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A case of renal trauma successfully treated by close monitoring of intravesical pressure and subsequent intervention

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ABSTRACT

Management of abdominal compartment syndrome (ACS) due to renal injury is important. A 21-year-old man was taken to an emergent care unit with grade IV right kidney trauma and hypovolemic shock due to a road traffic injury. Despite twice targeted transcatheter arterial embolization of a renal artery, intravesical pressure increased and blood pressure was difficult to maintain. After right nephrectomy and ligated the bleeding lumbar arteries and veins to avoid ACS, the patient's general condition improved, and he did not develop ACS. Monitoring of intravesical pressure may be useful for deciding treatment strategy.

1. Introduction

The American Association for the Surgery of Trauma (AAST) published organ injury scales for grading renal trauma, in which renal trauma was graded into grade I to V, and revised it in 2018 "to reflect the increased reliance on computed tomography scans and non-operative management of high-grade renal trauma (HGRT)."[1] According to the AAST, most renal injuries are low-grade renal trauma (LGRT) of grade I and II which should be expectantly managed and have minimal morbidity.[2] Although more controversial, management of HGRT (AAST grade III to V) has also become predominantly nonoperative, and the American Urological Association guideline recommends observation in most hemodynamically stable patients.[2]

Any abdominal trauma can increase intra-abdominal pressure (IAP) and has a higher risk of causing intra-abdominal hypertension, which can compromise organ perfusion and thus lead to multiple organ dysfunction called abdominal compartment syndrome (ACS).[3] Among trauma patients, aggressive fluid resuscitation is the most common risk factor for increased IAP.[3] Close monitoring of organ function and IAP allows clinicians to detect the development of ACS rapidly and to intervene with target-specific management to reduce the risk of ACS.[3]

2. Case presentation

A 21-year-old man with multiple trauma after a motorbike vs car accident arrived at our critical care center. Contrast-enhanced computed tomography (CT) showed the right kidney crushed into multiple parts with a large hematoma (AAST grade IV) and a smaller hematoma around the abdominal aorta and inferior vena cava, which had a clear boundary with Gerota's fascia surrounding the right renal injuries (Fig. 1A–D). As the patient was in a state of hypovolemic shock, we administered noradrenaline at 0.2 μg/kg/min. We started to measure the intravesical pressure as a substitute for IAP and the intravesical pressure was 13 mmHg on admission. Despite the blood transfusion and noradrenaline administration, the patients remained hemodynamically unstable. Therefore, transcatheter arterial embolization (TAE) was performed immediately. Aortography (Fig. 2A) and selective right renal arteriography (Fig. 2B) revealed multiple bleeding sites from branches of the right renal artery and stop signs, which suggested temporal hemostasis by vasospasm (Fig. 2). After TAE with an absorbable gelatin sponge, blood pressure stabilized and the dose of noradrenaline could be reduced to 0.13 μg/kg/min. However, the patients become hemodynamically unstable again and we had to increase the dose of noradrenaline to 0.16 μg/kg/min. At this time, the intravesical pressure increased to 18 mmHg (Fig. 3A).

We suspected re-bleeding from the embolized artery or bleeding from another unidentified area and decided to repeat TAE. At the second

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Abbreviations

AAST	American Association for the Surgery of Trauma
ACS	abdominal compartment syndrome
APP	abdominal perfusion pressure
CT	Computed tomography
HGRT	high-grade renal trauma
IAH	intra-abdominal hypertension
IAP	intra-abdominal pressure
LGRT	low-grade renal trauma
TAE	Transcatheter arterial embolization
WSACS	World Society of the Abdominal Compartment Syndrome

failure and was discharged without any complications.

3. Discussion

Retroperitoneal bleeding from renal trauma due to road traffic injury can be expected to stop because of the tamponade effect by Gerota's fascia. Expectant/conservative management is currently the standard of care for LGRT and is also recommended for most cases of HGRT if patients are hemodynamically stable.[4,5] However, any abdominal trauma can increase IAP and the risk of developing ACS.[3] The World Society of the Abdominal Compartment Syndrome defines ACS as a sustained IAP greater than 20 mmHg associated with new organ dysfunction or failure.[3] Close monitoring of IAP leads to rapid diagnosis of ACS, enabling targeted interventions to reduce IAP.[3] In this case, although the hemodynamics of the patient was stabilized after two TAEs along with blood transfusions and noradrenaline administration, the intravesical pressure

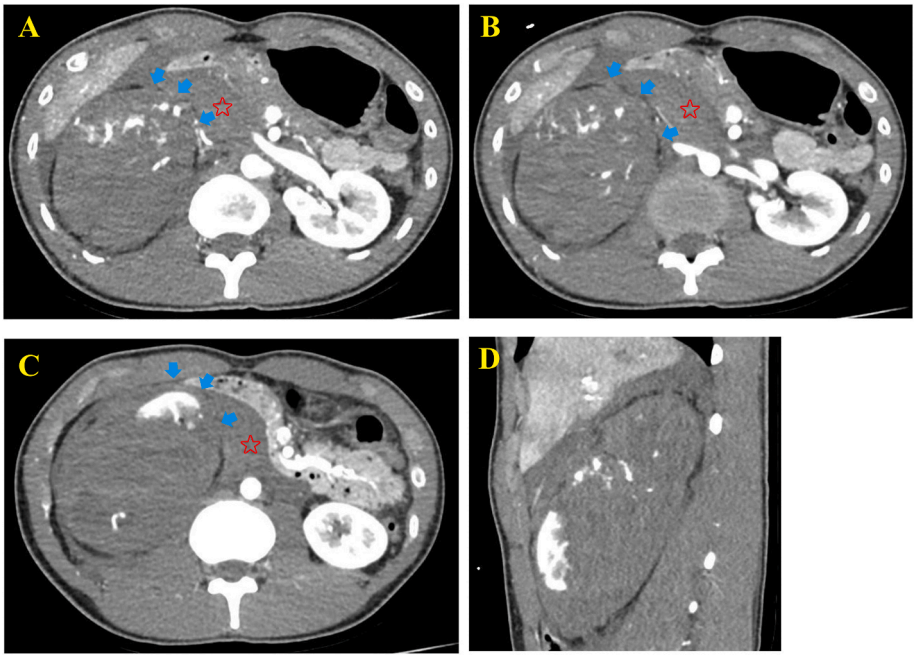

Fig. 1. Computed tomography images. Contrast-enhanced CT showed right renal trauma and hematoma within Gerota's fascia and the smaller hematoma (red asteroids) around inferior vena cava and abdominal aorta, which was clearly separated from perirenal hematoma by Gerota's fascia (blue arrows). A–C: Coronal section image. D: Sagittal section image. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

TAE, the right renal artery was found to be bleeding again, so embolization was performed using a steel microcoil. Subsequently, blood pressure stabilized with mean blood pressure around 100 mmHg and the dose of noradrenaline could be reduced to 0.05 μg/kg/min. Although hemodynamics was stabilized, the intravesical pressure continued to increase up to 20 mmHg at 27 hours from admission (Fig. 3A), which strongly suggested that the patient started to develop ACS. To avoid multiple organ dysfunction due to ACS, we decided to perform surgical resection of large retroperitoneal hematoma with right nephrectomy.

We approached the retroperitoneal cavity via the peritoneum and found that the injured right kidney and hematoma were completely encapsulated in Gerota's fascia. The removed kidney was crushed into many parts of various sizes and buried in hematoma in Gerota's fascia (Fig. 3B). Additionally, we observed bleeding from the second and third right lumbar arteries and the third right lumbar vein, which might cause the smaller hematoma around the inferior vena cava and abdominal aorta. These vessels were ligated, and complete hemostasis was achieved. After the operation, the intravesical pressure decreased to less than 12 mm Hg (Fig. 3A). The patient did not experience multiple organ as a substitute for IAP continued to increase and reached 20 mmHg, which led us to perform surgery to reduce IAP and avoid organ dysfunction by ACS.

The injured right kidney and hematoma were completely encapsulated in Gerota's fascia, while the removed kidney was crushed into many parts of various sizes and buried in hematoma in Gerota's fascia, as shown on contrast-enhanced CT. This phenomenon might partially contribute to the increase in IAP. Additionally, contrast-enhanced CT confirmed a smaller hematoma around the inferior vena cava and the abdominal aorta in the retroperitoneum, which had a clear boundary with a right renal trauma and hematoma encapsulated in Gerota's fascia. During the surgical procedure, we observed bleeding from the right lumbar arteries and veins. It was unclear why the first and second angiographies did not detect bleeding from these vessels; we assume that the amount of bleeding was too small to be detected on angiography.

ACS is a complication of trauma or surgical conditions that involves increased IAP and subsequent organ hypoperfusion. Our case highlights the importance of two issues: (1) close monitoring of intravesical pressure in avoiding ACS and (2) predicting the possible existence of

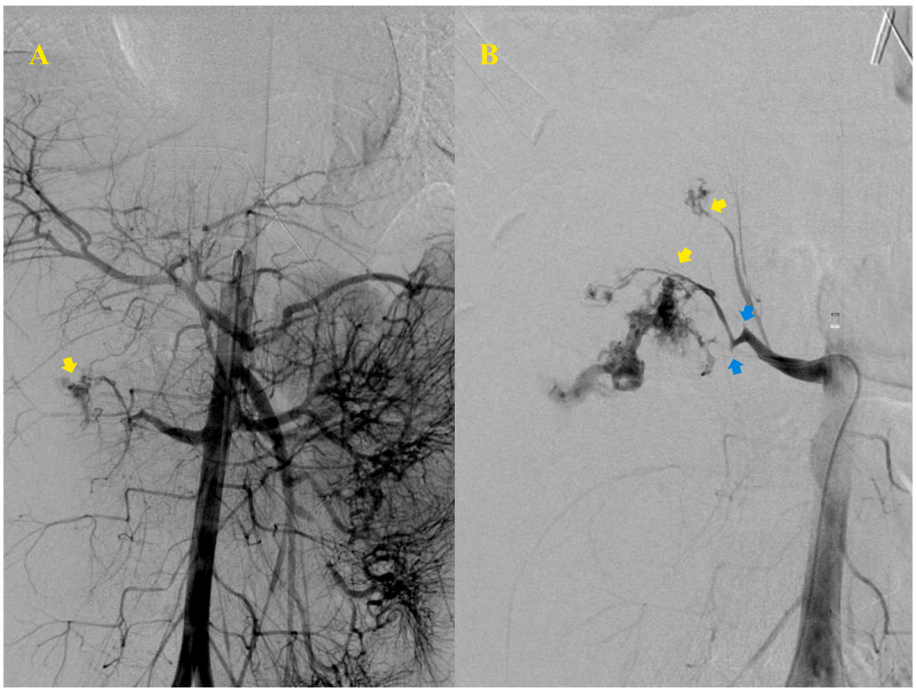

Fig. 2. Angiography images. A: Abdominal aortography revealed active bleeding from a branch of the right renal artery (yellow arrow). B: Selective right renal arteriography revealed multiple bleeding sites (yellow arrows) and stopping signs (blue arrows) from branches of the right renal artery. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

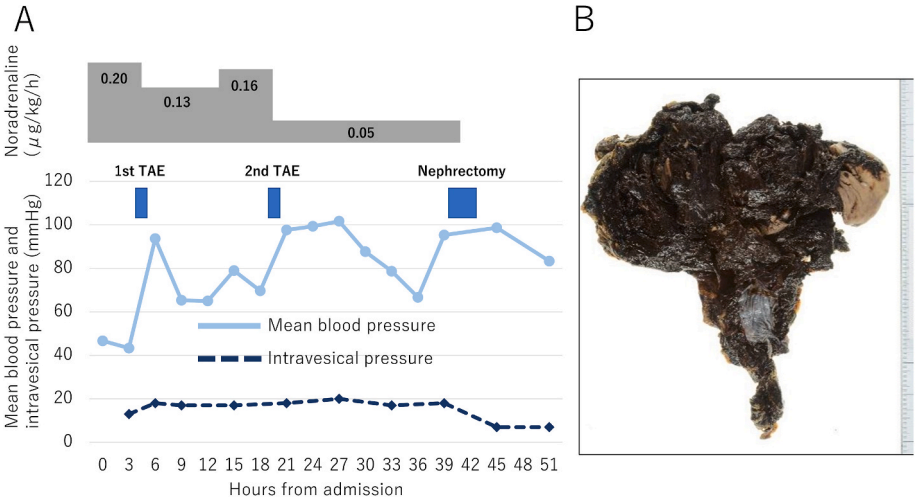

Fig. 3. Clinical course of the patient. A: Changes in mean blood pressure and intravesical pressure. Regardless of two transcatheter arterial embolization (TAE), intravesical pressure continued to increase. After surgery, intravesical pressure normalized. B: Macroscopic appearance of crushed right kidney and hematoma.

bleeding sources unidentified on angiography.

Approval of the research protocol by an institutional reviewer board

Not applicable.

Informed consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Registry and the registration no. of the study/trial

Not applicable.

Declaration of competing interest

The authors declare no conflict of interest.

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