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.

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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 transaminitsis (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.
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. 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.

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.
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].

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 90% of blunt renal injuries seen in pediatric populations being self-limiting and may be treated with cautious nonoperative approaches [4,5].

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 collision 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 pedi-
atriic cases reported that were managed by endovascular treat-
ment [22]. Jawas et al. advocated conservative treatment in uni-
ilateral 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 renovas-
cular hypertension. About 25–50% of these patients will develop
hypertension; most patients who develop renovascular hyperten-
sion, most within the first year after the trauma [13]. These patients
may need delayed nephrectomy. However, the incidence of hyper-
tension 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 man-
agement of severe blunt hepatic trauma and an excellent alterna-
tive 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 pe-
diatric 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.

References

pseudoaneurysm after blunt renal trauma in a pediatric patient: management
[3] Brown SL, Elder JS, Spinak JP. Are pediatric patients more susceptible to major
138–40.
Nonoperative management of blunt pediatric major renal trauma. Urology
[5] Dinkel HP, Danuser H, Triller J. Blunt renal trauma: minimally invasive man-
gement with microcatheter embolization experience in nine patients. Radi-
Association for the Surgery of Trauma Organ Injury Scale I: spleen, liver,
and kidney, validation based on the National Trauma Data Bank. J Am Coll Surg
Management and hospital outcomes of blunt renal artery injuries: analysis of
517 patients from the National Trauma Data Bank. J Am Coll Surg 2006;203:
317–22.
[8] Bruce LM, Croce MA, Santanilimo JM, Miller PR, Lyden SP, Fabian TC. Blunt renal artery
injury: incidence, diagnosis, and management. Am Surg 2001;67:
317–22.
risk assessment, surgical management, and outcome. J Trauma 1990;30:
547–52. discussion 553–4.
[12] Fraser JD, Aguayo P, Ostlie DJ, St Peter SD. Review of the evidence on the
management of blunt renal trauma in pediatric patients. Pediatr Surg Int
[13] Haas CA, Dinchman KH, Nasrallah PF, Spirnak JP. Traumatic renal artery oc-
[14] Eliott SP, Olweny EO, McAninch JW. Renal arterial injuries: a single center
analysis of management strategies and outcomes. J Urol 2007;178:
2451–5.
Evaluation and management of renal injuries: consensus statement of the renal
trauma subcommittee. BJU Int 2004;93:937.
[16] Lee SH, Lee HC, Oh SJ, Park MC, Park KJ, Moon YS, et al. Percutaneous inter-
vention of spontaneous renal artery dissection complicated with renal
infarction: a case report and literature review. Catheter Cardiovasc Inter-
v 2003;60:335–8.
in a patient with a solitary kidney: case report of treatment with endovascular
[18] Flugrslub CB, Breedle M, Roise O. Endovascular stent in the acute treatment of
management with microcatheter embolization experience in nine patients. Radi-
treated by insertion of a Palmaz stent. Cardiovasc Interv Radiol 1998;21:
69–72.
taneous renal artery intervention in a patient with acute traumatic renal artery
72.
management of unilaterial renal artery occlusion secondary to blunt abdominal
ence with conservative management at a pediatric trauma center. J Trauma
2002;52:928–32.
[26] Nance ML, Lutz N, Carr MC, Canning DA, Stafford PW. Blunt renal injuries in
children can be managed nonoperatively: outcome in a consecutive series of
[27] Radmayr C, Oswald J, Müller E, Höltl L, Bartsch G. Blunt renal trauma in
children: 26 years clinical experience in an alpine region. Eur Urol 2002;42:
297–300.