

Management of high-grade renal traumas with collecting system injuries

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Abstract

Introduction: Approximately 50% of all high-grade renal traumas (HGRT, American Association for the Surgery of Trauma [AAST] grade 4/5) have associated collecting system injuries. Although most of these collecting system injuries will heal spontaneously, approximately 20–30% of these injuries are managed with ureteric stents. The objective of the study was to review the management of HGRT with collecting system injuries in a level 1 trauma center.

Methods: This was a single-center, retrospective cohort study of trauma patients with HGRT and collecting system injuries from 1998–2019.

Results: We identified 147 patients with HGRT. Of the 105 patients who had trauma computed tomography (CT) imaging within 24 hours, 46 were found to have collecting system injuries. Seven of these patients underwent intervention based on initial CT findings; the remaining 39 patients with urinary extravasation were conservatively managed. Of the 37 patients who underwent reimaging, 22 (59%) demonstrated a stable or resolving collection and 15 (41%) demonstrated continued urinary extravasation. Resolution of extravasation on subsequent imaging was observed in 10 of those patients, while five patients (14%) required intervention (four stents, one percutaneous drain) for symptoms/signs of urinary extravasation.

Conclusions: In this study, most patients with HGRT and collecting system injuries did not require intervention unless the patient became symptomatic. The majority of collecting system injuries resolved with no intervention. This study underscores the need for future prospective trials to investigate the necessity of intervening in HGRT collecting system injuries and, secondarily, the need for routine re-imaging in these asymptomatic patients.

Introduction

High-grade renal trauma (HGRT, American Association for the Surgery of Trauma- AAST grade 4/5¹), account for

18–43% of all renal traumas.^{2–6} Current guidelines recommend followup imaging at 48 hours in all conservatively managed HGRT to prevent complications associated with a developing urinoma or hemorrhage.^{7–9} The guidelines also recommend urinary stenting for urinary extravasation or percutaneous drainage of a urinoma if the patient becomes symptomatic.^{7–9} However, it is unclear whether any intervention is necessary in the asymptomatic patient after repeat imaging reveals continued urinary extravasation.

In a systematic review, Keihani et al¹⁰ found that approximately half of all HGRT of AAST grade 4/5 have associated collecting system injuries. Twenty-nine percent of all patients with HGRT and collecting system injuries underwent ureteral stent placement for urinary extravasation.¹⁰

In another multi-institutional series (2014–2017), there were 195 AAST grade 4/5 renal injury patients, of whom 54 underwent nephrectomy.¹¹ In this series, 29/141 patients (21%) with HGRT, who did not undergo nephrectomy, had ureteric stents placed for urinary extravasation.¹¹ However, the indication for stent placement in these collecting system injuries was not specified.

As routine re-imaging is recommended in the renal trauma guidelines at 48 hours,^{7–9} Bayne et al evaluated whether re-imaging changed management in a series of 216 HGRT patients.¹² Of 48 asymptomatic patients who underwent routine image re-staging (average 3.55 days, range 0.44–28.9), the only patients requiring intervention were patients with previously identified urinary extravasation. Of these 24 patients who had continued urinary extravasation on repeat imaging, six (25%) underwent ureteral stent insertion.¹² However, the indications for stent placement were not defined and likely left to the attending urologist's discretion.¹² Authors concluded that re-imaging in all asymptomatic HGRT (AAST grade 4/5) patients may not be necessary and possibly should be performed in only those with collecting system injuries.

The objective of this study was to review the management of HGRT with collecting system injuries in a level 1 trauma center.

Methods

The study was approved through the Sunnybrook Health Sciences Centre institutional review board (#2582). We conducted a retrospective chart review of all AAST grade 4/5 renal traumas identified at a level 1 trauma center from 1998–2019. All renal traumas were identified through the institutional trauma database. Specifically, grade 4/5 renal traumas were identified based on computed tomography (CT) scan, operative or pathology reports, or chart notes (AAST criteria) reviewed by the trauma data analyst and assigned abbreviated injury score codes.¹ Grade 1–3 renal traumas were excluded from this study. Two urologists identified those grade 4/5 renal traumas with collecting system injuries by reviewing the initial trauma CT scans and reports. Trauma CT imaging evolved over the time period of the study. The current trauma protocol includes a non-contrast head scan followed by a pump bolus of contrast (4 ml/sec for 25–30 seconds). Once the bolus is administered, there is a scan of the neck to upper abdomen in the arterial phase, and the mid-chest to pelvis in the late arterial/early portal venous phases. The duration of the scan is less than 70 seconds. If a grade 3–5 renal injury is identified, a delayed excretory phase is done at 10 minutes. Data collection included initial and followup imaging modality, timing of re-imaging, and radiological interpretation, as well as subsequent interventions and outcomes. Descriptive statistical analysis was used to analyze the data.

Results

Population demographics (Table 1)

From 1998–2019, 147 patients with HGRT (AAST grade 4/5) were identified of 1267 patients with a kidney injury of any grade (12%) (Fig. 1). The majority of patients were male (80%). The average age of the patients was 35 years, with a median age of 30 (range 18–83). Seventy-one percent experienced blunt trauma, while the remainder experienced penetrating trauma.

Of these 147 patients, 42 (29%) did not have immediate CT imaging because of hemodynamic instability. One patient expired in the trauma bay, and the remaining patients went directly to the operating room. Thirty-three of these patients (80%) underwent a nephrectomy and the remaining had either a partial nephrectomy (five patients), renorrhaphy (one patient), or a retroperitoneal drain (one patient). One patient died in the operating room after having clinical findings of a grade 4/5 renal trauma. Penetrating injuries accounted for 28/41 (68%) patients who went directly to the operating room. Penetrating trauma accounted for 19 nephrectomies and all partial nephrectomies, renorrhaphy, and drain

Table 1. Demographics of patients with high-grade renal traumas

Variable	Total
Male, n (%)	118 (80)
Female, n (%)	29 (20)
Age	
Mean (years)	35.2
Median (range) (years)	30 (18–83)
Mechanism of renal trauma	
Blunt (motor vehicle collision, falls, work site, etc.), n (%)	105 (71)
Penetrating, n (%)	42 (29)
Penetrating due to gunshot injury, n (%)	22 (52)
Patients with immediate CT trauma protocol imaging with a urologist involved in care, n (%)	57 (54)
1998–2002, n (%)	6/19 (32)
2003–2007, n (%)	9/34 (27)
2008–2012, n (%)	17/23 (74)
2013–2019, n (%)	25/29 (86)
Injury severity score	
Before 2008 (mean)	38.2
After 2008 (mean)	34.4

CT: computed tomography.

placement. The majority of nephrectomies (31/33) were performed by trauma surgeons. Two of the partial nephrectomies and the renorrhaphy were performed by a urologist.

The remaining 105 (71%) patients with HGRT had their initial CT trauma imaging within 24 hours of injury. Fifty-nine of these patients had no collecting system injuries and were managed with no intervention (30), renal embolization (13), nephrectomy (13), and open renal repair (three). Nineteen patients underwent a trauma laparotomy for other injuries without renal exploration.

Diagnosis and management of collecting system injuries

Of the 46 patients with a collecting system injury, 36 (78%) were due to blunt trauma and the remainder were penetrating. Seven patients underwent immediate intervention based on their initial CT findings. One patient had a stent inserted for a solitary kidney, three patients had retroperitoneal kidney drains placed at the time of laparotomy, two patients underwent a nephrectomy, and one patient underwent surgical exploration, the details of which are unknown.

The remainder of the patients (39/46, 85%) were managed conservatively and did not undergo any renal intervention based on their initial CT scan (Fig. 2). Nine underwent a trauma laparotomy for other concomitant injuries without exploration of the kidney. Two did not have re-imaging while in hospital for unknown reasons. Thirty-seven patients underwent repeat imaging (eight abdominal ultrasound, three non-contrast CT, and 26 contrast CT). There was no set re-imaging protocol in these cases. Of those re-imaged, 22 (59%) demonstrated a stable or resolving collection (i.e., smaller or

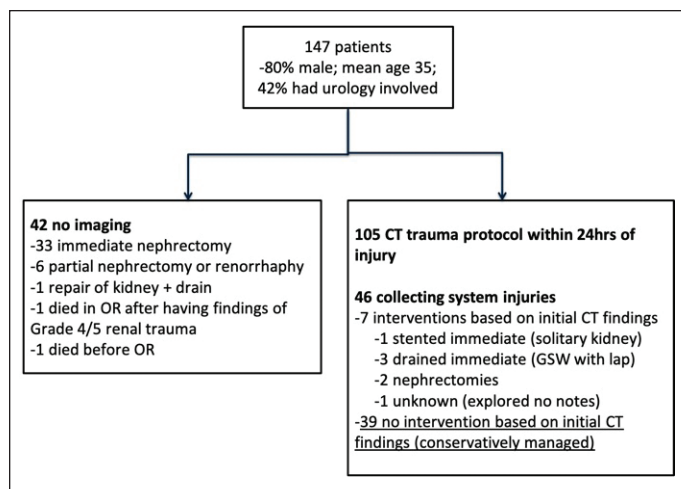


Fig. 1. Management of 147 patients with high-grade renal traumas (HGRTs). CT: computed tomography; GSW with lap: gunshot wound with laparotomy; OR: operating room.

non-expanding collection on ultrasound or no extravasation, with coexisting smaller or non-expanding collection on CT (median re-imaging time three days [range 1–112 days]) and 15 (41%) demonstrated continued urinary leak (median re-imaging time four days [range 1–28 days]). The 22 patients with stable or resolving collections remained asymptomatic and required no followup intervention.

Resolution of urinary leak on subsequent imaging was observed in 10 of the 15 patients (median followup six weeks [range 4–6 weeks]) while five patients (14%) required subsequent intervention (four stents, one drain) for symptoms or ongoing urinary leak. Of the five patients who required intervention, patient 1 had a horseshoe kidney with significant injury to the isthmus and bilateral collecting system injuries with increasing abdominal pain. Patient 2 developed worsening abdominal and flank pain secondary to an increasing urinoma. Patient 3 developed a fever and abdominal distention nine days after HGRT due to a gunshot wound and was found to have a small urine leak. A fourth asymptomatic patient had an ureteropelvic junction (UPJ) leak and was stented based on the diagnosis of persistent leak on re-imaging CT. The fifth patient became symptomatic 13 days after the trauma and was found to have a large urinoma. In these five patients, we were unable to determine if mechanism of injury was a predictor for delayed intervention.

Urologist involvement in trauma care

Overall, 57/105 or 54% of those with immediate initial CT trauma imaging had a urologist involved in their care (Table 1). Urological involvement increased over the duration of the study (32% in first quartile 1998–2002 to 86% in last quartile 2013–2019). Thirty-five of the forty-six patients (76%) with collecting system injuries had a urologist involved in their care.

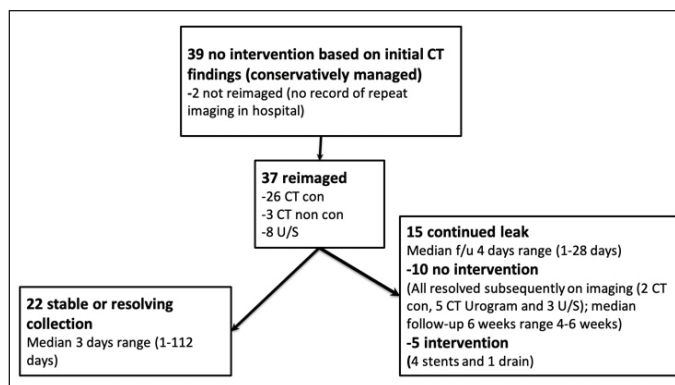


Fig. 2. Management of 39 patients with high-grade renal traumas (HGRT) and collecting system injuries who, based on initial CT findings, were conservatively managed. CT con: computed tomography contrast; CT non con: computed tomography non-contrast; U/S: ultrasound.

Discussion

Current American Urological Association (AUA), European Association of Urology (EAU), and World Society of Emergency Surgery (WSES)-AAST guidelines suggest re-imaging routinely at 48 hours in patients with HGRT regardless of symptoms.⁷⁻⁹ The AUA urotrauma guideline states that, “Followup CT imaging (after 48 hours) is prudent in patients with deep renal injuries because these are prone to developing troublesome complications, such as urinoma or hemorrhage.”⁹ The EAU guideline states that, “Repeat imaging 2–4 days after trauma minimizes the risk of missed complications, especially in grade 3–5 blunt injuries.”⁷ The WSES-AAST guideline states that, “In severe injuries (AAST 4–5), contrast-enhanced CT scan with excretory phase (in cases with possible or documented urinary extravasation) or ultrasound and contrast-enhanced ultrasound are suggested within the first 48 hours after trauma in adult patients.”⁸

In this study, of the 37 conservatively managed patients who had HGRT with collecting system injuries and had various modalities of repeat imaging, only five (14%) had interventions on repeat imaging. Four of the five patients required intervention because of symptoms related to their collecting system injury and one was asymptomatic but stented because of a solitary kidney. All five patients had satisfactory outcomes in followup. The remaining 86% of those re-imaged were asymptomatic, did not require any additional intervention, and demonstrated a stable or resolving collection on subsequent re-imaging. This data suggests that the majority of asymptomatic patients with HGRT and collecting system injuries will resolve with time and re-imaging should be reserved for only symptomatic patients.

It is unclear in the literature which imaging modality (CT vs ultrasound) is the best choice for re-imaging in asymptomatic patients. In this study, there was no re-imaging protocol so both modalities were used. An ultrasound may detect an enlarging leak by measuring increased collection size.

Routine repeated CT imaging is not without the possibility of increased long-term cancer risk in these polytrauma patients.^{13,14} It has been shown that trauma patients are exposed to significant amounts of CT radiation during their time in hospital.^{13,15}

The “as low as reasonably achievable” (ALARA) principle was introduced in 2008 to emphasize using the lowest dose of radiation possible and reduce unnecessary imaging.¹⁶ Several groups are trying to reduce ionizing radiation exposure in trauma patients in keeping with the ALARA principle.^{17,18} In keeping with this principle, in polytrauma patients who require re-imaging for other injuries, it seems prudent that the urology team be aware of these investigations and suggest appropriate genitourinary scan protocols if required at the same time. This will reduce overall unnecessary repeat CT scans and radiation exposure.

A surprise finding in this study was that overall, only 54% of the HGRT patients with CT imaging had a urologist involved in their care. This did improve from 32% (1998–2002) to 86% (2013–2019) through the study period. Specific to those with collecting system injuries, 76% had a urologist involved in their care. Of the 46 collecting system injuries, 11 did not have a urologist involved in their care; nine of these cases occurred before 2007. These trends highlight how the trauma surgeons are more frequently involving the urologist in the care of modern day HGRTs. In a review by Yeung and Brandes,¹⁹ it was found that compared to urologists, trauma surgeons were more likely to want to immediately stent collecting system injuries (50 vs. 24%, $p < 0.001$). Furthermore, the authors found differing opinions in treating renal traumas between trauma surgeons and urologists and recommended large-scale, multi-institutional, interdisciplinary, prospective studies on renal trauma to “standardize” management.¹⁹

There were several limitations to this study. It is a single-center, small-number, retrospective review over a long period of time (1998–2019). In this study, we did not systematically evaluate the severity of collecting system injuries other than AAST grading and thus cannot make any recommendation on which patients should have re-imaging or intervention. There was no standardized method for managing collecting system injuries among the urologists but, in general, a more conservative approach to these injuries was undertaken. Lastly, it is unknown if earlier intervention in those who ultimately required it would have prevented the onset of delayed symptoms. Also, as most patients did not require intervention, we cannot comment if early stent/drain placement in those that were asymptomatic would have led to unnecessary morbidity. Urologist involvement was only determined based on chart review and, therefore, some consultations may not have been recorded.

Conclusions

In this study, the majority of patients with HGRT and collecting system injuries did not require an intervention unless the patient became symptomatic. Most collecting system injuries resolved with no intervention. This study underscores the need for future prospective trials to investigate the necessity of intervening in HGRT collecting system injuries and, secondarily, the need for routine re-imaging in the asymptomatic HGRT.

Competing interests: Dr. Herschorn has been an advisory board member for and has received payment from Astellas, Boston Scientific, and Pfizer; has received speaker honoraria from Astellas; and has participated in clinical trials supported by Astellas, Allergan, and Purdue. The remaining authors do not report any competing personal or financial interests related to this work.

This paper has been peer-reviewed.

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