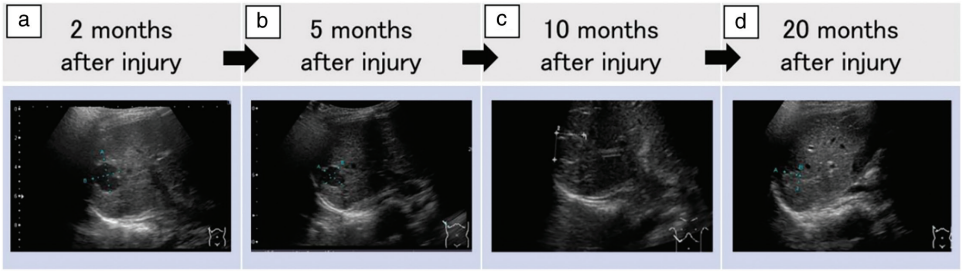

Figure 3 Abdominal echography at outpatient follow-up 2 months (**a**), 5 months (**b**), 10 months (**c**), and 20 months (**d**) after the injury. The biloma gradually became smaller and organized. Complete resolution was confirmed 20 months after injury.

The biloma gradually got smaller and organized, and complete resolution was confirmed 20 months after injury. Blood flow signal suggesting pseudoaneurysm formation or findings suggesting infection or abscess formation were not observed throughout the course of the case.

Ethical Approval and Informed Consent

Ethical approval was not required. Written informed consent was obtained from the patient's family for the publication of this case report.

DISCUSSION

NOM is considered the standard of care in children with blunt solid organ injury who are in a hemodynamically stable condition [2]. In the adult population, TAE is recognized as a well-established procedure that increases the success rate of NOM [3]. However, the role of TAE in NOM for pediatric blunt hepatic trauma is still unclear, and it is only in recent years that the procedure became recognized as a possible treatment option by the American Pediatric Surgical Association guidelines [4].

The novelty of our report is the successful application of TAE in a preschooler, with an in-depth description of the procedure using a 3 Fr system and extensive follow-up information. The literature describing the application of this procedure to young children, a preschooler as in our case, is limited to sporadic and brief case reports [5,6]. To be useful for future reference, reports of endovascular intervention for children must include precise details of the procedure, specifying the devices used and long-term follow-up information after the procedure to check for any possible complications, and, to our knowledge, this is the first report to do so.

While NOM for blunt hepatic trauma is considered the standard of care in stable children, the number of reports describing the failure of NOM without TAE is staggering, with reported failure rates being 5–30% [2]. Waiting for the patient to become unstable and then suddenly going into emergent laparotomy is a dangerous and unnecessarily risky strategy, when we have an alternative treatment option that enables safe and effective hemostasis. We strongly believe TAE for blunt hepatic trauma is also useful in young children and hope this case report will serve as one additional example showing the utility of the procedure.

No complications specifically related to the endovascular intervention occurred. In addition, no signs of arterial thrombosis, which is one of the noteworthy complications in pediatric interventional radiology [7], were observed. Biloma formation cannot be attributed as a specific consequence of the endovascular procedure, since it is one of the most common complications of liver trauma in NOM without TAE in pediatric hepatic trauma [8]. Further study is warranted regarding whether this complication rate alters by adding TAE to NOM in the pediatric population.

All radiographic tests and procedures were performed adhering to the As Low As Reasonably Achievable (ALARA) principle to minimize the effect of radiation in children, in accordance with the ICRP recommendations [9]. We decided the benefit of definite and immediate control of arterial hemorrhage profoundly outweighed the risk of radiation exposure from the procedure.

CONCLUSION

TAE is a safe and effective strategy to control arterial hemorrhage in blunt hepatic trauma. To raise the success rate of NOM, it should be strongly considered as a treatment option not only in adults but also in young children, and even in preschoolers.

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Ethics Statement

(1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
(2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Author Contributions

TS was responsible for drafting, editing, and submission of the manuscript. KH, RU, YM, TI, TT, HK, and KS contributed to the critical revision of the manuscript for important intellectual content and provided intellectual input to the research and manuscript. All authors read and approved the manuscript.

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