Prospective observational study with an abbreviated protocol in the management of blunt renal injury in children

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Abstract

Background: There are no published management schemes for blunt renal injuries. We are conducting a 2-center prospective observational study with a fixed management scheme.

Methods: Children with CT proven renal injuries were enrolled with permission. Ambulation is allowed when able regardless of grade. Discharge occurs when tolerating a diet and pain is controlled regardless of hematuria. Urinalysis occurs at follow up in 2–4 weeks and repeated as indicated.

Results: Between 9/2008 and 9/2012, 70 patients were enrolled. Mean age was 11.8 years (3–17), and 70% were male. The mean grade of injury was 2.8 ± 1.1 [1–5]. One nephrectomy (1.4%) was performed for a grade 5 injury. Other renal interventions included an embolization for the hilar bleed and one cystotomy for a clot. Mean LOS was 2.9 days ± 2.4 days. In patients without other major injury, LOS was 1.9 ± 1.7 days (0.4–8 days). There were 5 (7%) readmissions: 3 for pain, 1 for hematuria, and 1 for a bladder clot. 58 patients (83%) gave urinalysis samples at initial follow up (med 18 days), where 31 (53%) were positive for blood.

Conclusions: Children with blunt renal injury may benefit from management without strict bedrest guidelines. Hematuria appears to have little influence on recovery.

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Over the past quarter of a century, management of blunt renal injuries has progressed toward primary non-operative management [1–6]. This trend has resulted in operative rates of 10% or less with renal salvage in 95% or more [1,2]. Therefore, there seems little need to pursue operative management in the face of renal injuries, similar to injuries of the spleen and liver. While several protocols have been published which dictate the hospital course in the non-operative management of spleen and liver injuries, there are no such protocols for renal injuries. The literature lacks definitive data on the hospital management of these patients [6]. We previously performed a retrospective review on renal injuries, in which we questioned the necessity for strict bedrest and the relevance of hematuria in the course of recovery [7]. Therefore, we designed a prospective observational study employing a management protocol without a mandatory period of bedrest that does not require resolution of hematuria prior to ambulation or discharge.

1. Methods

After IRB approval (#08-07-110) patients identified by computed tomography (CT) as demonstrating blunt renal injury were approached for the study. Informed parental permission/patient assent was obtained during the initial hospitalization. The initial scan was graded according to the American Association for the Surgery of the Kidney Injury Scale [8].

1.1. Protocol

The management protocol allows for ambulation when the patient is comfortable as is usual after any general abdominal operation. This is true regardless of grade or the presence of gross hematuria, therefore there is no minimum period of bedrest. Urinalysis was performed upon admission to the hospital. While hematuria is monitored, the presence of hematuria did not impact the allowance of ambulation or influence the decision of discharge from the hospital. Routine placement of a urinary catheter is avoided unless patients are unable to void. In addition, routine antibiotics are not given and routine urinary cultures are not obtained. Patients are managed by the trauma service and urology consults were not routinely obtained.

Discharge planning began when the patient tolerates a regular diet and oral pain medications. Urinalysis is evaluated at follow up...
2–4 weeks after discharge, and repeated as indicated. Imaging is performed for urinary extravasation or other specific concern on initial imaging. Patients are followed for the long-term blood pressure outcomes for 3 years which is not part this report.

1.2. Data collection/analysis

Patient demographics, mechanism of injury, associated injuries, hospital course, transfusions, operations and outcomes were recorded. Patients that required transfusions were analyzed to identify the dominant injury that likely accounted for the need for transfusion.

Associated injuries were defined as a fracture, intracranial blood, laceration requiring operative treatment, an abrasion requiring debridement/burn therapy, pneumothorax requiring intervention, or an additional organ injury. Injuries not considered associated included soft tissue injury, laceration closed at the bedside, concussion, untreated pneumothorax, pulmonary contusion that did not affect hospital stay and dental injury not requiring attention while in the hospital.

Data are expressed as mean ± standard deviation.

2. Results

Between 9/2008 and 9/2012, 70 patients were enrolled. Mechanisms of injury are depicted in Fig. 1. Mean age was 11.8 ± 4.0 years (3–17 years) with mean weight of 49.4 ± 21.2 kg (13–99 kg) and there were 49 (70%) males. Laterality of injury was 38 (54%) right, 31 (44%) left and 1 (1.4%) bilateral.

The mean grade of injury was 2.8 ± 1.1 (Fig. 2)[1–5]. Transfusions were used in 6 patients (8.6%), 5 of which were unrelated to renal injury with 1 (1.4%) due to a grade 5 injury and hilar vessel bleeding. One nephrectomy (1.4%) was performed for a devascularizing grade 5 injury. Other renal interventions included an angiographic embolization for the aforementioned hilar bleed and one cystotomy was performed for a clot in the bladder.

Mean time to ambulation was 1.5 ± 2.3 days (0–12 days). This includes 11 patients with concomitant injuries that prevented ambulation for 3 or more days (2–12 days), excluding these patients yielded a time of 0.8 ± 0.6 days (Table 1).

Mean duration of hospitalization was 2.9 days ± 2.4 days for the entire population. There were 42 patients (60%) who had no concomitant injuries that would prolong hospitalization. In those patients, duration of hospitalization was 1.9 ± 1.7 days (0.4–8 days). There were 5 (7%) readmissions, 3 for pain, 1 for worsening hematuria, and 1 for a bladder clot. The patient with bladder clot had hematuria and difficulty voiding. There were no patients who developed delayed bleeding or required subsequent transfusion after initial stability.

There was no urinalysis documented during hospitalization in 7 patients, of the remaining 63 patients, 60 (95%) were positive for blood. There were 58 patients (83%) who provided urinalysis samples at initial follow up (med 18 days) where 31 (53%) were positive for blood. Due to the fact that no patients demonstrated tachycardia or signs concerning for anemia, repeat blood counts were not performed.

Follow-up imaging was obtained in 10 patients (14%). In 9 of these patients, the indication for follow up imaging was concern for urinary extravasation on initial CT. They all underwent an ultrasound at follow-up and none were abnormal. The other patient had a perfectly circumscribed hematoma concerning for an underlying tumor and therefore a repeat CT was performed in 6 weeks demonstrating a
circular lesion with resolving hematoma. This lesion was followed for the next 4 years with ultrasound and it appears to be a stable calceal diverticulum. There was no mortality or persistent morbidity.

3. Discussion

While blunt renal injuries occur with less than half the frequency of either spleen or liver injuries [5], children are more susceptible to renal injury than adults [9]. The relative infrequency of renal injuries relative to spleen and liver may contribute to the dearth of information regarding the management of these patients. Non-operative management has become the standard of care for all solid organ injuries in children. The steps involved in the non-operative management of spleen and liver injuries have been articulated clearly in the literature beginning with extended bedrest recommendations as reported by the Trauma Committee of the American Pediatric Surgical Association in 1999 [10]. Although several groups have challenged the need for the prolonged periods of bedrest initially proposed, most centers still employ some period of observation without mobility until stability is proven [11–13]. The rationale for bedrest with spleen and liver injuries may be supported by the concept that these organs are intra-abdominal with limited opportunity for early tamponade such that the organ must simply stop bleeding by primary coagulation. Due to the lack of information on managing blunt renal trauma, we witnessed many renal patients being managed according to spleen and liver protocols with grade-specific periods of bedrest. However, the renal parenchyma is contained in Gerota’s fascia in the retroperitoneum. These barriers should create early tamponade and limit blood loss making it less likely to have substantial losses from a purely parenchymal injury. In our previously reported prospective experience with 130 blunt spleen and liver injuries, 13% required a transfusion that could be attributed to the solid organ injury [11]. In this study, the single patient requiring a transfusion attributable to the renal injury was secondary to hilar vessel bleeding. Therefore, we feel that stable patients presenting with renal parenchymal injuries would stand to gain no benefit from bedrest.

Separate from the concept of bedrest to stop bleeding, renal injury patients introduce the variable of hematuria. Prior to instituting this protocol, some patients would be kept in bed or not allowed discharge with gross hematuria. However, in our retrospective review of blunt renal injuries we found many patients with documented hematuria for up to a month from injury without sequelae [7]. This led us to question the importance of this variable in management decisions. In our retrospective experience, which included management that was surgeon specific and combined the occasional application of bedrest criteria and using hematuria to guide discharge, we recorded a mean duration of hospitalization of 6.6 days for all renal injuries and 3.8 days for those without substantial concomitant injuries. By employing a protocol, lifting bedrest requirements and not using hematuria to guide management we documented the duration of hospitalization to be 2.9 days in the entire population and 1.9 days in those without concomitant injuries requiring hospital care. This protocol therefore resulted in a 3–4 day reduction in hospitalization per patient.

Although there were no strict bedrest requirements, patients still took nearly a day on average to ambulate. This was usually because the symptoms created by the retroperitoneal hematoma included pain exacerbated by motion and also because the data set included patients with other injuries which limited mobilization. Similarly, although discharge was allowed when able to tolerate oral intake, the nearly 2 day hospitalization in those without concomitant injury was due to pain as well as nausea, also frequently reported by these patients. Adequate comfort was usually the limiting factor for discharge, and also the most common reason for readmissions in this series.

There were 9 patients with signs of urinary leak, and these patients did not suffer complications in spite of the fact that we do not routinely place urinary catheters. This is likely due to the fact that most patients have a competent ureterovesical junction and patients without a catheter were able to void spontaneously.

The removal of hematuria as a management guideline would seem to have no ill-effects given the results of this study. The longest patient continued to demonstrate microscopic hematuria was 82 days. However, we do not know at this time what the clinical meaning of the hematuria is or if it relates to long-term outcomes. As this study cohort continues to mature we hope we will be able to identify presenting and early course variables that relate to long-term outcome and the development of renal hypertension.

Table 1

<table>
<thead>
<tr>
<th>Associated Injuries</th>
<th>Number</th>
<th>Grade I-II</th>
<th>Grade IV-V</th>
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<tbody>
<tr>
<td>Spleen Injury</td>
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<td>8</td>
<td>5</td>
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<tr>
<td>Liver Injury</td>
<td>10</td>
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<td>5</td>
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<tr>
<td>Pelvic Fracture</td>
<td>6</td>
<td>5</td>
<td>1</td>
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<tr>
<td>Other Abdominal Organ (adrenal, small bowel, bladder)</td>
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<td>4</td>
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<tr>
<td>Limb Fracture</td>
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<td>1</td>
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<tr>
<td>Pulmonary Contusion</td>
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<td>1</td>
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<td>1</td>
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References


Discussion

Discussant: Dr. Dennis King (Columbus, OH): Could you highlight the readmission patients, if you could possibly pick those out? As you are well aware, if we get any readmissions in the coming years we’re all going to get spanked and so how do we avoid these readmissions?
Response: Dr. Shawn St. Peter: I would say that the majority of readmissions, in this case four out of five, could have potentially been prevented. Whenever a patient comes back, then we have to fill out this form and the big question is could it have been prevented. In four of the five, I think it potentially could have been prevented. In the hematuria case with better counseling to explain that sometimes gross hematuria will pick up again, and I've seen several patients who leave that are clear and then after 2–3 days they'll pick up hematuria and then it'll settle down again — if they understand that, then the one patient who was readmitted for worsening hematuria probably would not have come back. When they came back in, they were just admitted by the night staff and discharged the next day, but were otherwise fine so I think that was probably an unnecessary readmission. In the three patients who were admitted for pain, all of which probably could have been prevented by just making sure we had adequate control of the pain prior to discharge. I was part of the readmission for two of those patients and the transition from using IV medications to oral medications was done a little bit quick on review, so they went from getting intermittent boluses of morphine to just saying okay, you are tolerating your Roxicet and then they went home and then once they got home and were depending on their Roxicet or threw up their Roxicet because sometimes they can have nausea with these injuries, then they came back in because they were inadequately controlled.

Discussant: Dr. Dennis Vane (St. Louis, MO): Two quick questions. What was your level of hematuria? You sent these patients home with gross hematuria? That's one question. And did you see any arterial urinary tract fistulas in your group?

Response: Dr. Shawn St. Peter: There have been no fistulas to date and for the gross hematuria — right now the data as expressed are all microscopic hematuria and we didn't have adequate documentation to completely delineate gross hematuria. We could prove that about 20% of the patients were discharged with gross hematuria but the data as expressed are irrefutable proof or microscopic proven hematuria.

Discussant: Dr. Douglas Barnhart (Salt Lake City, UT): Could you highlight how many of your patients had collecting system injuries and urinary extravasation at the time of diagnosis? Did you exclude those or did you include them? Do I understand correctly that no patient got a Foley catheter no matter how much urinary extravasation they had?

Response: Dr. Shawn St. Peter: No, there were a few Foley catheters placed. At our center we had three and that was all early in the series and it was provider specific so a Foley was placed and then we had to all have a talk about it. There were 10 patients that had repeat imaging, nine of which were because of suspicious or proven urinary extravasation at the time of their injury, none of which ended up developing a complication on the follow-up imaging in the collecting system. The other patient, the tenth patient, who got repeat imaging was because of a perfectly circular hematoma and had a suspicion that there could be a mass there and so we continued to image him for a couple of years until it turned out to be a calyceal diverticulum that has decreased in size since we started this process.