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Endovascular treatment of renal arterial perforation after blunt trauma: Case report

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ABSTRACT

INTRODUCTION: Isolated renal arterial perforation is a rare consequence of blunt abdominal trauma. Meticulous surgical control of retroperitoneal active bleeding is difficult due to oozing of soft connective tissue, the deep position of operative field, and the presence of friable vascular tissue. Therefore, endovascular treatment is often preferred.
PRESENTATION OF CASE: An 83-year-old man was transferred to our trauma center due to retroperitoneal active bleeding after a car accident, in which his right upper abdomen struck the steering wheel. Contrast-enhanced abdominal computed tomography (CT) showed a retroperitoneal hematoma behind the inferior vena cava and contrast medium extravasation on the medial side of the right kidney. Selective right renal arteriography confirmed a perforation in the proximal right main renal artery, approximately 3 cm from the ostium. We successfully placed a covered stent across the perforation site.
DISCUSSION: Endovascular management may reduce the likelihood of extensive abdominal surgery, surrounding organ damage, risk of bleeding, and postoperative morbidity. We regarded embolization as inappropriate for kidney salvage in our patient, and therefore used a self-expanding covered stent to treat the perforation.
CONCLUSION: Endovascular management of a traumatic renal arterial injury is the best approach to preserve renal function in hemodynamically stable patients who cannot tolerate laparotomy, due to risks associated with general anesthesia, and who can tolerate anticoagulation therapy.

1. Introduction

Renal arterial injury is a rare consequence of blunt abdominal trauma, with a reported incidence of 0.08% among all patients with blunt abdominal traumas and 1%–4% in patients with renal injuries [1–4]. Optimal management strategies for renal arterial perforation are mainly surgical treatments such as simple repair of the injured artery, use of an interposition graft, and nephrectomy. However, meticulous surgical control of retroperitoneal active bleeding is difficult due to oozing through the soft connective tissue, the deep position of the operative fields, and the presence of friable vascular tissue. Therefore, endovascular treatment is often a superior approach. Some case reports have described endovascular management of the blunt renal arterial occlusion with thrombosis or intimal dissection [4–9]. The present report describes a patient with an isolated renal arterial perforation and retroperitoneal bleeding who was successfully treated using an endovascular approach. This case report has been reported in line with the SCARE criteria [10].

2. Presentation of case

An 83-year-old man with no relevant medical history was transferred to our trauma center due to retroperitoneal active bleeding after a car accident, in which his right upper abdomen struck the steering wheel. Upon arrival, 4 h after the accident, he was fully conscious and had a pulse rate of 105 beats/min, blood pressure of 66/46 mmHg, hemoglobin of 13.2 g/dL, platelet count of 317,000/mm^3, and serum creatinine level of 0.96 mg/dL. After resuscitation with 1000 mL crystalloid fluid, his hemodynamics improved, with a blood pressure of 114/52 mmHg and a pulse rate of 104 beats/min. A physical examination indicated right upper abdominal tenderness without distension. A contrast-enhanced abdominal computed tomography (CT) scan showed a retroperitoneal hematoma behind the inferior vena cava, and contrast medium extravasation on the medial side of the right kidney (Fig. 1). Because the origin of retroperitoneal bleeding was unclear and the advanced age of the patient, which increased the risk for adverse effects from general anesthesia, angiography was performed by an experienced interventional radiologist. Selective right renal arteriography confirmed a perforation in the proximal right main renal artery, approximately 3 cm from the ostium (Fig. 2A).

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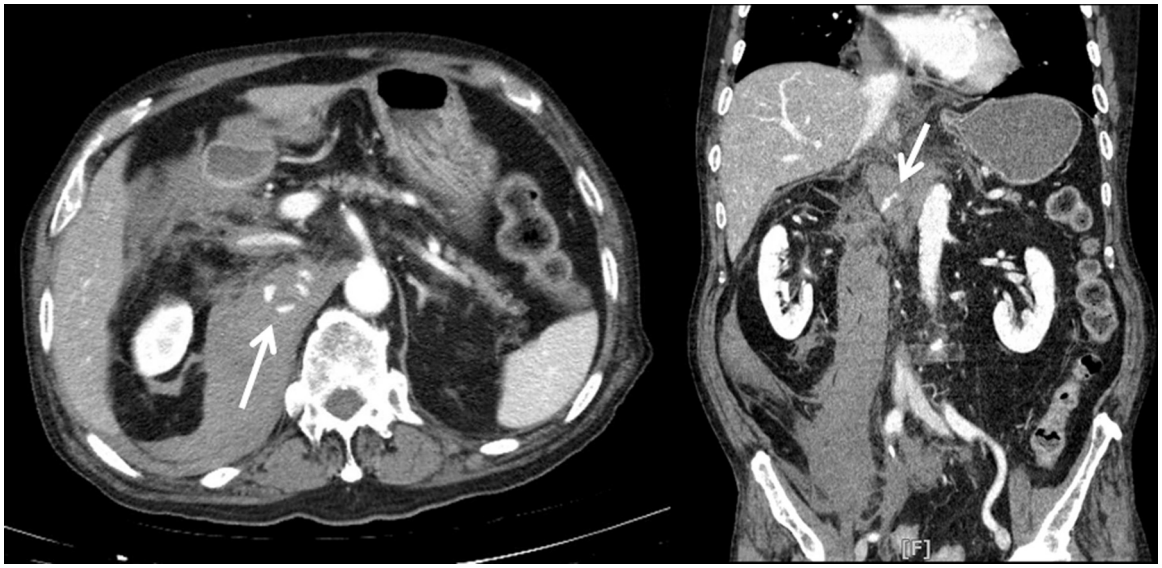

Fig. 1. Initial contrast-enhanced abdominal CT scan, showing contrast medium extravasation medial to the right kidney.

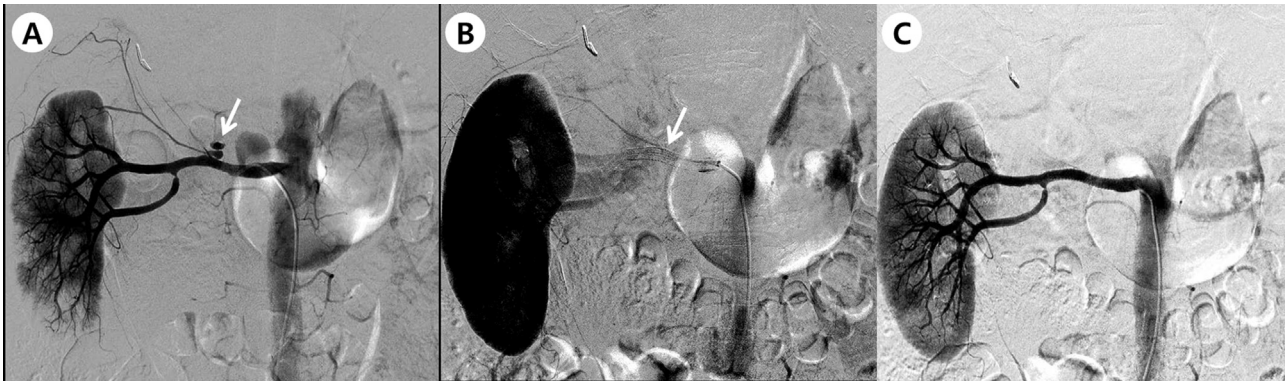

Fig. 2. Selective right renal arteriography, showing (A) a perforation in the proximal right main renal artery approximately 3 cm from the ostium, (B) successful implantation of a covered stent under the perforated site, and (C) satisfactory restoration of distal flow.

Review by an interventional radiologist and a vascular surgeon suggested the feasibility of endovascular repair using a right transfemoral approach. Thus, a 6 × 50 mm covered stent (nitinol metal stent covered with polytetrafluoroethylene, VIABAHN® endoprosthesis; W.L. Gore & Associates, Flagstaff, AZ) was placed across the perforation site in the right renal artery (Fig. 2B). The time from injury to stent placement was 5 h. Subsequent angiography showed good blood flow across the stented segment and restoration of distal flow (Fig. 2C). Thus, the patient was transferred to the surgical intensive care unit for close monitoring. Beginning on the third day of hospitalization, the patient initiated aspirin at 100 mg/day. He was discharged 12 days after admission, with instructions to take 100 mg/day aspirin to prevent thrombotic occlusion of the stent graft. He reported being satisfied that he did not need a laparotomy. A follow-up abdominal CT scan 3 months later showed that the covered stent was patent, and the hematoma had completely resolved (Fig. 3). After 1 year, the patient was normotensive and had a normal serum creatinine level.

3. Discussion

Renal arterial injury due to blunt abdominal trauma is rare, and an intimal tear is the most likely cause of the vascular occlusion. Despite the low incidence of this type of injury, the rate of detection has increased due to the increasing use of CT scans to evaluate and manage patients with blunt abdominal trauma. Injuries to the left kidney are slightly more common (ratio of 1.4–2:1), because the right renal artery is protected and stabilized by the inferior vena cava and duodenum, whereas the left renal artery is shorter and more acutely angled, and therefore more susceptible to stretch injury. Children may also be more susceptible to renal artery injury following blunt trauma because of their relatively larger kidneys, their greater mobility, and their more limited surrounding protective tissues [2,8,11].

Penetrating or blunt trauma can cause isolated renal artery injury. A blunt trauma may cause renal artery injury due to sudden acceleration-deceleration forces that stretch the vessel wall, or due to direct impact that compresses the renal vessel against the vertebral column. These forces can lead to intimal tearing, dissection, thrombosis, pseudoaneurysm, and complete or incomplete transection of the renal artery. Because the kidneys are fixed in place only by the vascular pedicle and ureter, injuries usually occur at the proximal part of the artery, about 2–4 cm from the origin of the main renal artery [4,12,13].

A diagnosis of blunt renal artery injury may be delayed due to the absence of specific symptoms and signs. Hematuria is not present in 36% of patients who sustain renal vascular injury [14], so gross hematuria may be unreliable indicator. Patients with renal artery avulsions and lacerations may present with hemorrhagic shock. However, most intimal injuries and minor lacerations are

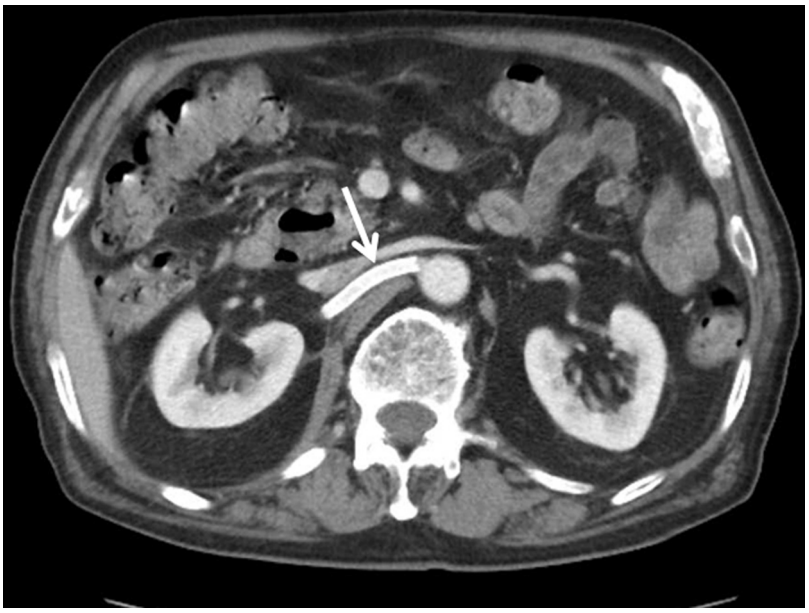

Fig. 3. Follow-up CT scan showing the patency of the covered stent.

asymptomatic. A high index of suspicion, together with high quality imaging, is essential for early detection and treatment of these injuries. Previous studies recommend contrast-enhanced CT for imaging of renal trauma patients, in which the suggestive findings are irregular linear hypodensities, including delayed or diminished enhancement of the affected kidney; non-opacification of the pelvicalyceal system; "cortical rim sign" indicative of non-enhancing renal parenchyma, except for the peripheral outer portion of the cortex; and direct visualization of a renal artery irregularity, filling defect, contrast medium extravasation, or complete vessel occlusion [4,11,15]. Chow et al. suggested that CT results suggesting a need for angiography and embolization may include arterial lacerations, avulsions, global or segmental hyperperfusion of the kidney, intimal tears or false aneurysms, subsegmental arterial bleeding, and thrombosis. Selective renal angiography remains the gold standard for diagnosis of renal artery injury because of its high sensitivity and specificity [16].

The optimal treatment for blunt renal artery injuries depends on the type of injury and characteristics of the patient. Management decisions are mainly based on the patient's hemodynamic status and the extent of damage to the renal artery. A minor renal artery injury should be treated conservatively, but aggressive renal revascularization may be attempted in patients with a unilateral occlusion in a solitary kidney or bilateral injury of renal arteries to restore adequate renal function. Historically, the long-term results after renal revascularization have been unsatisfactory due to the high incidence of hypertension and the need for a subsequent nephrectomy [3,17]. For example, a study of 34 patients who received surgical revascularization for renal artery injuries reported that 8 (23%) had satisfying technical results, whereas 6 (18%) developed postoperative hypertension [18]. Another study reported reduced renal function in 67% of patients who underwent successful revascularization for unilateral renal artery injury after a mean follow-up time of 1.8 years [19]. The incidence of delayed nephrectomy for renovascular hypertension ranges from 12% to 35% [3]. If the renal artery is injured at the hilum area, nephrectomy should be the treatment of choice [20]. Nephrectomies have also been performed semi-electively to prevent infection and septic complications from an infarcted kidney, and to prevent the development of delayed renovascular hypertension and subsequent renal insufficiency.

In recent years, endovascular therapy appears to be the best therapeutic option for management of most blunt renal artery injuries. Stent placement in a renal artery is a well-established elective treatment for atherosclerotic vascular disease and fibromuscular dysplasia [21]. Endovascular stenting of renal arteries provides limited benefit for patients with traumatic injuries, because maintaining stent patency requires anticoagulation, which is inappropriate if the patient is bleeding at other sites. Several recent case reports have described favorable outcomes from renal artery stenting in the trauma setting [4–9]. All previous studies describing endovascular treatment for blunt renal arterial injury examined occlusion or stenosis of the renal artery after trauma [9]. To the best of our knowledge, the present study is the first case report of endovascular treatment of a perforated renal artery after blunt trauma. Endovascular treatment may reduce the likelihood of extensive abdominal surgery, damage of surrounding organs, risk of bleeding, and postoperative morbidity. We regarded embolization as inappropriate for kidney salvage in our patient, and therefore used a self-expanding covered stent to bypass the perforated site.

4. Conclusion

Endovascular management such as covered stenting may be beneficial and feasible for hemodynamically stable patients with blunt renal arterial perforation. Long-term follow-up of these patients is needed to check for the development of delayed renovascular hypertension. Because the success rate of surgical revascularization is poor, endovascular management of traumatic renal arterial perforation is often the best option for preservation of renal function in hemodynamically stable patients who are unsuitable for laparotomy due to risks associated with general anesthesia and who can tolerate anticoagulation therapy.

Conflicts of interest

None.

Funding

None.

Ethical approval

Because this was a report of an interesting case, and not a trial or observational research, we had an exemption from ethical approval.

Consent

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

Author contribution

Hunkyu Ryeom contributed to the endovascular procedure of this patient.

Kyoung Hoon Lim and Jinyoung Park were involved with the case and writing of the manuscript, general management of the patient and revised the manuscript for important intellectual content.

All authors read and approved the final manuscript.

Registration of research studies

None.

Guarantor

Kyoung Hoon Lim, Hunkyu Ryeom, Jinyoung Park.

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