Salvageability of kidney in Grade IV renal trauma by minimally invasive treatment methods

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ABSTRACT

Context: Renal trauma is increasingly being managed conservatively. Grade I-III injuries are managed conservatively whereas Grade V injuries may end in surgery. Managing Grade IV renal trauma is individualized and managed accordingly. Aims: To evaluate retrospectively all Grade IV renal injuries managed in our institute over five years and to review the available literature. Settings and Design: Reviewing the records of patients who sustained renal trauma and study all Grade IV renal injuries. Materials and Methods: We retrospectively analyzed all Grade IV renal injuries (16) managed at our institute between July 2008-August 2013. All patients were treated conservatively initially by hemodynamic stabilization, strict bed rest, if required endoscopic procedures. These patients were followed up with CECT. Statistical analysis: Descriptive statistics was performed using Microsoft excel spreadsheet 2007. Continuous data were described as mean and range. Categorical data was described as percentages. Results: Sixteen patients with Grade IV renal injury were included in the study. All patients had gross hematuria and 15 had urinary extravasation. D-J Stenting was done in 7 patients; perinephric tube drainage with D-J stenting was done in 2 patients. One required selective upper pole arterial embolisation. Nephrectomy was not required in any of the patients. In the follow-up period, no patient had delayed complications. Conclusions: Successful conservative management of Grade IV renal trauma requires constant monitoring both clinically and radiologically, and if properly managed, kidneys can be salvaged in all stable patients as reinforced by our study.

Key Words: Conservative management, renal trauma, renal artery embolisation, urinary extravasation

INTRODUCTION

Renal trauma occurs in 8-10% of all blunt and penetrating abdominal injuries,185-95% renal injuries are due to blunt injuries.3 They can be associated with other abdominal organ injuries such as bowel, liver, spleen, pancreatic and other visceral injuries. The severity of injury varies and is graded as per AAST (American Association for the Surgery of Trauma (AAST) classification).3 The majority of renal injuries is under Grades I-III and can be successfully managed nonoperatively with good functional preservation. In the past, high-grade renal injuries (Grades IV-V) were mostly managed surgically. In the present era of advanced imaging and interventional techniques such as multi-detector CT scanning and precise angiographic embolisation methods, these high-grade renal injuries can be managed conservatively. The aim of the study is to analyze the role and feasibility of minimally invasive renal preservation strategies in Grade IV renal trauma.

MATERIALS AND METHODS

We retrospectively reviewed the records of 70 renal injuries over a 5-year period from July 2008 to August 2013. Data regarding
clinical presentation, CECT findings, grading of renal trauma, associated injuries, duration of hospital stay, complications, and follow-up imaging were noted for all patients. Injuries were classified according to the renal injury scale defined by the American Association for the Surgery of Trauma (AAST) \[1\] [Table 1]. All Grade IV renal trauma patients were included in this study and were managed conservatively. In patients who required laparotomy for associated organ injuries (liver, spleen and bowel), renal injuries were not explored and were still managed conservatively.

The treatment consists of strict bed rest until gross hematuria is resolved, prophylactic antibiotics, adequate fluid, and blood resuscitation, serial hematocrit measurements and close monitoring of vital signs. All patients underwent follow-up CECT after 48 hours. Minimally invasive therapies such as stenting, perinephric drainage of urinoma, and vascular embolisation were performed as and when required [Figure 1]. They were followed up at 1 month, 3 months, 6 months, and 1 year, and thereafter yearly. During follow-up visits, relevant symptoms, ultrasound, serum creatinine, blood pressure were recorded. CT was done for all patients at 1 month and at 1 year after trauma.

**RESULTS**

Of 70 blunt renal trauma patients, 51 (73%) had low-grade renal injuries (Grades I-III), 16 (23) had Grade IV, and 3 (4%) had Grade V renal injuries [Figure 2].

All Grade IV patients were included in the study. The age of patients ranged from 12-40 years (mean 29 years). Two were children, and the rest were young, active males. The mechanism of injury was a motor vehicle accident in 13, fall from height in 3. The right kidney was affected in 6 and left kidney in 10 patients. All patients had gross hematuria on initial presentation. Six patients presented with hypovolemic shock to emergency. Patients with associated splenic laceration (3/6) and both the children with Grade IV renal injury presented with shock.

On initial CECT, multiple renal lacerations with perirenal hematoma were found in all patients. Urinary extravasation was seen in 15 patients. Co-existent visceral injury was seen in 5 patients (1 liver laceration, 1 splenic laceration, 1 ileal injury, and 2 bowel and splenic injuries). Of these 5 patients, 4 underwent laparotomy. The patient with liver laceration was managed conservatively. Splenectomy was done in all 3 patients with splenic injury. In the 4 patients who underwent laparotomy, renal injury was not explored and hence the management of renal trauma was considered conservative. No delayed exploration was needed in observed group. Serum creatinine was normal in all patients.

Patients with urinary extravasation were treated with broad-spectrum antibiotics initially then on urine culture based antibiotics. On repeat CECT at 48 hours, persistent or increasing urinary leak was noted in 9 patients. Of these 9 patients, D-J Stenting was done in 7 patients and combined perinephric tube drainage with DJ stenting was done in 2 patients. The regression of perinephric collections after stenting and/or percutaneous drainage was followed up with serial ultrasound scans [Figure 3].

All patients required transfusion of 2-8 units of blood (mean 3.6 units per patient). Those associated with other visceral organ injuries had more average transfusions (4.6 units vs. 3.1 units per patient). Hematuria resolved over a period ranging from 2-7 days (mean 5 days). Hematuria recurred in 6 patients. One patient had significant gross hematuria with hypovolemic shock on 14th day due to rupture of upper renal artery pseudo aneurysm into pelvicalyceal system. Emergency renal angio revealed three renal arteries supplying the right kidney with pseudoaneurysm from upper renal artery. Bleeding was controlled by upper pole renal arterial coil embolisation [Figure 4]. In the remaining 5 patients, hematuria subsided with bed rest and conservative management.

The duration of hospital stay ranged from 6 to 20 days with a mean of 11.5 days. In the follow up, all patients had normal serum creatinine levels and blood pressure, with the resolution of perinephric hematoma and urinary extravasation. DJ stent was removed after 6-8 weeks.

**DISCUSSION**

About 85-95% of renal injuries are due to blunt trauma, while the remaining are the result of penetrating injuries.\[2\] The goal of present day treatment approach for any trauma is organ preservation while assuring patient safety. The kidney has a remarkable ability to heal. The aim of the trauma surgeon in a renal trauma situation is to maintain hemodynamic stability, maintain unobstructed urinary flow, and prevent persistent urinary extravasation. Surgical intervention is required in only 5-10% of renal injuries\[4\] and continues to decline with the increasing availability of minimally invasive techniques. There is a high rate of renal loss on early surgical intervention. The absolute indications for renal exploration are persistent, life-threatening hemorrhage from renal injury, renal pedicle avulsion (Grade V injury), and expanding, pulsatile, or uncontained retroperitoneal hematoma.\[3\]

Analyzing our study, all were males with mean age around 29 years (12-40 years). Majority of renal trauma patients are young males,

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**Table 1: AAST classification**

| Grade | Description |
|-------|-------------|
| I     | Contusion or subcapsular hematoma with no parenchymal laceration |
| II    | Nonexpanding perirenal hematoma or cortical laceration <1 cm deep with no urinary extravasation |
| III   | Parenchymal laceration extending >1 cm into the cortex with no urinary extravasation |
| IV    | Parenchymal laceration extending through the corticomedullary junction and into the collecting system, contained hematoma with a segmental artery or main renal artery |
| V     | Multiple major lacerations resulting in a shattered kidney, avulsion of renal hilum |
comprising 76.3% (Knudson et al.), 67% (Sangthong et al.), and 75.3% (Chow et al.) in three other reported studies. The most common mechanism of injury in our study was motor vehicle accident, which accounted to 81% (13 out of 16 patients). In
National Trauma Data Bank and Bruce et al. study, motor vehicle accident was the cause in 67% and 80%, respectively.[8,9]

In our study, all patients underwent multi-detector CECT to grade renal injuries. Multi-detector CT (MDCT) has been shown to be rapid and accurate method for detecting the presence of and grading the extent of abdominal injuries.[10] McAninch and Federle showed the usefulness of this modality for differentiating minor from major renal injuries. It also has the advantage of identifying associated injuries, which would modify the initial and subsequent management. MDCT scan accurately identifies vascular injury, parenchymal laceration, urinary extravasation, and perirenal hematoma.[11] Arteriovenous phase scanning is necessary to detect arterial extravasation. Injury of the renal collecting system can be accurately seen in delayed films done 10-20 min after the injection.[12] The delayed films may be omitted when the kidneys are deemed normal, and no perinephric, retroperitoneal, pelvic or perivesical fluid is present.

All patients in our series had gross hematuria at their presentation, which is in accordance with 96.4% and 97% of incidences reported by Gourgiotis et al. and Hai et al., respectively.[13,14] Although it is a common sign of renal trauma, several studies have established that there is no absolute relationship between the presence, absence, or degree of hematuria and the severity of renal injury.[13,15]

Sequelae of conservative management of high-grade injuries are persistent extravasation or urinoma, fever and loin pain. Urinary extravasation associated with major renal lacerations will resolve spontaneously in 80-90% of patients.[14] Urinoma development can be quite insidious, with intervals between the date of trauma and the development of symptoms or signs varying from few days to weeks. The management of persistent urinoma is by placement of ureteric stent and/or percutaneous drainage of perinephric collections. Urinary extravasation was managed by D-J stenting alone in 7 of our patients, combined percutaneous drain and stenting in 2 patients for large urinoma accounting to 56.2% of total patients. In 6 patients who had minimal extravasation, spontaneous resolution was seen on follow-up ultrasound scan.

Matthews et al.[14] reported that 4 of 31 patients with major blunt renal lacerations and extravasation required ureteric stenting for persistent extravasation, while 27 (87%) had spontaneous resolution of the extravasation.

One of the important complications of conservative management of renal injuries is delayed bleeding (secondary hemorrhage) seen in 13-25% of the cases.[17] The interval between the injury and the onset of secondary hemorrhage is 2-36 days.[17] The common causes of delayed bleeding are dislodgement of the clot due to increased activity, arteriovenous fistula (AVF), and pseudoaneurysm formation.[18] Bleeding because of clot dislodgement is usually not severe and can be managed conservatively. Patients with a pseudoaneurysm present with hematuria and large perinephric hematoma or hypertension. Angiography is the investigation of choice, although CT can reveal lesions as well. Majority of the pseudoaneurysms can be managed successfully with selective angiographic embolisation.[19] Rebleeding is noted in 25% (4/16) of our cases. These are managed by strict bed rest and avoiding straining one patient had rebleeding due to pseudoaneurysm on 14th day after trauma, which was controlled by selective upper renal artery embolisation.

A wide range of mean length of hospitalization has been reported, ranging from 6.5 to 24.0 days, which may correlate with the type of management employed in some studies and associated injuries.[8,10,14] Hospital stay in our patients ranged from 6 days to 20 days with mean of 11.5 days.

The long-term complications of managing high-grade renal trauma are posttraumatic arteriovenous fistula (0% to 7%), perinephric hematoma, renovascular hypertension and renal insufficiency.[20] Traumatic fistulas are typically caused by stab injuries, rarely resolve spontaneously, and often require treatment. Large subcapsular or perirenal hematoma can compress the kidney causing renal ischemia, inducing renovascular hypertension (page kidney). The incidence of posttraumatic hypertension is also influenced by the severity of renal injury and the prevalence of pre-existing essential hypertension, which is affected by the age, sex, and race of the population.[21] The pooled mean (range) rate of hypertension after renal injury in published series is 5.2% (0.6-33%).[22] Monstrey et al.[23] who studied 622 patients with renal trauma did not observe any increase in the incidence of arterial hypertension. They found no definitive relation between hypertension and renal trauma. A multi-institutional study of 89 patients with Grade IV/V renovascular injuries reported post-traumatic renal failure in 6.4%, diminished renal function in 16%, and hypertension in 4.5%. angiographic embolisation is associated with a 0-10% loss of function of the affected kidney.[23] No patient in our series had such delayed complications in the follow up. We could manage all our Grade IV renal trauma patients conservatively without loss of renal unit. Moundini et al. (2001)[26] also managed all of their patients conservatively, whereas Dugi et al.[27] and Elashry et al.[28] managed 89% and 84.2% of their patients by conservative methods, respectively (Table 2).
Non-operative management of renal trauma, specifically high grade, requires constant monitoring both clinically and with radiological investigations. The increased use of multidetector CT for diagnosis, grading and follow up has contributed to the increased use conservative management in high-grade renal injuries. The availability of angiography as an interventional tool can limit emergency explorations. Urinary extravasation resolves spontaneously in majority of the patients. Persistent urinary extravasation can be managed successfully with endourological techniques. Vascular injury can be managed by selective embolisation and can salvage renal parenchyma. Immediate surgical exploration is warranted for hemodynamically unstable patients. There is definite role for conservative management of Grade IV renal trauma as reinforced by our study.

CONCLUSIONS

Non-operative management of renal trauma, specifically high grade, requires constant monitoring both clinically and with radiological investigations. The increased use of multidetector CT for diagnosis, grading and follow up has contributed to the increased use conservative management in high-grade renal injuries. The availability of angiography as an interventional tool can limit emergency explorations. Urinary extravasation resolves spontaneously in majority of the patients. Persistent urinary extravasation can be managed successfully with endourological techniques. Vascular injury can be managed by selective embolisation and can salvage renal parenchyma. Immediate surgical exploration is warranted for hemodynamically unstable patients. There is definite role for conservative management of Grade IV renal trauma as reinforced by our study.

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