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## Trauma Case Reports

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## Effective use of fibrinogen concentrate in a pediatric splenic injury requiring transcatheter arterial embolization

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### ABSTRACT

Correction of coagulation is a crucial aspect of trauma care. While there are reports highlighting the effectiveness of fibrinogen concentrate in severe trauma cases with coagulopathic complications, literature on its use in pediatric cases remains limited. This paper discusses the case of a 5-year-old male presenting with a splenic injury and associated coagulopathy. We administered fibrinogen concentrate to enhance his coagulability prior to performing transcatheter arterial embolization utilizing gelatin sponges, aiming for optimal hemostasis. Post-administration, the patient's fibrinogen levels improved significantly, leading to successful hemostasis and a positive clinical outcome.

### Introduction

In severe trauma, coagulopathy is a triad of signs of death, indicating a lethal situation [1]. This holds true even for pediatric patients [2]. Recently, resuscitation strategies such as massive transfusion protocols have been shown to be effective in ameliorating coagulation disorders [3]. Fibrinogen concentrates (FC) have improved coagulation disorders and reduced transfusion-related complications in obstetric hemorrhage, cardiac surgery, and trauma [4]. However, the efficacy of fibrinogen concentrates in these conditions remains to be verified [4]. Here, we report a case of a child with hemorrhagic shock due to traumatic splenic injury and severe coagulopathy, who underwent successful hemostasis by transcatheter arterial embolization (TAE) with FC.

### Case report

The case involves a 5-year-old Japanese male with a past medical history of Kawasaki disease. He sustained blunt abdominal trauma to the left side after being struck by a piece of furniture. Initially presenting with abdominal pain, he was evaluated by his family physician and referred to the pediatric department of another general hospital. He vomited, and an abdominal ultrasound showed ascites. Subsequent computed tomography (CT) confirmed a traumatic splenic injury (Fig. 1).

He was transferred to our institution with red blood cell transfusion and arrived approximately 7 h after the injury. Upon arrival, He exhibited pallor, a declining level of consciousness, and the following vital signs: blood pressure of 90/55 mmHg, pulse rate of 144 beats per minute, and a respiratory rate of 38 breaths per minute. Laboratory findings included a hemoglobin level of 6.1 g/dL, platelet count of 33,000/ $\mu$ L, and fibrinogen level of 75 mg/dL. He was intubated in the emergency department, and red blood cell (RBC) and

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fresh frozen plasma (FFP) transfusions were immediately started according to the massive transfusion protocol.

TAE was selected for hemostasis due to the isolated nature of the splenic injury and the patient's young age, as splenectomy was considered undesirable. He was already highly coagulopathic with low fibrinogen level. To facilitate successful hemostasis via a gelatin sponge (GS), coagulopathy was addressed at the TAE. Two grams of FC were administered. Angiography showed extravasation of contrast from the lower pole of the spleen (Fig. 2), which was successfully embolized with GS. The TAE procedure successfully achieved hemostasis with an embolic volume comprising approximately 15 % of the spleen. Post-procedure fibrinogen levels improved to 270 mg/dL.

He was admitted to the intensive care unit and extubated the following day. By the third day post-procedure, he was transferred to the general wards and was discharged on the 10th day without complications.

## Discussion

We report a pediatric case of traumatic splenic injury accompanied by hemorrhagic shock and coagulopathy, successfully managed with FC and TAE using GS. FC have been shown to elevate blood fibrinogen levels more efficiently than FFP [5], and their efficacy in pediatric trauma is currently under investigation in a randomized controlled trial [6]. However, definitive evidence supporting their use is still lacking [7]. In this case, TAE with GS was selected due to the isolated splenic injury. However, GS itself has little coagulation-promoting effect, thus its ability to achieve hemostasis may be reduced in a state of coagulopathy [8]. Specific coagulation parameters, such as a PT-INR of 1.5, have been proposed for GS hemostasis [9]. However, no concrete fibrinogen level has been established. Since a fibrinogen level of less than 150 mg/dL has been proposed as an indicator for using FC in trauma patients [3], we considered that a fibrinogen level higher than this threshold is necessary to obtain sufficient hemostatic effect with GS. Therefore, rapid elevation of blood fibrinogen levels is crucial for effective hemostasis during TAE. In adults, a dose of 3 g of FC is expected to increase fibrinogen by about 100 mg/dL [10]. Thus, we utilized 2 g of FC with FFP, considering the smaller body size of the pediatric patients and his initial fibrinogen level, resulting in a rapid improvement of fibrinogen levels to those adequate for hemostasis.

Adverse events commonly associated with FC include allergic reactions and thrombosis [7,11]; however, these are generally infrequent and were not observed in this case.

Although the use of FC in pediatric trauma is not yet a standard practice, it may serve as an efficient resuscitation strategy in pediatric populations, especially in scenarios where TAE is employed for hemostasis.

## CRedit authorship contribution statement

**Sho Ando:** Writing – original draft, Project administration, Investigation. **Hisashi Dote:** Writing – review & editing, Writing – original draft, Supervision. **Seigo Okuma:** Writing – review & editing, Investigation. **Takahiro Atsumi:** Supervision.



Fig. 1. Computed tomography showing splenic injury (white arrows) and intra-abdominal hemorrhage (white arrow heads).

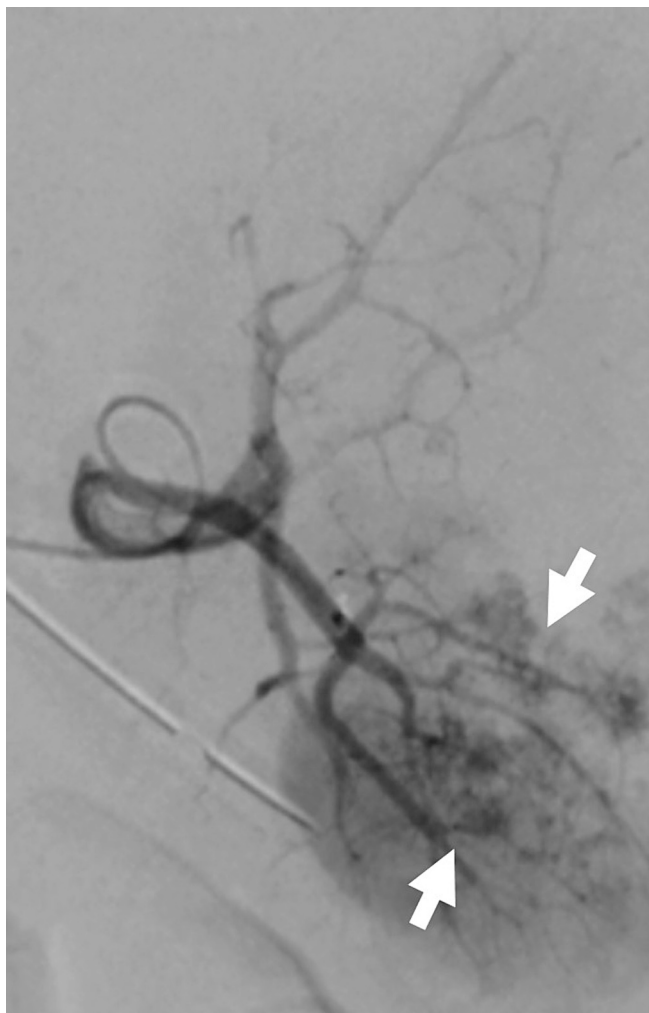


Fig. 2. Angiography shows extravasation of contrast from the lower pole of the spleen (white arrows).

#### Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT in order to English proofreading. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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