Management algorithm for complete blunt renal artery occlusion in multiple trauma patients: Case series

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Abstract

Objective: To study the management of complete renal artery occlusion in multiple trauma patients so as to develop a management algorithm.

Design: Retrospective study.

Patients and methods: All blunt trauma patients who had complete renal artery occlusion and were treated at Tawam and Al-Ain Hospitals during 2005–2007 were studied.

Results: There were five patients having a median age of 21 years and a median ISS of 34. Four were males and four had motor vehicle collisions. Three had the injury on the right side while two on the left side. Three patients were treated conservatively. The kidney was left in situ in one patient who underwent damage control laparotomy. An attempted renal artery repair was aborted due to haemo-dynamic instability in another patient. Patients were followed up for a median of 9 months and creatinine was normal in all patients. One patient developed hypertension and had interval nephrectomy.

Conclusions: Conservative management is advised in the treatment of unilateral complete blunt renal artery thrombosis. These patients need close follow-up for the risk of hypertension. Blunt renal artery thrombosis in multiple trauma patients indicates severe injury. Surgeons should critically assess the added risk of mortality against chances of recovering the renal function.

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1. Introduction

Renal artery thrombosis is a rare complication of blunt abdominal trauma. It was initially described by Von Recklinghausen in 1861. However, not many cases have been reported in the literature (less than 400 cases).

Optimal management of traumatic renal artery occlusion has been controversial; options include immediate surgical revascularization, nephrectomy and non-operative conservative therapy. Even with the aggressive approach of prompt surgical revascularization, return of normal renal function is rarely achieved. Moreover, the majority of these patients have other life threatening associated injuries, the management of which takes a high priority. These situations have resulted in a shift toward more conservative approach toward this kind of injury. To support this approach, we report our experience in managing complete blunt renal artery occlusion and suggest a management algorithm for this condition.

2. Patients and methods

The medical records of all patients with complete blunt traumatic renal artery occlusion who were managed at Al-Ain and
Tawam Hospitals between January 2005 and December 2007 were retrospectively studied. Only patients with complete occlusion of renal artery were included. These cases were analyzed for age, sex, mechanism of injury, site of injury, CT findings, associated injuries, treatment provided and outcome. The Injury Severity Score (ISS) was calculated manually by the Trauma Registry coordinator. Data were retrieved from our hospital based Trauma Registry. The Local Ethics Committee of Al-Ain Health District Area has approved data collection for all trauma patients who were admitted to Al-Ain and Tawam Hospitals for more than 24 h and all patients who have died after admission or in the Emergency room to be entered into our Trauma Registry. These two hospitals are tertiary centers with the availability of general and vascular surgeons, urologists, and critical care physicians. The care of these patients was multidisciplinary.

3. Results

There were five patients with complete unilateral renal artery occlusion. An average of 1600 blunt trauma patients is admitted to both hospitals annually. This gives an incidence of 0.1% for this rare condition. The median (range) age of these patients was 21 (7–43) years. There were four males and one female. All patients were healthy with no previous known co-morbidities. Motor vehicle collision caused four of these injuries and the fifth injury was caused by a fall from a height. High injury blunt trauma was the cause in all patients. Acceleration/deceleration injury occurred in three patients (Patients A, C and E; Table 1) (Fig. 1). Two patients had direct impact trauma by motorcycle bar or steer wheel causing severe localized injury to the liver and right renal artery in one patient (Patient B, Table 1) (Fig. 2) and to the spleen, left colonic flexure and left renal artery in the other (Patient D, Table 1) (Fig. 3).

When presenting to the Emergency Department, all patients were haemo-dynamically stable. Four of them had immediate trauma CT scan; one of them who had severe liver injury became haemo-dynamically unstable and needed a laparotomy (Patient B, Table 1). One patient who was drunk (Patient D, Table 1) had a fracture femur and was admitted to the orthopaedics ward. After 12 h of admission he became hypotensive with a blood pressure of 90/50 mmHg. The patient was resuscitated and had a trauma CT scan which has

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Fig. 1 – A 43 years old laborer who fell from 6 m high during work. The acceleration/deceleration injury caused a complete occlusion of the left renal artery (arrow).
shown free intraperitoneal air. The patient was then taken directly to theatre for a laparotomy.

The median range ISS of the patients was 34 (25–38). The injuries were three on the right side and two on the left side. None of these patients had bilateral lesions. Severe associated injuries occurred in all five patients.

Two patients needed laparotomy. In one patient (Patient D, Table 1) a splenectomy was performed with primary repair of a colonic perforation. A trial to repair the left renal artery using the anterior approach (Fig. 3B) was abandoned secondary to patient haemo-dynamical instability and concerns about the patient’s overall clinical status. Nephrectomy was performed on the same setting. The other patient (Patient B, Table 1) had a damage control laparotomy for his severe liver and splenic injuries requiring splenectomy, liver packing, massive blood transfusion and recombinant activated factor VIIa. No attempt was made to repair the renal artery under this situation.

All patients have survived with a median (range) hospital stay of 29 (18–57) days. As none of these patients underwent renal artery surgical revascularization and one patient had a nephrectomy, a renal technetium scan was not performed. Our follow-up of these patients has mainly consisted of serum electrolytes and creatinine level measurements and blood pressure monitoring. One patient developed hypertension 2 months after the injury and required to have an interval nephrectomy for blood pressure control. All five patients have normal creatinine at median range follow-up of 9 (1–20) months.

4. Discussion and management algorithm

Renal vascular injury has been reported in 1–4% of patients who sustain blunt abdominal trauma. Despite the relative rarity of this injury, the incidence has been increasing over the past few decades, possibly because of the liberal use of...
the CT scan in the management of abdominal trauma. This study has shown that the annual incidence of this injury is only 0.1% in our blunt trauma admissions. These traumatic injuries have usually been associated with deceleration/acceleration events, both of which may produce intimal tear followed by subintimal dissection and thrombosis. Furthermore, renal vessels compression against the vertebral bodies of the spine may cause intimal damage and thrombosis of the injured vessel.\(^4\) Four of our patients were involved with motor vehicle collisions, three of them were drivers and one pedestrian. Abdominal injuries in car occupants can be caused by acceleration/deceleration injuries or direct trauma compared with pedestrians whose abdominal injuries are usually caused by direct hood and screen impact.\(^5\)

Physical examination was not sensitive in establishing the diagnosis of renal artery injury. Findings of abdominal trauma, flank pain, proteinuria or hematuria were variable and nonspecific in all of our cases. CT scan was the study of choice in establishing the diagnosis of renal artery injury. This is supported by recent reports which strongly suggest that the diagnosis of renal artery occlusion can be made with high accuracy using CT. Accuracy rates reaching as high as 98% are often reported.\(^6\)

Renal vascular injuries rarely occur as an isolated event. All of our patients had multiple traumas with others major associated injuries. All our patients had severe injury with a median ISS of 34. This is much higher than the median ISS of four of our Trauma Registry of more than 2500 patients which were collected at the same period of time of this study. Furthermore, the median hospital stay of 25 days is much higher than the mean hospital stay of 9 days in our registry. In a series of 41 patients with renal vascular injuries, Cass et al. have reported an average of 3.7 associated injuries per patient with 85% of the patients requiring laparotomy for their intra-abdominal injuries.\(^7\)

Management of traumatic renal artery occlusion has been controversial with opinions divided between immediate surgical revascularization and observation. This controversy has been complicated by several factors: First, the experience of each center with this type of injury is limited owing to the rarity of this condition. Second, immediate revascularization had seldom resulted in return of normal kidney function, although surgeons report it to be technically successful at time of operation. Third, prolonged ischemia time due to delay in diagnosis, if more than 12 h the chances to recover the kidney function are dismal. Despite an improvement on the warm ischemia time in some studies, there was lack of correlation with retrieval of the renal function. The critical time to save the kidney may be shorter than 2–3 h.\(^8\) and usually this time elapse before revascularization of the kidney is achieved. In a study by Ouriel et al.,\(^9\) none of their patients with embolic or traumatic renal artery occlusion regained significant renal function, even when operation was undertaken within 6 h of the occlusion. Also in Hass et al.\(^10\) series, despite a median warm ischemia time of 5 h, only one out of five patients who underwent surgical revascularization had a return to 9% differential of renal function on postoperative renal scan.

Diagnosis usually requires a high index of suspicion because external signs may be absent. Hematuria was absent in 36% of patient who sustained renal vascular injury.\(^1\) Fourth, the vast majority of these patients have other associated life threatening injuries which render them to be unstable and management of these injuries takes precedence. Coagulopathy, hypothermia and acidosis are the killing triad in these patients and damage control surgery principles are advised in this situation.\(^11,12\)

In a study by Stables et al., only two kidneys were saved out of 17 cases of traumatic renal artery occlusion who have undergone operative management.\(^13\) Hass et al. have reviewed their management of 12 patients with diagnosis of traumatic renal artery occlusion. Revascularization was attempted in 5 patients, of the four patients whose surgical revascularization were deemed technically successful, three showed no function and one showed minimal function on postoperative renal scans.\(^10\)

In addition, Hass et al. have reviewed the literature and identified 139 patients with unilateral renal artery occlusion. Surgical revascularization was attempted in 34 and was successful in 9 (26%). Evidence of decrease renal function was noted in 67% of those who had a successful revascularization at a mean 1.8 years’ follow-up.\(^14\)

Clark et al. have reviewed the literature and identified 250 patients with blunt renal artery injury. Vascular repair was attempted in 34 with unilateral injuries. Only eight of these 34 patients regained renal functions without hypertension.\(^15\) Cass has performed immediate vascular repair on three patients out of 27 with main renal artery injury. One patient died in hospital, the two survivors had no hypertension. Their isotope study at 36 months showed that the repaired kidney were smaller than normal and accounted for only 25% of total renal function.\(^7\) In a recent large study by Sanghong et al.,\(^16\) the National Trauma Data Bank of the Committee on Trauma of the American College of Surgeons has been analyzed for blunt renal artery injury. Out of a total of 945,326 patients with blunt trauma admissions, 517 had renal artery injury. Only 45 (9%) of patients underwent surgical revascularization. The authors have concluded that non-operative management is an acceptable treatment. In Bruce et al. study\(^7\) three patients underwent revascularization out of 28 with blunt renal artery occlusion; one kidney had no renal function, a second patient developed hypertension and underwent nephrectomy and a third was lost on follow-up. A summary of the reported studies in this article is shown in Table 2.

Given the results reported in these reviews we have advocated a conservative approach toward these types of injuries with the presence of a normal contra-lateral kidney, main concern is to follow up these patients for hypertension. About 25–50% of the patients will develop hypertension; most patients who develop renovascular hypertension do so within the first year, with a mean of 96 days.\(^14\) These patients may need delayed nephrectomy. Our findings do not suggest a need for immediate nephrectomy in all cases as more than half of these patients will undergo unnecessary surgery.

Hypertension has occurred in only one of four of our patients in whom the kidney was left in place after a median follow-up of 9 months. This patient required delayed nephrectomy. Clarke has shown that out of the 109 patients who have no surgery, 31 (28%) developed hypertension and 24 (22%) required nephrectomy to treat the hypertension.\(^15\) In the study by Hass and Spiriak, hypertension developed in 34 (32%) of 105 patients who did not have surgical revascularization.\(^14\)
We have therefore outlined an algorithm for the management of traumatic blunt renal artery occlusion (Fig. 4). Renal revascularization should not be attempted in a stable patient with the presence of a normal contra-lateral kidney, even if laparotomy is indicated for associated injuries. Only rarely we believe that attempted revascularization may be worthwhile in the optimal patient with a very short ischemia time, less than 2 h, and the absence of other major associated injuries or prolonged periods of hypotension. It may be possible in those rare ideal patients situation to salvage some of the renal function.

However, aggressive renal revascularization is indicated in the treatment of bilateral renal artery occlusion or unilateral occlusion in a solitary kidney regardless of time delay. Most importantly, prolonging surgery and endangering patient life to save some of the renal function in the setting of unstable patient should be highly condemned even in the presence of bilateral renal artery occlusion.

Our study does not address partial renal artery occlusion by an intimal flap, dissection or thrombus. In these situations endovascular stenting has greater role. Rha et al. have described a successful percutaneous revascularization of a blunt thrombotic complete occlusion of an anomalous inferior polar renal artery. However, information on this novel therapeutic approach comes mainly from case reports. No large series has been published and no long term follow-up is available in these cases. The future management of blunt renal artery injury may likely be percutaneous endovascular intervention and this would provide an attractive option in these multi-trauma high surgical risk patients.

In summary conservative management is advised in the treatment of unilateral blunt renal artery thrombosis.
patients need a close follow-up to identify the subgroup that may develop hypertension. Blunt renal artery thrombosis in multiple trauma patients indicates severe injury. Surgeons should critically assess the overall clinical status of these patients with the added risk of mortality against chances of recovering the renal function. The potential role of endovascular intervention is promising and further studies are needed to explore this option.

Conflicts of interest
None.

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Ethical approval
The Local Ethics Committee of Al-Ain Health District Area, Al-Ain, UAE, RECA/02/44.

References