Case Report

Complete Traumatic Transection of the Renal Vein with Renal Venous Hemostasis via Arterial Embolization before Nephrectomy: A Case Report

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Abstract

A 44-year-old man fell off a cliff and was taken to a community hospital. He was a non-responder and was transferred to our tertiary care hospital. Contrast-enhanced computed tomography images revealed a right renal vein injury and a massive retroperitoneal hemorrhage. Angiography of the right renal artery showed extravasation during the venous phase; therefore, the artery was immediately embolized with N-butyl cyanoacrylate and coils. Subsequently, nephrectomy was performed. Arterial embolization of the renal artery for a renal vein injury in a patient with hemodynamic instability may be effective as a damage-control interventional radiology bridge to emergency nephrectomy.

Key words: trauma, blunt abdominal injury, damage control interventional radiology

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Introduction

Traumatic main renal vein injury without injury to the renal artery and parenchyma is rare [1, 2]; however, it can result in hemorrhagic shock due to the volume of blood flow in the vein. Damage-control surgery (DCS) to prevent circulatory collapse is recommended to prevent the lethal triad of trauma: hypothermia, metabolic acidosis, and coagulopathy [3].

Interventional radiology (IR) has become a major part of damage-control strategies, including procedures such as resuscitative endovascular balloon occlusion of the aorta (REBOA), or prompt and rapid endovascular strategies in trauma occasions (PRESTO) [4]. The concept of damage control IR is to improve the hemodynamics and achieve rapid hemostasis. IR should precede surgery if major bleeding can be controlled earlier by IR than by surgery [5]. Furthermore, preoperative IR could help prevent intraoperative bleeding.

We report here, a case of complete traumatic transection of the renal vein with successful control of the renal venous bleeding by arterial embolization as a damage control IR before nephrectomy.

Case report

A 44-year-old man fell to the ground from a 4 m cliff and landed hard on the right side of his back. He was taken to a community hospital by ambulance. His hemodynamics was initially stable and non-contrast computed tomography (CT) revealed a pneumothorax and a large retroperitoneal hematoma on the right side. He gradually deteriorated into shock, despite immediate fluid resuscitation. The emergency physician, flown-in by an emergency medical helicopter, found the patient in agonal respiration with a weak thready...
pulse and bradycardia. The physician immediately performed tracheal intubation, inserted a chest tube to relieve the pneumothorax, and initiated a blood transfusion. The patient was transferred to our tertiary care hospital and had received 2 units of packed red blood cells (RBC) and 4 units of fresh frozen plasma (FFP) by the time he arrived at our emergency department (ED).

In Japan, one unit of transfusion is made from 200 mL of the donor blood.

On arrival, the patient had a Glasgow Coma Scale score of 10 (E3TM6), his body temperature was 35.1°C, with a blood pressure of 60/40 mmHg, heart rate 120 beats/min, and respiratory rate 38 breaths/min. He had cold, clammy skin and his capillary refill time was > 2 s. Laboratory data findings were as follows: RBC count 119 × 10⁷/μL, hemoglobin 3.8 g/dL, and platelet count 6.0 × 10⁴/μL, prothrombin time and international normalized ratio 1.76, fibrinogen 89.6 mg/dL, fibrin degradation product 46.4 μg/dL, blood urea nitrogen 20.5 mg/dL, serum creatinine 1.66 mg/dL, bicarbonate 16.2 mmol/L, lactate 7.0 mmol/L, and pH was 7.093. He had developed the lethal triad of hypothermia, metabolic acidosis, and coagulopathy. On arrival at our hospital, his Injury Severity Score, Revised Trauma Score, and the probability of survival were 36, 5.15, and 0.67, respectively.

We continued the transfusion and immediately performed REBOA, via a left femoral artery approach, in the ED. His blood pressure later improved to 90/50 mmHg. We assessed the patient and proceeded to perform a contrast-enhanced CT, which showed a large retroperitoneal hematoma on the right side. Extravasation (EV) of the contrast medium in the hematoma was seen only during the delayed-phase (Fig. 1). The right renal vein also identified during the delayed-phase, was not connected to the inferior vena cava (IVC) and the EV appeared to originate directly from the right renal vein. These findings suggested that the right renal vein injury and exsanguination were from the renal side of the injured right renal vein rather than from the IVC. No renal artery or renal parenchymal injuries were evident.

Continuous transfusion pump and REBOA were required to maintain circulation after the CT. The patient was transferred to the IR room and a 4 Fr sheath introducer was placed in the right femoral artery. A 4Fr catheter was introduced and a selective right renal arteriography was obtained with the REBOA deflated. The arteriography did not show arterial injury but revealed renal venous EV of the contrast.

Fig. 1.

a: Contrast-enhanced computed tomography (CT) image (arterial phase, 40 s, contrast injection via the right brachial vein)
b, c: Contrast-enhanced CT images (delayed phase, 100 s; b: axial image, c: coronal image)
CT images showing massive hemorrhage in the right retroperitoneal cavity. Extravasation of the contrast medium (b, c: arrows) from the right renal vein (b: black arrowhead) is seen in only the delayed phase. The right renal vein is separated from the inferior vena cava (b: white arrowhead).
There is no injury to the right renal parenchyma.
There was no extravasation of the contrast medium in the arterial phase (a). Extravasation appeared in the venous phase (b). The right renal vein injury was diagnosed from arteriography. Renal arteriography after embolization shows an absence of extravasation.

Complete transection of the right renal vein (arrow) confirmed at surgery.

Discussion

Renal vein injuries are very rare. Renal injuries comprise 1-5% of total blunt injuries [1] and main renal vessels injuries account for less than 3% of all renal injuries; 70% involve an artery, 20% a vein, and 10% involve both vessels [2]. In the present case, a shearing force at the point of falling to the ground was thought to be the cause of renal vein injury alone without damage to the parenchyma.

The Advanced Trauma Life Support guidelines recommend that hemodynamically unstable patients should receive immediate treatment by open abdominal surgery without performing CT [3]. However, CT in unstable trauma patients has not been absolutely unacceptable in recent years. Ordonez et al. reported that CT in unstable patients did not decrease mortality compared to immediate DCS, and they instead avoided surgery in approximately half of the cases [6]. In addition, the CT findings can help in deciding a specific surgical or IR management. Therefore, we thought that the benefit of contrast-enhanced CT might outweigh the risk.

DCS for the kidney in principle is nephrectomy. Meanwhile, successful arterial embolization in hemodynamically
unstable patients with retroperitoneal bleeding has been documented [5, 7]. We opted for IR before nephrectomy for two reasons. One, embolization from the arterial side was expected to be the fastest way to control the EV on the venous side. Complete transection of the renal vein was suspected based on contrast-enhanced CT findings of massive EV of the contrast medium from the renal vein, which was separated from the IVC (Fig. 1). High retroperitoneal compartment pressure was also suspected because of the massive hemorrhage in the retroperitoneal cavity and no extravasation from the IVC side. Therefore, embolization of the renal artery was expected to stop most of the venous bleeding. Even if the vein was not completely transected, the high retroperitoneal compartment pressure due to the massive hemorrhage would suppress the retrograde bleeding from the IVC side after embolization. Moreover, the surgeons were concerned that opening the abdomen would exacerbate the venous bleeding due to a sudden decrease in the abdominal pressure and an increase in venous return [8]. Further massive bleeding can occur during incision of the retroperitoneum or again during removal of the hematoma, due to the loss of compartment pressure. IR was thus considered to prevent intraoperative bleeding.

REBOA could be performed to reduce the bleeding, but the prolonged aortic occlusion could result in catastrophic ischemia or ischemia-reperfusion injury. Selective arterial inflow control would provide significant benefit compared to REBOA. We, therefore, employed IR for arterial inflow control to the right kidney, before nephrectomy. Renal artery embolization was performed as a more definitive and simpler method to reduce the renal venous bleeding compared to balloon occlusion of the renal artery. Additionally, balloon occlusion carries the risk of balloon migration during the patient transfer to the OR. If the patient had been hemodynamically stable, repair of the isolated vein would have been possible after detaining the balloon catheter in the renal artery [9].

The venous approach might be useful for placing a covered stent in the right renal vein, but this is not always available. Vena cavaography was also not performed because of the additional operative time that it would require. Hence, we chose damage control embolization via the arterial approach before proceeding with nephrectomy in our hemodynamically unstable patient with a severe renal vein injury. The duration from the patient’s arrival to the arrest of major bleeding by IR was 2 h and 29 min and that to the completion of the surgery was 6 h. A surgery in the ED or a hybrid OR could have a favorable outcome on time manage-
The postoperative course was satisfactory, and the patient was discharged to a rehabilitation facility 18 days later.

Complete traumatic transection of the renal vein is very rare. Arterial embolization may be useful to control bleeding before nephrectomy as a damage control IR.

**Ethical approval**

Approval from a review board was not required for this study.

**Informed consent**

Written informed consent was obtained from the patient.

**Conflict of Interest** All authors declare that they have no conflicts of interest.

**References**