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Traumatic renal artery occlusion associated with a grade III hepatic injury in an 11-year-old boy: A case report

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ABSTRACT

Blunt trauma represents a major cause of death in children. Multi-trauma is defined as life-threatening injury of two or more body regions and remains a challenge for diagnosis and therapy. Here, we present a case of an 11-year-old boy with a traumatic renal artery occlusion associated with a hepatic injury, which was treated with conservative non-operative treatment. Prompt diagnosis and conservative treatment of a traumatic renal artery occlusion in a pediatric patient may lead to a successful outcome, avoiding unnecessary laparotomy.

Trauma is the leading cause of morbidity and mortality in the pediatric population. There has been a shift to conservative management of solid-organ injuries in children. Renal artery injury is an uncommon complication of blunt abdominal trauma. However, the management of renal artery injury remains controversial. Some patients do well with conservative management, while others require emergency or urgent surgery. Treatment is chosen based on the patient's hemodynamic status, renal function, and the feasibility of the treatment modality. Here, we present a case of an 11-year-old boy with right renal artery occlusion associated with a grade III hepatic injury which was treated with non-operative conservative therapy.

1. Case report

An 11-year-old child was brought to the emergency department 40 min after a motor vehicle accident. On admission, he was hemodynamically stable. Physical examination revealed mild tenderness over the right abdomen with no guarding or rigidity. Initial laboratory investigation found a hematocrit of 37.7, a normal coagulation panel and moderate transaminitis (AST 696 IU/L, ALT 597 IU/L). Urinalysis showed microscopic hematuria. He was started on intravenous (IV) fluids and a computed tomography (CT) scan was obtained, which showed a 5 cm liver laceration involving segments 5 and 6 (grade III) with a small amount of hemoperitoneum. It also revealed lack of contrast enhancement of the right kidney, with focal extravasation of contrast medium and surrounding hematoma, suggesting renal vascular injury (Fig. 1a–c). The left kidney was normal. Moreover, radiographs and CT scans demonstrated a right proximal humerus fracture which was treated with non-operative conservative therapy.

After stabilization, he was taken to the emergency interventional radiology suite for diagnosis and treatment (4 h after injury). Superior mesenteric arteriography revealed intact portal venous flow. Celiac arteriography did not reveal extravasation from the posterior segmental branch of the right hepatic artery or in the area of the liver laceration. This branch was embolized with gelatin sponge particles. Right renal arteriography revealed complete occlusion of the main renal artery (grade IV renal injury) by an intimal flap (Fig. 2). In an attempt to preserve the patient's renal function, recanalization and angioplasty of the renal artery was performed, but treatment was unfortunately unsuccessful.

Surgical revascularization of the renal artery has a low probability of success, and is technically challenging, with high potential morbidity. In light of the patient's hemodynamic stability, he was treated with IV fluids and bed rest. Serial hemoglobin levels revealed him to be hemodynamically stable throughout his hospitalization. Serum creatinine was within normal limits.

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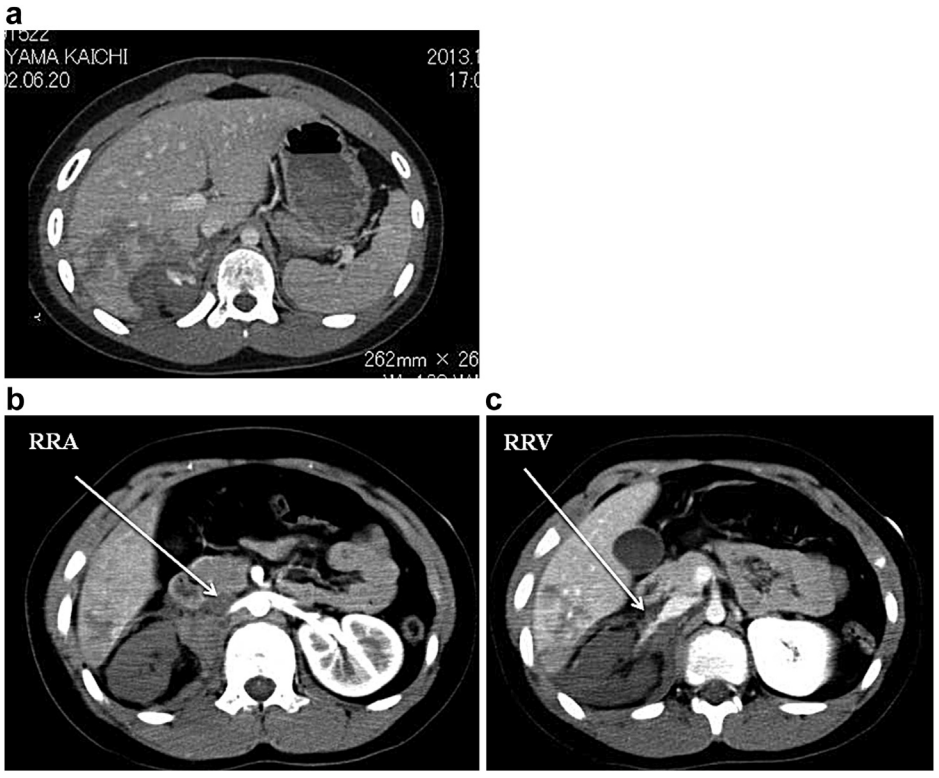

Fig. 1. (a–c) CT scan showed a 5 cm liver laceration involving segments 5 and 6 (grade III) with a small amount of hemoperitoneum. It also revealed lack of contrast enhancement of the right kidney, with focal extravasation of contrast medium and surrounding hematoma. The left kidney was normal. RRA: right renal artery, RRV: right renal vein.

A follow-up abdominal CT scan with contrast on hospital day 12 showed nonenhancing areas over the right renal parenchyma with contrast-enhancement in the cortical area (cortical rim sign) without perinephric abscess formation (Fig. 3).

He was discharged in good condition on hospital day 14. During follow-up at two and six weeks after discharge, the patient was doing well, without abdominal complaints. Two months following the trauma, imaging revealed resolution of the retroperitoneal hematoma. The injured right kidney underwent atrophy and the left kidney underwent compensatory hypertrophy (Fig. 4a). There was no evidence of function in the right kidney on 99mTc-DTPA (diethylene-triamine-pentaacetic acid) scan (Fig. 4b). On six-month follow-up, the patient was well and had no signs of renovascular hypertension.

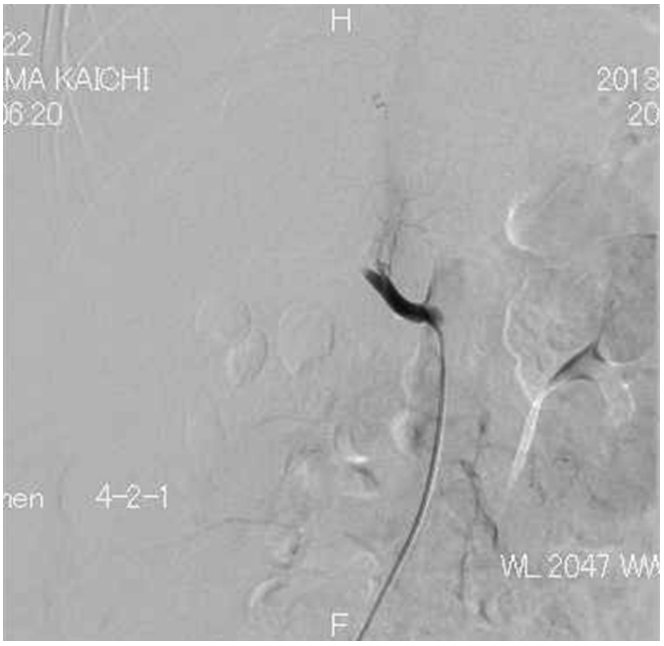

Fig. 2. Right renal arteriography revealed complete occlusion of the main renal artery (grade IV renal injury) by an intimal flap.

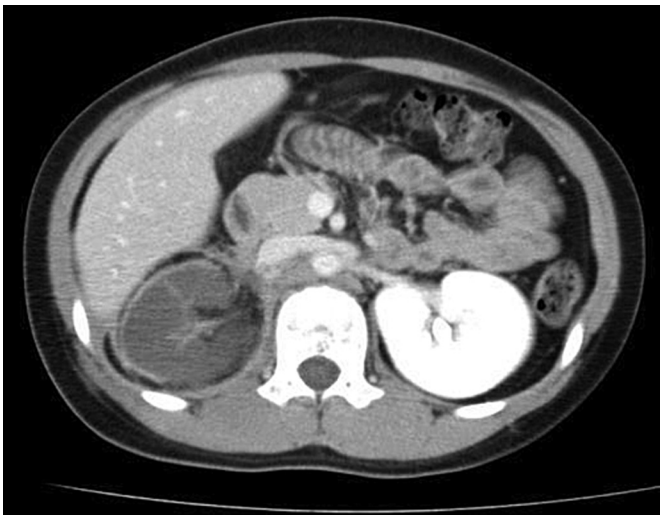

Fig. 3. CT scan with contrast showed nonenhancing areas over the right renal parenchyma with contrast-enhancement in the cortical area (cortical rim sign) without perinephric abscess formation.

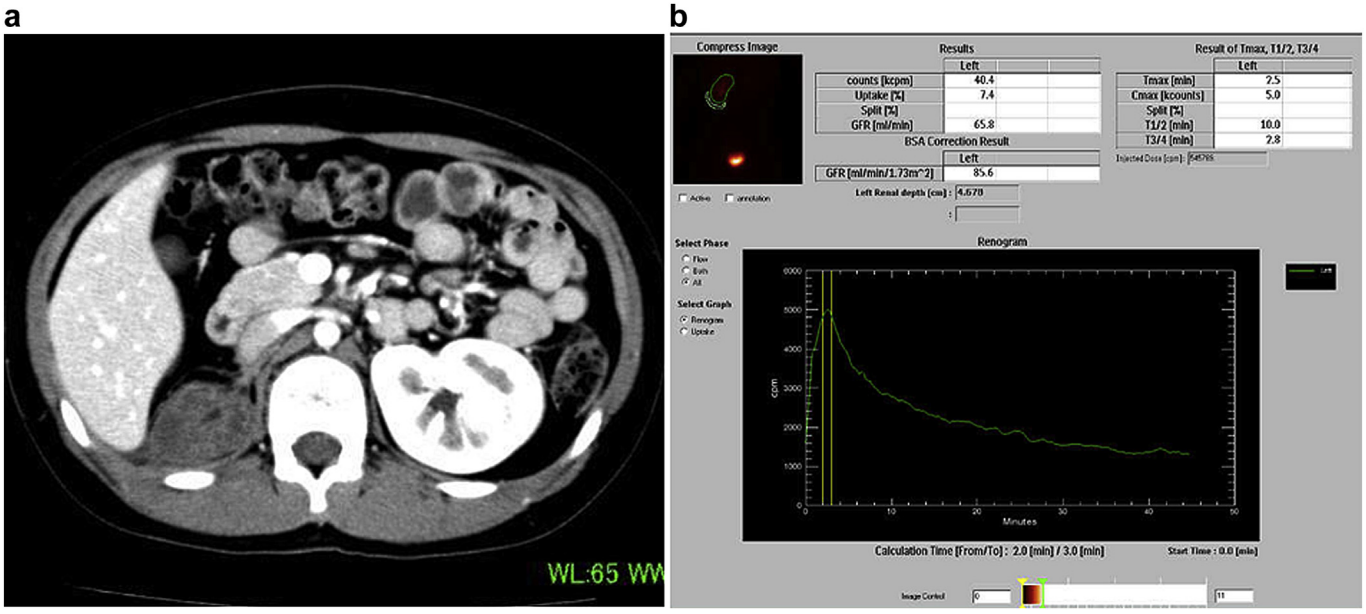

Fig. 4. (a) The injured right kidney underwent atrophy and the left kidney underwent compensatory hypertrophy. (b) Nuclear medicine renogram performed 2 months after injury shows no evidence of function in the right kidney.

2. Discussion

The pediatric kidney sustains injury in approximately 10% of all abdominal trauma cases, with blunt trauma accounting for 85% of all renal injuries [1,2]. Children are thought to sustain more renal injuries than adults because of important anatomic differences; children's kidneys are larger in proportion to overall body size than those of adults. They have more lobulations and have less protection from the immature rib cage and flank musculature and the lower volume of perirenal fat [3]. The ultimate goal of managing pediatric renal trauma is preservation of renal tissue and, at the same time, minimizing patient morbidity. Fortunately, 90% of blunt renal injuries seen in pediatric populations are self-limiting and may be treated with cautious nonoperative approaches [4,5].

Using CT, the injury grade can be staged (graded) according to the American Association for the Surgery of Trauma Organ Injury Severity Scale [6]. Almost 85% of pediatric renal injuries are considered relatively minor, with grade I and II contusions and minor parenchymal lacerations predominating. Traumatic renal artery occlusion is rare. Various studies report the overall incidence of renal artery injuries as 0.05–0.1% in children [7–9]. As in our case, renal vascular injuries rarely occur in isolation. Cass et al. have reported an average of 3.7 associated injuries per patient, with 85% of patients requiring laparotomy for their intra-abdominal injuries [10].

The pathogenesis of renovascular injuries due to blunt trauma is thought to be caused by rapid deceleration, which results in stretching of the renal vasculature, disruption of the arterial intima, and arterial thrombosis. Blunt arterial injury occurs more commonly on the left side than on the right side because the right renal artery is longer than the left and may be better able to withstand the stretching caused by deceleration [11].

Although there is little controversy regarding management of low-grade, less complex renal injuries in hemodynamically stable patients or the management of high-grade, complex renal injuries in hemodynamically unstable patients, the approach to a relatively severe injury in a hemodynamically stable patient depends on time to diagnosis, type and extent of the vascular injury, and extent of the associated injuries. Treatment options include immediate surgical revascularization, nephrectomy, and non-operative therapy [12].

It is clear that surgical revascularization or stent placement should be attempted in patients with bilateral injury or a solitary kidney [9]. In these situations, success should be defined by the deferral of dialysis. In contrast, the optimal treatment in unilateral renal artery injury in a patient with two kidneys like our case is a dilemma because management of renal artery occlusion remains controversial. The main reason performing revascularization of a unilateral renal artery occlusion secondary to intimal injury with thrombosis is to preserve sufficient renal function in order to avoid the need for renal replacement therapy if the patient ever loses the contralateral kidney. The second purpose of revascularization is to prevent renovascular hypertension, which is a major problem after conservative treatment renal artery occlusion.

Nonoperative management is currently the accepted therapeutic option in most patients with traumatic collusion of the main renal artery. Surgical revascularization after renal artery occlusion requires special expertise. The results of surgical revascularization have been poor, with long-term preservation of kidney function in fewer than 25% of patients [13,14]. Kidney salvage rates have been especially low after surgical revascularization of blunt injuries, with very high rates of recurrent thrombosis [7,13,14]. These poor results have convinced most surgeons that operative renal artery revascularization should be avoided when there is a functioning contralateral kidney [14,15]. Moreover, the majority of these patients have other life-threatening injuries, the management of which takes a high priority. These situations have resulted in a shift toward a more conservative approach to this kind of injury. Recently, there have been reports about percutaneous revascularization by endovascular stenting in stable patients with unilateral renal artery occlusion [16–21]. However, the feasibility and effectiveness of this modality has not been confirmed [16].

A review of the literature shows very few pediatric patients with traumatic renal artery injury/occlusion [12–14]. Many other large series in the review literature gave a mean age of presentation with no subgroup of pediatric cases. Gonzalez et al. reported nine

conservatively-managed pediatric cases. There are also three pediatric cases reported that were managed by endovascular treatment [22]. Jawas et al. advocated conservative treatment in unilateral cases, with surgical revascularization only in cases of bilateral injuries and injuries associated with solitary kidneys [9]. We think the same is applicable to pediatric patients. Moreover, if renal function and vital signs are normal, invasive treatment such as surgical or endovascular revascularization may not be necessary, because medical treatment alone with strict blood pressure control is as effective as surgical management.

The follow-up of these conservatively managed patients is very important. One of the most important complications is renovascular hypertension. About 25–50% of these patients will develop hypertension; most patients who develop renovascular hypertension, most within the first year after the trauma [13]. These patients may need delayed nephrectomy. However, the incidence of hypertension is less in pediatric cases of renal artery occlusion. The true incidence is underreported due to the traditionally poor long-term follow up in trauma series. The reported incidence is 0%–6.6% in the pediatric literature [23–26]. In a retrospective study, Cortes-Gonzalez et al. reported hypertension to be present in only two of nine pediatric cases reported. The reason for this may be age and absence of age-related vascular disorders already present before the time of trauma [22].

Some studies have verified that conservative treatment of major blunt renal or hepatic trauma is appropriate in hemodynamically stable patients. However, the association of two or more solid organ lesions is a predictor of failure of a conservative approach. Our case is of successful conservative non-operative management of a high-grade (IV) renal injury associated with an intermediate (grade III) hepatic lesion. Arteriography is important in the non-surgical treatment of hepatic and renal trauma in hemodynamically stable patients like our case, and we consider that transcatheter arterial embolization (TAE) may also be useful in the nonsurgical management of severe blunt hepatic trauma and an excellent alternative to laparotomy in children. We attempted endovascular intervention of renal artery occlusion. Unfortunately, the treatment was unsuccessful, but surgical revascularization of renal artery dissection is no longer performed in this patient. The kidneys may have a potential for spontaneous recovery even long after occlusion because of the development of sufficient collaterals [27,28]. But the incidence and the factors related to this late spontaneous recovery are not yet. Because of the patient's stable vital signs and normal renal function, we elected to manage him conservatively. Follow-up CT showed that the infarcted right kidney was atrophied and the left kidney developed compensatory hypertrophy (Fig. 4a), while the patient's blood pressure remained normal.

We consider that when renal function is normal, non-operative conservative treatment, rather than surgical or endovascular revascularization, may be sufficient. However, we might have attempted delayed endovascular procedures like stent placement and thrombolysis following angiography and percutaneous balloon revascularization because this patient was hemodynamically stable. We should take the patient's medical status into consideration when deciding treatment for renal artery occlusion.

3. Conclusion

Traumatic renal artery occlusion is a rare occurrence in the pediatric age group. As demonstrated by our case, prompt diagnosis and conservative treatment of a traumatic renal artery occlusion in a pediatric patient may lead to a successful outcome, avoiding unnecessary laparotomy.

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