



Perinephric Hematoma Size is Independently Associated with the Need for Urological Intervention in Multisystem Blunt Renal Trauma

Logan Zemp, Uday Mann and Keith F. Rourke*

From the Division of Urology, Northern Alberta Urology Centre, University of Alberta, Edmonton, Alberta, Canada

Purpose: We examined radiographic predictors of intervention for blunt renal trauma independent of AAST-OIS (American Association for the Surgery of Trauma-Organ Injury Scale).

Materials and Methods: A total of 328 patients with blunt renal trauma from October 2004 to December 2014 were identified for analysis. Hospital records and diagnostic imaging were reviewed to identify the need for urological intervention, including angiographic embolization, nephrectomy, renorrhaphy, ureteral stenting or percutaneous drainage. Factors examined included patient age, gender, length of stay, ISS (Injury Severity Score), AAST-OIS, laceration location, length and number, perinephric hematoma characteristics, intravascular contrast extravasation and devitalized segment status. Descriptive statistics and binary logistic regression were performed as appropriate.

Results: Mean patient age was 37.0 years and mean ISS was 31.7. A total of 31 urological interventions were required in 27 patients (8.2%), including ureteral stenting in 38.7%, angiographic embolization in 32.3%, nephrectomy in 22.6%, renorrhaphy in 3.2% and percutaneous drainage in 3.2%. On univariate analysis AAST-OIS, hematoma diameter, hematoma area, intravascular contrast extravasation, laceration length, laceration number, degree of devitalization and devitalized fragment presence were associated with the need for intervention (each $p < 0.001$). On multivariate analysis only AAST-OIS grade (OR 69.4, 95% CI 6.4–748.3, $p < 0.001$) and hematoma diameter (OR 1.5, 95% CI 1.1–1.9, $p = 0.004$) or area (OR 1.03, 95% CI 1.01–1.06, $p = 0.012$) remained associated with urological intervention.

Conclusions: Although AAST-OIS is strongly associated with the need for urological intervention, perinephric hematoma size is also independently associated with this occurrence. Perinephric hematoma diameter should be considered during clinical decision making and incorporated into a revised injury grading system.

Key Words: kidney; wounds, nonpenetrating; hematoma; risk assessment; trauma severity indices

KIDNEYS are the most commonly injured genitourinary organ and blunt trauma is the leading mechanism of injury.^{1–3} Renal trauma as classified by AAST-OIS was first described by

Moore et al on a scale of I to V based on the depth of renal parenchymal damage and involvement of the collecting system or renal vessels.⁴ This classification scheme, which was last updated

Abbreviations and Acronyms

AAST = American Association for the Surgery of Trauma

CT = computerized tomography

ICE = intravascular contrast extravasation

ISS = Injury Severity Score

OIS = Organ Injury Scale

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* Correspondence: Division of Urology, Department of Surgery, Northern Alberta Urology Centre, University of Alberta, 7th Floor, 11400 University Ave., Edmonton, Alberta, T6G 1Z1 Canada (telephone: 780-407-5800; FAX: 888-414-6282; e-mail: krouke@ualberta.ca).

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in 2012, has been widely used to stratify renal injuries and has been validated as a predictor of intervention specifically for higher grade injuries.⁵⁻⁷ Patients deemed at higher risk may be monitored more closely and perhaps undergo intervention sooner to prevent unnecessary complications and renal loss.

The AAST-OIS grading system has even been used as a guide for nontraumatic endoscopic, angiographic or open renal procedures. However, it does not include a number of factors that have been suggested as important factors to predict intervention.⁸ These factors include perinephric hematoma size, laceration location, ICE and the presence or extent of devitalized renal fragments.⁹⁻¹² Dugi et al from Parkland Hospital were among the first to describe other diagnostic imaging parameters that may predict the need for intervention of renal trauma, namely ICE, perinephric hematoma diameter greater than 3.5 cm or a medial renal laceration site.^{9,10} These criteria were examined by other groups but often assessed as univariate associations not independent of AAST-OIS grade.^{11,12}

The objective of our study was to determine independent risk factors associated with urological intervention in a severely injured population of patients with blunt renal trauma. We hypothesized that perinephric hematoma characteristics would be independently associated with the need for urological intervention.

MATERIALS AND METHODS

This study is a health ethics board approved, retrospective review of the Alberta Trauma Registry from October 2004 through December 2014 inclusive. To qualify for the Alberta Trauma Registry a patient must be involved in a trauma with ISS 12 or greater and be admitted to a level 1 trauma center. The database was interrogated for ICD code 866 (kidney injury), which identified 487 major traumas managed at a level 1 trauma center at our institution. All charts were reviewed by at least 2 of the 3 study investigators to ensure data completeness and accuracy.

Inclusion Criteria

All patients 18 years old or older with blunt renal trauma were included in analysis regardless of AAST-OIS classification. Patients with penetrating trauma were excluded from study as they are more likely to undergo operative intervention based on the mechanism of injury rather than on clinical status or imaging findings. CT with intravenous contrast medium at hospital admission and prior to selective angioembolization or operative intervention were also requirements.

Radiological Review

All CT images were reviewed by a trainee who had been trained by a staff urologist in reading renal trauma imaging and by a staff reconstructive urological surgeon blinded to patient intervention status. The staff urologist

ultimately determined the final reporting in the event of any discrepancy.

Recorded radiographic features included perinephric hematoma characteristics (maximal diameter, location and area), ICE, renal laceration site, length and number, and devitalized segment status. The length of the perinephric hematoma diameter variable was calculated in a manner similar to that of Nuss et al by measuring the longest distance from Gerota's fascia to the renal parenchyma.⁹ Perinephric hematoma area was also calculated in a similar manner using the formula for the area of an ellipse. Each of these measurements was made using the CT image that provided the largest hematoma size.

Patient Characteristics

Hospital records were reviewed to determine patient age, gender, length of stay and ISS. Records were reviewed to identify the need for intervention related to the renal injury, including ureteral stenting, angiographic embolization, nephrectomy, renorrhaphy or percutaneous drainage. Ureteral stenting was performed for symptomatic urine leak or urinoma not responding to conservative treatment. Embolization and renal exploration were typically performed for hemodynamic instability.

Statistical Analysis

Descriptive statistics were used to characterize patient information. Univariate and multivariate binary regression analysis with categorical and continuous variables was done to assess the relationship between predictor variables and outcomes.

RESULTS

Demographics

Of the 487 trauma cases that presented during the study period 328 met study inclusion criteria (table 1). Mean patient age was 37 years, 79% of the patients were male and mean ISS was 32. Injuries were classified by AAST grade as grade I (hematuria with normal studies or subcapsular, nonexpanding hematoma) in 58 of the 328 patients (18%), grade II (nonexpanding perirenal hematoma or less than 1 cm parenchymal laceration without urinary extravasation) in 76 (23%), grade III (greater than 1 cm renal cortex laceration without collecting system injury) in 118 (36%), grade IV (parenchymal laceration extending into the collecting system or main renal artery, or vein injury with contained hemorrhage) in 65 (20%) and grade V (a completely shattered kidney or vascular avulsion of the renal hilum devascularizing the kidney) in 11 (3%) (table 1). The most common injury mechanisms were motor vehicle accidents in 52% of cases followed by pedestrians or cyclists injured by vehicles in 10% and a fall from a height in 10%.

Urological Interventions

Of the patients 8.2% underwent a total of 31 interventions (table 1). All renal trauma interventions were done for grade IV and V injuries. There was no

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