CASE REPORT

Acute traumatic renal arteriocalyceal fistula: selective angioembolisation for haemodynamic instability

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SUMMARY

Abdominal angiography with selective arteriography and subsequent embolisation is an accepted management modality in the treatment of selected solid organ injuries following blunt abdominal trauma. This management practice is well established in the haemodynamically stable patient; however, this remains more controversial in haemodynamically compromised patients, though warrants consideration in both cases due to the associated benefits of non-operative management. This case report describes the successful non-operative management of a severe renal injury in a young polytraumatised patient following a high-speed motor vehicle crash. In addition, the rare CT diagnosis and management of an acute traumatic arteriocalyceal fistula is discussed with a focus on the importance of renal parenchymal preservation.

BACKGROUND

Most blunt renal injuries are managed non-operatively and are generally associated with no major long-term sequelae.¹ However, the long-term development of hypertension is a complication that may occur following renal trauma. Traumatic renal arterial injuries secondary to blunt abdominal trauma are potentially fatal and require rapid diagnosis and definitive management. Surgical repair is indicated in the presence of persistent haemodynamic instability, renal vascular pedicle injury and significant renal collecting system injury.¹ Traumatic arteriocalyceal fistula (arterial bleeding directly into a renal calyx) is a rare entity that has seldom been described in the literature.^{2–4} Persistent post-traumatic gross haematuria may be secondary to such a fistula. One case report from 1981 describes the delayed diagnosis of a traumatic arteriocalyceal fistula on angiography 7 days post-original injury—a stab wound to left upper quadrant.²

Usually, blunt abdominal trauma associated with gross haematuria requires CT imaging of the renal tract (CT of the abdomen/pelvis with intravenous contrast, including a dedicated delayed phase or excretory phase to assess the renal collecting system) to rule out urological trauma.⁵ However, a traumatic arteriocalyceal fistula is often not identified via CT imaging.⁶ This may be due to various factors including that arterial extravasation may not be directly observed as the pyelocalyceal tract is often already opacified from previous contrast studies (eg, a prior CT angiogram of the neck and/

or chest).² In addition, significant pararenal compression, such as that from a large expanding perinephric haematoma, may induce resistance to rapid flow of contrast from the artery into the calyx. An arteriocalyceal fistula is more likely to be detected angiographically and consequently represents the gold standard investigation when suspicious of a renovascular injury in a trauma patient.¹

In this case the rare diagnosis of an acute traumatic arteriocalyceal fistula was identified on CT-imaging early during the patient's initial presentation. This timely diagnosis proved critical and allowed prompt angiographic management in the haemodynamically labile patient. In addition, this case demonstrates the importance of pursuing non-operative management (via abdominal angiography and selective angioembolisation) in traumatic solid organ injury patients who would have previously undergone operative management. This approach may result in maximal parenchymal preservation.

CASE PRESENTATION

A 20-year-old man, a single occupant driver was admitted to Royal Perth Hospital (the state level 1, adult major trauma centre) following a high-speed motor vehicle crash. According to first responders, the patient had been ejected from the vehicle and the vehicle had been split in half on impact with a tree.

At the injury scene, the patient was haemodynamically unstable and agitated. His Glasgow Coma Scale score was 8. On arrival to the emergency department, he remained haemodynamically unstable (heart rate 140, blood pressure 82/50) and his Glasgow Coma Scale score had decreased to 4. Standard Advanced Trauma Life Support protocol was followed. He was intubated, underwent an aggressive haemostatic resuscitation and required a right-sided intercostal catheter for a large pneumothorax and associated pulmonary contusions (identified on chest X-ray in the trauma bay). A urinary catheter was inserted with no immediate complications. Frank haematuria was present. Following the primary and secondary survey, the patient was haemodynamically stabilised, and was taken for CT scanning of the head, neck and torso, prior to transfer to the intensive care unit for on-going fluid resuscitation, haemodynamic and ventilatory support.

CT imaging of the abdomen (with intravenous contrast) revealed multiple liver lacerations involving multiple segments, a complex right renal

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laceration (grade 4) and associated perinephric haematoma with acute contrast extravasation (suggestive of active bleeding), and a grade 2 laceration of the anterior pole of the spleen associated with contrast extravasation (suggestive of active bleeding). In addition, a right-sided arteriocalyceal fistula was identified due to the presence of a hyperdense unilateral ureter early in the arterial phase (suggestive of the right calyx and ureter filling with arterial contrast or blood during the arterial phase while the left ureter remained non-opacified during the arterial phase) and hyperdense extravasation into the bladder via the right vesicoureteric junction (a ureteric jet of arterial contrast) producing a layering effect within the bladder (figures 1 and 2).

The patient was urgently transferred to the interventional radiology suite to undergo angioembolisation of both the right renal and splenic injuries. The trauma team, consisting of a trauma surgeon, an anaesthetist, an intensive care unit doctor and other junior surgical and critical care staff, continued to monitor and resuscitate the patient in the angiography suite.

The emergent angiogram was performed via a right common femoral artery puncture. The catheter placed in the right renal artery demonstrated both rapid filling of the renal vein and inferior vena cava from the upper pole (in keeping with an arteriovenous fistula) and also rapid filling of the pelvicalyceal system in keeping with active extravasation into the pelvicalyceal system and ureter. This represented the formation of a traumatic arteriocalyceal fistula whereby arterial blood was filling the renal calyx and ureter (figures 3–5). These areas were selectively

Figure 1 Right ureter (red circle) hyperdense during arterial phase. Left ureter (yellow circle) non-opacified during arterial phase (normal finding).

Figure 2 Hyperdense extravasation into the bladder via the right vesicoureteric junction (a ureteric jet of arterial contrast—see red arrow).

Figure 3 Angiogram sequence 1 of 3—traumatic arteriocalyceal fistula demonstrated by rapid filling of the pelvicalyceal system in keeping with active extravasation into the calyx and ureter.

Figure 4 Angiogram sequence 2 of 3—traumatic arteriocalyceal fistula demonstrated by rapid filling of the pelvicalyceal system in keeping with active extravasation into the calyx and ureter.

Figure 5 Angiogram sequence 3 of 3—traumatic arteriocalyceal fistula demonstrated by rapid filling of the pelvicalyceal system in keeping with active extravasation into the calyx and ureter.

Figure 6 Successful embolisation of right-sided arteriocalyceal fistula.

embolised successfully with complete cessation of bleeding from the kidney at the end of the procedure (figure 6). The right main renal artery was not embolised and preserved. The angiogram of the spleen demonstrated a trace of contrast extravasation relating to the lateral aspect of the spleen; however, due to an arcuate ligament and severe angulation of the coeliac axis the splenic artery itself could not be catheterised and as a result the splenic injury could not be treated. The splenic injury was successfully managed non-operatively.

OUTCOME AND FOLLOW-UP

Repeat percutaneous abdominal angiogram performed 7 days post initial angioembolisation of the right renal arteriocalyceal fistula revealed no evidence of renal or splenic pseudoaneurysm, fistula or contrast extravasation. The patient was discharged home after a 36-day hospital admission.

DISCUSSION

Arteriocalyceal fistula remains an uncommon diagnosis in patients who experience blunt abdominal trauma (BAT) and this is evidenced by its limited description in the literature (PubMed, EMBASE, Ovid, MEDLINE).¹⁻³ Selective angioembolisation is a non-invasive, effective and preferred management option in most patients.¹⁻⁶ Patients who experience BAT and frank haematuria usually undergo CT imaging prior to consideration of angiographic management. Two important CT findings consistent with a traumatic arteriocalyceal fistula include: a unilateral hyperdense ureter during the arterial phase of a contrast CT abdomen (suggestive of arterial blood and contrast filling the ureter) and hyperdense extravasation into the bladder via a single vesicoureteric junction (a ureteric jet of arterial contrast). To ensure early mobilisation of the interventional radiology team in the trauma setting, clinicians must be aware of these subtle CT findings that may significantly alter patient management pathways (non-operative intervention via angioembolisation).

In the haemodynamically stable patient, non-operative management of solid organ injury after BAT is now widely accepted as standard practice. It is also universally accepted that the haemodynamically unstable BAT patient (despite aggressive volume resuscitation) must undergo immediate operative

management. However, it is becoming increasingly recognised that successful non-operative management is possible in another subgroup of patients.⁴⁻⁷ Those considered to be of 'assisted stability' or the 'metastable patient'; a patient with evidence of on-going volume loss that can be controlled haemodynamically with volume resuscitation ($\pm$ inotrope support) long enough to undergo CT imaging and subsequent angioembolisation. While this concept remains somewhat controversial, the importance of solid organ parenchymal preservation in the generally young trauma patient population must be significantly considered in the management decision of the 'metastable' patient.

Operative management of a haemodynamically labile patient with splenic and/or renal injuries will often lead to splenectomy and/or nephrectomy at laparotomy.¹⁻² In the multitrauma patient at risk of contrast nephropathy and haemorrhagic-shock-induced acute tubular necrosis, as well as postsplenectomy sepsis and impaired immune function, parenchymal preservation may be of significant benefit in determining the degree of organ recovery and the patient's long-term morbidity.⁸

The authors suggest that in appropriately resourced level 1 trauma centres, with 24 hour access to experienced trauma surgeons, interventional radiologists and intensive care specialists, haemodynamically labile patients with solid organ injury may be considered for non-operative management including the use of angioembolisation, instead of operative intervention. It is important to acknowledge that experienced trauma surgeons and critical care doctors are present to perform on-going resuscitation and monitoring of the patient during the angioembolisation process, and be prepared to swiftly proceed to the operating theatre if angiographic management fails. There remains a subset of patients who are too haemodynamically unstable to undergo any CT imaging and must proceed directly to the operating theatre on arrival to the emergency department.

In this case report, a 20-year-old man multitrauma victim, underwent angiographic management of his solid abdominal organ injuries, avoiding a laparotomy and possibly a nephrectomy and splenectomy. The management of this specific clinical scenario is particularly suited to be performed in a hybrid operating theatre with angiographic capabilities where surgical and endoluminal techniques may be used side-by-side.

Learning points

- ▶ CT-findings consistent with a traumatic arteriocalyceal fistula include: (1) a unilateral hyperdense ureter during the arterial phase of a contrast-enhanced CT abdomen, and (2) hyperdense extravasation into the bladder via a single vesicoureteric junction.
- ▶ Persistent frank haematuria following blunt abdominal trauma may be secondary to a traumatic arteriocalyceal fistula.
- ▶ Angioembolisation of renovascular trauma is feasible as a first line management in select haemodynamically labile patient groups at appropriately resourced trauma centres. This may avoid the need for surgical management (partial or complete nephrectomy) resulting in increased parenchymal preservation.

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Competing interests None declared.

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