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The utility of initial and follow-up ultrasound reevaluation for blunt renal trauma in children and adolescents

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Abstract *Objective:* To discover if renal ultrasound (RUS) can be utilized as the primary follow-up imaging modality in the management of blunt renal injuries in children and adolescents.

Methods: We initiated a protocol utilizing RUS reevaluations for children and adolescents treated for blunt renal injuries. Patients following this protocol (Post) had initial computerized tomography (CT) with RUS reevaluation at day 2 and 2 weeks. We retrospectively compared this group to a 2-year cohort treated between 2007 and 2009 (Pre).

Results: In our study, 28 Post protocol patients were retrospectively compared with 22 Pre cohort patients. No significant differences were observed in age, length of stay (LOS), injury severity score (ISS), and utilization of CT reevaluation. Follow-up reevaluation was obtained in 13 Pre patients versus 21 Post patients ($p = 0.231$). No patients had any evidence of long-term complications in either cohort.

Conclusion: Our results suggest that RUS can be utilized as the primary surveillance imaging modality in the management of blunt renal injuries in children and adolescents. The lack of benefit of usage of RUS demonstrated in the acute post-injury surveillance period calls into question the benefit of RUS immediately following the blunt trauma.

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Introduction

The most common genitourinary tract injury from trauma is blunt or penetrating injury to the kidney. Radiologic imaging with CT scan is necessary to evaluate the extent of renal injury for formulation of a treatment plan [1]. Usage of CT reevaluation of blunt injury to the abdomen has been called into question because of concerns of radiation-induced malignancy and the lack of proven post-injury CT benefit. The ALARA concept (“As Low As Reasonably Achievable”) was borne out of the desire to reduce radiation exposure in post-injury monitoring [2]. Some have questioned the scientific evidence of the linear relationship between radiation exposure and increased risk of malignancy, but nevertheless, the goal of reducing radiation exposure should carry strong consideration in patient management [3]. Eeg et al. evaluated the utility of CT reevaluation in combination with *renal ultrasound* (RUS) monitoring in the acute recovery period for children with blunt renal injuries and concluded that renal injury monitoring can be performed in most patients with RUS rather than CT scan [4]. However, evidence from the adult renal trauma experience suggests that imaging in the acute post-injury period is usually not necessary and may lead to additional unnecessary expense without benefit [5]. Malcom et al. concluded in their study that the grade of renal injury might determine whether or not imaging is necessary. They suggested that grades I–III of injury do not need routine follow-up imaging [6].

Multiple series recommend reassessment of the kidney approximately 3 months following the injury in order to reassess renal anatomy following resolution and to rule out any occult complications [4,6–9]. However, no randomized, controlled trials for children with renal trauma have critically evaluated the utility of post-injury reevaluation with CT at 3 months following blunt renal injury. To our knowledge, RUS without subsequent CT scan or MRI has not been evaluated as the primary surveillance modality for children with blunt renal trauma at 1–3 months following the injury.

Our aim is to *determine if RUS can be utilized as the primary follow-up imaging modality in the management of blunt renal injuries in children and adolescents.*

Methods

In 2009, we initiated a protocol utilizing initial and follow-up outpatient RUS for children and adolescents treated for blunt renal injuries at our institution. All patients in the protocol (Post) had an initial contrast enhanced CT performed using low dose technique on one of two scanners: the Toshiba Aquilion One 320 or the Toshiba 64 slice scanner. Hemodynamically stable patients with no hypertension, age appropriate vital signs, and/or transfusion requirements were managed conservatively and had RUS at day 2 and repeat RUS with their 2-week post-discharge visit. Renal ultrasounds were performed using standard grayscale transverse and longitudinal imaging on Sequoia units prior to 2011 and Phillips IU22 after 2011. With institutional review board approval, we retrospectively compared this group with a 2-year cohort with blunt renal

trauma treated between 2007 and 2009 (Pre). Variables compared include age, renal injury severity as graded by the American Association for the Surgery of Trauma (AAST), length of stay (LOS), imaging reevaluation, surgical intervention, presence of hypertension, and length of follow-up (follow-up visit and/or phone interview). Inclusion criteria for the study consisted of blunt renal trauma in stages I–V of the AAST grading system [10]. Patients over 18 years of age were excluded. Differences between protocols were estimated using the Mann–Whitney–Wilcoxon test for continuous variables and a two-group test of equal proportions for binary variables.

For both groups, patients were discharged home following demonstration of stable blood pressure, ambulation, urine without visual evidence of blood, bowel sounds, bowel movement, resumption of normal diet and successful transition to oral analgesics. Patients with low- to mid-grade renal lacerations (grades 1–3) had follow-up in the Trauma Clinic. Patients with high-grade renal injuries (grades 4 and 5) and/or incidentally found congenital anomalies underwent follow-up in the Urology Clinic. A follow-up phone inquiry was performed for all patients successfully contacted in the spring of 2012 with the reported long-term results incorporated into the follow-up data.

Results

Thirty patients managed in the ultrasound-based Post protocol group after 2009 were identified and retrospectively compared with 23 patients managed in the Pre cohort between 2007 and 2009. Of the 53 patients, two Post and one Pre patients underwent emergent nephrectomy and, therefore, were excluded from the analysis leaving 28 patients in the Post cohort and 22 patients in the Pre cohort (Table 1).

The Pre group consisted of 13 males and nine females. Their mechanisms of injury included: motor vehicle collisions, falls, pedestrian versus vehicle collisions and ATV collisions. The mean age for the Pre group was 11 years with a median ISS score of 11.5 and a median LOS of 2 days. The median injury grade was II and length of follow-up was 40.5 months. Three patients in the Pre group had grade 4 or 5 renal injuries, which were managed without nephrectomy (Table 1). Of the 22 patients, 16 had multisystem organ trauma. They had an average injury severity score of 17. The other six patients with isolated kidney injury had a combined injury severity score of ten. No patients with multisystem organ trauma went to the OR for an abdominal procedure not related to the kidney injury.

The Post group consisted of 19 males and 9 females. Their mechanisms of injury included: motor vehicle collisions, ATV collisions, falls and animal related injuries. The mean age for the Post group was 10.6 years with a median ISS score of 14 and a median LOS of 2 days. The median injury in the Post cohort also was grade II and length of follow-up was 14.2 months. Four patients in the Post group had grade 4 or 5 renal injuries, which were managed without nephrectomy (Table 1). Twenty of the 28 patients in the Post group had multi-organ trauma with an average injury severity score of 16. The patients with isolated

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