Computerized Tomography Findings in Pediatric Renal Trauma—Indications for Early Intervention?

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Purpose: We sought to determine if initial computerized tomography findings in pediatric patients suffering blunt renal trauma with urinary extravasation were predictive of the need for operative intervention.

Materials and Methods: A total of 17 patients with grade IV blunt renal trauma and urinary extravasation were identified between 2000 and 2007. Each computerized tomogram was reviewed to determine location, size and number of sites of extravasation, as well as the presence of contrast material in the ipsilateral ureter. These findings were compared with subsequent ureteral stent placement, percutaneous urinoma drainage, angiographic embolization and nephrectomy.

Results: A total of 13 male and 4 female patients (mean age 11.1 years) were identified. Eight patients (47%) required delayed intervention. Conservative treatment was unsuccessful in patients with absence of contrast material in the ipsilateral ureter and large separation of the upper and lower poles, and in 3 of 5 patients with multiple areas of extravasation and 4 of 5 patients with transfusion requirements. The diameter (9.6 vs 9.7 mm, $p = 0.96$) and location of extravasation were not predictive of subsequent intervention. Two of 5 patients with posterior extravasation required intervention, both for symptomatic urinoma.

Conclusions: Early ureteral stent placement may be considered for pediatric patients with blunt renal trauma who demonstrate absence of contrast material in the ipsilateral ureter, since clinical indications for stent placement will likely develop. Further study may show if wide separation of the upper and lower poles, multiple areas of extravasation and transfusion requirement are factors in the decision for early intervention.

Key Words: tomography, x-ray computed; pediatrics; wounds, nonpenetrating; kidney

The treatment of pediatric patients suffering blunt renal trauma with urinary extravasation remains controversial. Selective ureteral stent placement for symptomatic urinomas is usually successful but is often performed after a prolonged course of conservative management.[1–10] Urinomas are responsible for the majority of delayed interventions in children with blunt renal trauma.[7,9] Among adults with grade IV renal trauma 91% can be treated without stent placement. Those with persistent extravasation are identified with a followup CT at 3 to 7 days.[8] However, the experience with grade IV renal trauma in children is much more variable, with intervention rates varying between 9% and 45%.[1–10] The majority of these interventions are endoscopic ureteral stent placement, percutaneous nephrostomy drainage and, occasionally, nephrectomy.

At our institution all children with grade IV renal trauma are initially treated conservatively, except in cases of hemorrhage and hemodynamic instability. While a grade IV renal injury is either a renal laceration that extends through the kidney into the collecting system, an injury that involves the main renal artery or vein with contained hemorrhage, or segmental infarctions without associated lacerations,[11] for the purposes of this study we investigated only those patients with urinary extravasation. We sought to determine if initial CT findings in children with grade IV renal trauma were predictive of the need for later intervention. The decision to intervene could be made earlier, thereby shortening recuperation.

MATERIALS AND METHODS

A retrospective review of the pediatric trauma database at our hospital revealed 17 consecutive patients with grade IV blunt renal trauma (defined in this study as urinary extravasation) treated between 2000 and 2007. We excluded 3 patients with vascular injuries treated nonoperatively, 2 patients with ureteropelvic junction disruption and 3 patients who had a deep grade III laceration without urinary extravasation identified on followup review of the CT. Excluding the 3 cases that were incorrectly staged, these 17 cases represent 77% (17 of 22) of all cases of grade IV blunt renal trauma seen during this period.

Since 2002, all trauma patients with gross hematuria have undergone CT of the abdomen and pelvis with delayed images to look for possible urinary extravasation. A followup CT was obtained at 48 hours to determine if the degree of urinary extravasation had improved. For the purposes of this study we believed that the size and location of the urinary extravasation would be a risk factor for failure of

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conservative management and, therefore, proposed several radiological and clinical risk factors. Our assumption was that extravasation located medially (within 90 degrees of the renal pelvis) would be less likely to resolve than lateral extravasation (between 90 and 180 degrees from the renal pelvis, along the anterolateral surface) or posterior extravasation (between 90 and 180 degrees from the renal pelvis, along the psoas) due to less compressive parenchyma next to the renal pelvis.

The initial CT was reviewed to determine location, size and number of sites of extravasation, as well as the presence of contrast material in the ipsilateral ureter. The degree of injury was measured as the diameter of the largest area of extravasation along the renal pelvis or renal parenchyma. All patients had a parenchymal injury, although in some instances the larger injury was along the renal pelvis. The presence of contrast material in the ipsilateral ureter was noted on the delayed portion of the CT. We believed that absence of contrast material in the ipsilateral ureter would predict the need for stent placement. The need for blood transfusion was determined from the inpatient record. These radiological and clinical factors were compared with subsequent ureteral stent placement, percutaneous urinoma drainage, angiographic embolization and nephrectomy. Patients with ureteropelvic junction disruption were excluded from analysis, since they had an absolute indication for operative intervention.

The criteria for intervention in patients with known urinary extravasation after blunt renal trauma were progressive flank pain, persistent fever and failure of extravasation to resolve after 2 weeks of observation. The decision to intervene was based on the clinical judgment of the attending urologist. We used either a 7.5Fr or 10Fr pediatric cystoscope to place a 3.7Fr or 4.8Fr ureteral stent of appropriate length. Stents were removed 3 to 6 weeks later, after imaging confirmed that the urinoma had resolved. Analysis of variance was used to calculate differences in the size of extravasation. Renal scans were obtained in selected patients if there was concern about significant loss of renal function.

RESULTS

A total of 13 male and 4 female patients with a mean age of 11.1 years were identified. The mechanisms of injury were falls (8 patients), motor bike or all terrain vehicle accidents (3), sledding accidents (2), motor vehicle collisions (2), football injury (1) and bicycle injury (1). Location of injury, duration of hospital stay, complications and procedures are listed in tables 1 and 2. A total of 12 patients had extravasation from the renal pelvis or medial or anterolateral portion of the kidney, of whom 6 required intervention. Of these 6 patients 5 had radiographic risk factors—3 with 2 sites of extravasation, 1 with absence of contrast material in the ipsilateral ureter, and 1 with wide separation of the upper and lower poles by a 4 cm urinoma with no drainage of urine from the upper pole to the ureter. Three of these 6 patients required transfusion, of whom 1 underwent angiographic embolization to stabilize bleeding of a segmental arterial branch. Renal scans were obtained in 2 patients at 3 months following injury, and demonstrated relative renal function of 44% and 49%.

Of the 6 patients who did not require intervention 2 had 2 sites of extravasation—1 with absence of contrast material in the ipsilateral ureter, and 1 with separation of the upper and lower pole by a 1 cm urinoma with maintained drainage of the upper pole to the ureter. The patient with absence of contrast material in the ipsilateral ureter had minimal (4.6%) function on DMSA scan 4 months later. The patient with a 1 cm separation of the upper and lower poles by urinoma had a hematoma on ultrasound at 2 months but healed with minimal scarring (37% function) on DMSA scan at 5 months following injury. It appeared that this injury split a duplicated kidney, which could account for its good recovery. One patient treated with only bladder drainage maintained 47% function. One patient received a transfusion. The numbers of patients with multiple sites of extravasation and transfusion requirement are too small for meaningful statistical comparison. The diameter (9.6 vs 9.7 mm, $p = 0.96$, intervention vs no intervention) and location of the

TABLE 2. *Nonoperative risk factors for failure of conservative treatment*

Injury Site	Hospital Stay (days)
Medial, lateral*	13
Medial, lateral†	10
Medial	7
Medial	5
Medial	5
Medial	4
Posterior	12
Posterior‡	6
Posterior	5

* Additional finding was absence of contrast material in the ureter and complication of minimal renal function.
† Additional finding included 1 cm separation requiring transfusion and complication of urinoma which resolved within 5 months.
‡ Complication of urinoma with early resolution.

TABLE 1. *Operative risk factors for failure of conservative treatment*

Injury Site	Days to Operation	Procedure	Transfusion Required	Days Hospital Stay (days rehospitalized)
Medial*	17	Nephrectomy	Yes	11 (7)
Medial†	12	Stent + percutaneous drain	No	10 (7)
Medial, lateral	4	Stent	Yes	11
Medial, medial	2	Stent	No	5
Medial	2	Stent	No	6
Lateral, lateral	9	Embolization, stent	Yes	13
Posterior	12	Percutaneous drain	Yes	18
Posterior‡	90	Decortication	No	5

* Additional finding included 4 cm separation and complication of ileus required rehospitalization.
† Additional finding was absence of contrast material in the ureter, and patient required rehospitalization.
‡ Complications of hypertension and cyst.