

# Angiographic embolization in the treatment of intrahepatic arterial bleeding in patients with blunt abdominal trauma

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**BACKGROUND:** Angiographic embolization (AE) as an adjunct non-operative treatment of intrahepatic arterial bleeding has been widely used. The present study aimed to evaluate the efficacy of selective AE in patients with hepatic trauma.

**METHODS:** Seventy patients with intrahepatic arterial bleeding after blunt abdominal trauma who had undergone selective AE in 10 years at this institution were retrospectively reviewed. The criteria for selective AE included active extravasation on contrast-enhanced CT, an episode of hypotension or a decrease in hemoglobin level during the non-operative treatment. The data of the patients included demographics, grade of liver injuries, mechanism of blunt abdominal trauma, associated intra-abdominal injuries, indications for AE, angiographic findings, type of AE, and AE-related hepatobiliary complications.

**RESULTS:** In the 70 patients, 32 (45.71%) had high-grade liver injuries. Extravasation during the early arterial phase mainly involved the right hepatic segments. Thirteen (18.57%) patients underwent embolization of intrahepatic branches and the extrahepatic trunk and these patients all developed AE-related hepatobiliary complications. In 19 patients with AE-related complications, 14 received minimally invasive treatment and recovered without severe sequelae.

**CONCLUSIONS:** AE is an adjunct treatment for liver injuries. Selective and/or super-selective AE should be advocated to decrease the incidence and severity of AE-related hepatobiliary complications.

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**KEY WORDS:** angiography;  
selective embolization;  
liver injury;  
hepatic arterial bleeding;  
complication

## Introduction

Intrahepatic arterial bleeding has been considered as an indication of laparotomy for patients with blunt abdominal trauma complicated with liver injury, and accounted for 20%-35% of the patients who failed in non-operative treatment.<sup>[1]</sup> Over the past 20 years, significant changes have been made in the treatment of blunt liver injury. Non-operative treatment has become the standard therapy for hemodynamically stable patients with low-grade liver injuries (I-II).<sup>[2, 3]</sup> With angiographic embolization (AE) as an adjunct non-operative treatment, patients with high-grade liver injuries (IV-V) have also been successfully treated.<sup>[4]</sup> Although the potential of AE to expand the scope of non-operative management and to increase its success rate has been recognized, the actual benefit of AE is still unclear, and controversy remains over the efficacy of AE for patients with suspected intrahepatic bleeding after blunt abdominal trauma.<sup>[5]</sup>

Over the past decade, we have performed selective AE for the patients with active intrahepatic arterial bleeding after blunt abdominal trauma and have achieved some experience in the non-operative treatment of patients with liver injury. This study was undertaken to analyze the clinical characteristics of such patients, and to systematically evaluate the efficacy of selective AE.

## Methods

The patients with blunt liver injuries who had been

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admitted to our hospital from January 1, 2002 to December 31, 2011 were retrospectively studied. This study was conducted in compliance with the *Declaration of Helsinki* (revised in 2000) and approved by the Ethics Committee of the Chinese PLA Air Force General Hospital (Trial Registration Number: KZ2012024). Since the study was retrospective, the Ethics Committee waived the requirement for informed consent from the patients.

Inclusion criteria included: (1) patients who were hemodynamically stable on admission or stabilized by initial resuscitation; (2) patients with blunt liver injuries associated with injuries of solid organs such as the kidney, pancreas and spleen, which were within the scope of non-operative management; (3) patients with no symptoms and signs of peritonitis; (4) patients with no signs and signs of gastric or intestinal rupture; and (5) patients who underwent selective AE during the non-operative treatment because of high-risk intrahepatic arterial bleeding. Exclusion criteria included: (1) patients with abdominal trauma caused by penetrating injuries; (2) patients who were hemodynamically unstable after resuscitation in the Emergency Department and transported directly to the operating room for abdominal exploration; (3) patients with temporary stable hemodynamics who developed peritonitis and/or unstable hemodynamics during the non-operative management and were subjected to abdominal exploration in the operation room.

Selective AE was performed under digital subtractive angiography (DSA) by the right-sided femoral approach after local anesthesia. With fluoroscopic guidance, a 5-F reverse curve Mickelson (Cook, Bloomington, IN, USA) catheter was introduced, and the celiac and hepatic arteries were selectively catheterized. After identification of the extravasation of the contrast medium from the hepatic arterial branches, selective embolization was

performed using the microcatheter system to deploy multiple Tornado coils (Cook) of various sizes into the segmental or main branches of the hepatic artery. Follow-up imaging confirmed the position of the coils. Specific procedure was performed for each patient at the discretion of the attending interventional radiologist. Follow-up imaging was not routinely performed unless new symptoms or signs appeared. Successful selective AE was defined if there was no active bleeding shown angiographically after embolization.

Demographics, grading of liver injury, mechanism of blunt abdominal trauma, associated intra-abdominal injury, indications for AE, angiographic findings, type of AE, and AE-related hepatobiliary complications of the patients were all reviewed. Liver injuries were graded according to *Trauma Classification* (revised in 1994) of the American Association for Surgery.<sup>[6]</sup> AE-related hepatobiliary complications included liver abscess, hepatic necrosis, gallbladder infarction, bile peritonitis, bile leak, and biloma formation.<sup>[7]</sup>

## Results

Seventy patients with blunt liver injury underwent selective AE because of active bleeding of the intrahepatic artery. These patients comprised 52 men and 18 women, with a mean age of 36.3 years (range: 16-62). Trauma mechanism included motor vehicle collision in 32 (45.71%) patients, motorcycle crash in 11 (15.71%), pedestrian vs auto in 4 (5.71%), falling injury in 15 (21.43%), sports injury in 2 (2.86%), and explosive blast injury in 6 (8.57%). According to *Trauma Classification* of the American Association for Surgery, 13 patients (18.57%) had liver injuries of grade II, 25 (35.71%) grade III, 23 (32.86%) grade IV, and 9 (12.86%) grade V (Table 1).

Associated injuries of intra-abdominal organs were

**Table 1.** Liver injuries and severity of the 70 patients

Grade	Number (n, %)	Hematoma	Laceration	Vascular
I	0	Subcapsular, <10% surface area	Capsular tear, <1 cm parenchymal depth	-
II	13 (18.57)	Subcapsular, 10%-50% surface area; intraparenchymal, <10 cm in diameter	1-3 cm parenchymal depth, <10 cm long	-
III	25 (35.71)	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma	Intraparenchymal hematoma >10 cm or expanding, >3 cm parenchymal depth	-
IV	23 (32.86)	-	Parenchymal disruption involving 25%-75% of hepatic lobe or 1-3 Couinaud's segments within a single lobe	-
V	9 (12.86)	-	Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud's segments within a single lobe	Hepatic venous injuries
VI	0	-	-	Hepatic avulsion

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