



# Contrecoup Injury associated with Fatal Portal Vein Bleeding: A Case Report

## 반충손상 기전에 의한 간문맥손상에 대한 증례 보고

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A 64-year-old male visited our emergency department due to severe right flank pain after falling from a 2-meter height. Contrast-enhanced CT revealed a right hemothorax with multiple fractures in the right ribs and iliac bone. A small hematoma in the right perihepatic space was noted, but there was no hepatic laceration on CT. Initial surgical management led to continuous uncontrolled bleeding around the porta hepatis, and subsequent arterial angiography could not demonstrate a bleeding focus. However, immediate follow-up CT showed contrast extravasation on the left side of abdomen, and a percutaneous transhepatic portal venogram revealed active bleeding from the left portal vein. Although the wound was embolized with a glue, the patient suffered from a cardiac arrest and finally expired. In conclusion, during evaluation of abdominal trauma patients, portal vein bleeding and contrecoup injuries should be considered when hepatic arteriography findings are unremarkable.

**Index terms** Contrecoup Injury; Abdominal Injuries; Portal Vein; Therapeutic Embolization; Interventional Radiology

## INTRODUCTION

Liver is considered the most frequent injury site in patients who sustain abdominal trauma, and damages to hepatic vessels commonly occur in the arterial structures (1, 2). Therefore, patients with blunt body trauma and internal bleeding in the perihepatic area should be first evaluated for the hepatic arteries injury. Although a traumatic portal vein injury is rare, its mortality is fatal (3). Because early detection of a bleeding focus is critical for a patient's prognosis, a portal vein injury should be considered if an arterial injury is not detected.

The contrecoup injury mechanism, a contralateral injury phenomenon caused by inertia in a quick acceleration and deceleration situation with a firm outer wall, is a well-

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known concept in the evaluation and treatment of traumatic brain injury (4). Likewise, the contrecoup injury mechanism can be applied to evaluate trauma in other parts of the body surrounded by a hard-bony structure, such as the thorax, upper abdomen, and pelvis.

The purpose of this case report is to describe an unusual trauma patient who had both an upper abdominal contrecoup injury and portal vein bleeding, which can be easily missed during trauma evaluation.

## CASE REPORT

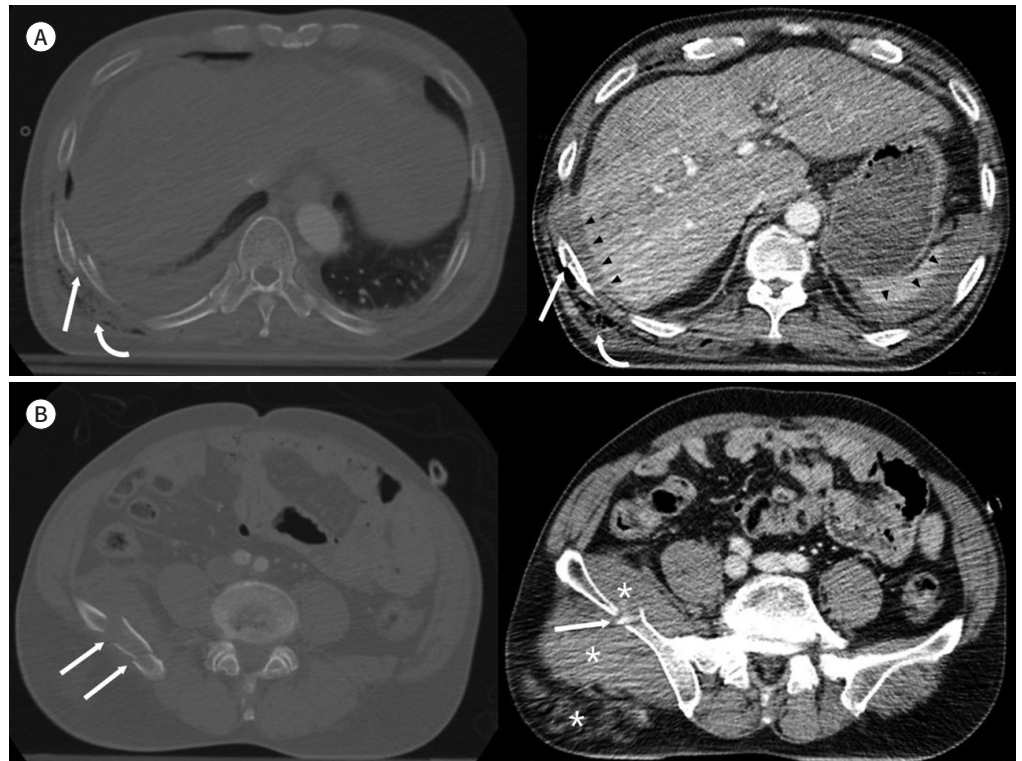
The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki.

A 64-year-old male presented with severe right flank pain after a fall from a height of two meters. On initial evaluation, he was conscious but pale with a blood pressure of 67/41 mm Hg and a pulse rate of 100 bpm. He had underlying alcoholic liver cirrhosis and showed international normalized ratio and platelet levels of 1.41 and  $108 \times 10^3/\mu\text{L}$ , respectively. An initial enhanced CT scan revealed fractures of right iliac bone and multiple fractures of right rib lateral arcs and also showed a small hematoma in right perihepatic space, and left perisplenic space, but a clear bleeding focus was not identified (Fig. 1A, B). The patient was considered to be in hemorrhagic shock.

**Fig. 1.** Fatal portal vein bleeding by contrecoup injury in a 64-year-old male.

**A.** Initial CT revealing multiple right-sided rib fractures (arrows), a traumatic subcutaneous emphysema (curved arrows), and small perihepatic and perisplenic fluid collections (arrowheads).

**B.** The initial CT also shows a complex fracture at the right iliac bone (arrows) and traumatic hematoma (asterisks) at the right iliacus and right gluteus medius muscles and adjacent subcutaneous fat.



He was referred to the general surgery department and, because of his hemodynamic instability, underwent emergency surgery. Intraoperatively, continuous bleeding was found around the porta hepatis and hepatic caudate lobe, but the bleeding could not be controlled because the bleeding focus was not identified. Because of the patient's right-sided pain and multiple right rib and iliac bone fractures, it was assumed that the patient had fallen in a right-sided position to the floor. Therefore, the search for bleeding was mainly focused on the liver and perihepatic organs.

Because the bleeding could not be controlled and its source could not be identified, an angiographic evaluation by the interventional radiology department was requested. Arterial angiography from the celiac trunk to the hepatic arteries was immediately performed, but no bleeding focus could be detected (Fig. 1C). The patient was subsequently moved to the CT room for multiphase contrast-enhanced CT scan to re-evaluate the patient's condition in real time.

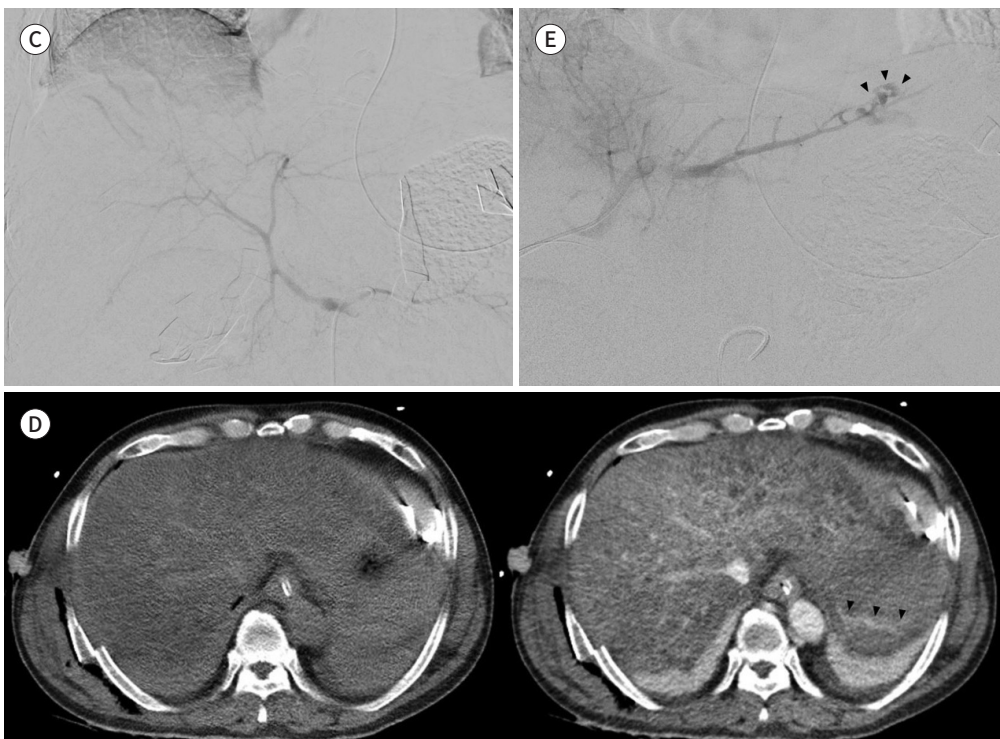
Immediately following the second CT scan, the patient suffered a cardiac arrest, possibly due to the progressed bleeding, and the heartbeat was recovered after several cycles of cardiopulmonary resuscitation. The CT scan showed contrast extravasation on portal phase in the left side of abdomen (Fig. 1D).

**Fig. 1.** Fatal portal vein bleeding by contrecoup injury in a 64-year-old male.

**C.** A hepatic arteriogram shows no bleeding focus.

**D.** Follow-up CT (pre-enhancement and portal phase) showing contrast extravasation (arrowheads) on the left side of the abdominal cavity, which suggests that the possible bleeding site was in the left portal vein because a hepatic arteriogram obtained immediately before the CT did not show a bleeding focus.

**E.** A percutaneous transhepatic portogram reveals that the bleeding focus was in the segment 2 branch of the left portal vein (arrowheads).



Finally, a percutaneous transhepatic portal venogram was performed, and it revealed extravasation of contrast media at the distal portion of the segment 2 branch of the portal vein (Fig. 1E). Transvenous embolization with glue was selected to control the active bleeding, and the bleeding eventually stopped. However, the patient's condition continued to deteriorate, and he suffered disseminated intravascular coagulation and finally expired.

## DISCUSSION

The liver is the most frequently injured solid organ in the abdominal cavity in patients with blunt body trauma and sometimes severe liver injury creates uncontrollable internal bleeding which can be the cause of mortality (5). However, because of the liver's complicated internal structures, a concomitant liver injury in patients with blunt abdominal trauma is sometimes hard to evaluate. The hepatic arterial structure is a common source of bleeding in patients with blunt abdominal trauma, but portal vein injury is rare with a reported incidence of 0.08–0.10% (1, 6). Although portal vein injuries rarely occur in traumatic events, the mortality associated with portal vein rupture is very high in the 50–70% range (7). Initial detection and isolation of a portal vein injury is difficult, and adjacent organs can also be severely damaged, that causes the high mortality rate (5). Buckman et al. (8) emphasized the difficulty of the preoperative diagnosis of a portal vein injury.

Anatomically, the abdominal cavity extends superiorly and neighbors the diaphragm which belongs to the lower thoracic cage. Therefore, the superiorly located organs of the abdominal cavity, such as the liver and spleen, can be affected from blunt injury to the lower chest. Because of its size, position, and friability, the liver is the more common injury site, and it is often lacerated in patients with blunt body trauma. If the impact of the rib over the liver exceeds the ribcage resistance, the liver and hepatic vessel structures can be contused or lacerated (6). The traumatic impact spreads to the liver through the rib cage in the form of waves, so direct impact from a rib is considered the most feasible mechanism for liver injury. Subedi et al. (9) reported that the probability of liver injury increased in cases of right-sided rib fractures, and the probability of splenic damage increased with left-sided rib fractures.

The patient in the present case suffered multiple right-sided rib fractures, so we expected the impact and injury site would be found in the right-sided organs, such as the right hepatic parenchyma or right hepatic vessels. However, the patient's injury site was located at the distal segment of the left side of the liver. Because the patient left lobe of the liver reaches to the left lower ribs over the spleen, the injury mechanism could be contrecoup injury in this case. Contrecoup injury, commonly found in the brain after head trauma, is caused by acceleration-deceleration forces when the brain is thrown against the opposite side of the skull and injured on the side opposite the trauma (4). A similar mechanism of injury can occur in the upper abdomen, especially in a patient with a liver large enough to cover the whole upper abdomen that lies bilaterally beneath the ribs, which are hard enough to inflict contrecoup injury to the liver. Several case reports explain and predict traumatic injuries to the pelvis and thorax (4). However, contrecoup injury mechanism has not been suggested to explain the reason for the upper abdominal trauma. Herein, we report the patient who had a contrecoup injury on the liver from the hard shell of the rib cage after lower chest blunt trauma.

In conclusion, this case provides two important lessons in the evaluation of abdominal bleeding after traumatic liver injury. Physicians should not only consider arterial hepatic bleeding but also evaluate the possibility of portal vein bleeding, because it can be deadly. In addition, if the injury site is surrounded by rib cage (including the abdomen), we should consider a contrecoup injury.

### Author Contributions

Conceptualization, C.H.H.; supervision, C.H.H., P.S., L.S.H.; visualization, P.S.; writing—original draft, Y.J.; and writing—review & editing, all authors.

### Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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## 반충손상 기전에 의한 간문맥손상에 대한 증례 보고

유중현 · 박성준 · 이승화 · 정환훈\*

64세 남성이 2미터 높이에서 낙상한 이후 심한 우측 옆구리 통증으로 내원하였다. 시행한 조영증강 전산화단층촬영에서 우측 혈흉과 다수의 우측 갈비뼈 골절 및 우측 장골의 골절 소견이 있었다. 또한 간 주변에 혈종이 있었으나, 간실질 외상 소견은 보이지 않았다. 먼저 시행된 수술 중, 간문에서 지혈되지 않는 지속적인 출혈이 관찰되었다. 이에 대한 진단을 위해 인터벤션 시술이 시행되었고, 최초 간동맥조영술에서는 출혈 소견이 보이지 않았다. 이어서 시행한 조영증강 전산화단층촬영에서 좌측 복부의 조영제혈관바깥유출이 보였는데, 이는, 경피경간문맥조영술에서 좌측 문맥의 출혈로 확인되었다. 이 지점에 접촉제 색전술을 시행했으나, 환자는 끝내 사망하였다. 이 증례를 통해 복부 외상환자 평가에서 간동맥조영술이 정상이라도 간문맥 손상의 가능성을 고려해야 한다는 것과 복부에서도 반충손상기전에 의한 손상이 가능하다는 것을 확인하였다.

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