High Grade Blunt Renal Trauma: Predictors of Surgery and Long-Term Outcomes of Conservative Management. A Prospective Single Center Study

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Abbreviations and Acronyms

AAST = American Association for the Surgery of Trauma

CT = computerized tomography

DMSA = dimercapto-succinic acid

NOM = nonoperative management

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Purpose: The management of major renal trauma has shifted in the last decade in favor of a nonoperative approach. Our level 1 trauma center promotes this approach with the objective of renal function preservation. However, certain situations still require surgery. In this study we analyze predictors of surgery and long-term outcomes after conservative management.

Materials and Methods: From January 2004 to March 2015 we prospectively collected data from all patients admitted to our institution for high grade blunt renal trauma (grades IV and V). Nonoperative management was considered successful when patients did not undergo surgical exploration, regardless of angioembolization or endoscopic treatment.

Results: Of 306 patients with renal trauma 151 presented with major injuries, including 124 grade IV and 27 grade V. Nonoperative management was successful in 110 (89%) cases of grade IV and 14 (52%) cases of grade V lesions. Deceleration mechanism ($p=0.03$), associated lesions ($p=0.001$), percentage of devitalized parenchyma ($p=0.012$), angioembolization ($p<0.001$), hemodynamic instability ($p<0.001$) and low hemoglobin ($p=0.001$) were more frequent in patients treated surgically. On multivariate analysis grade (OR 7.36, $p=0.01$) and hemodynamic instability (OR 4.18, $p=0.04$) were the only independent predictors of surgical treatment. Long-term followup of preserved kidneys revealed a remaining 40% and 0% relative renal function after grade IV and V injuries, respectively. Only devascularized parenchyma greater than 25% predicted the decline of long-term renal function.

Conclusions: Nonoperative management can and should be performed safely in cases of grade IV injuries whenever possible, with valuable long-term renal function. It can also be initiated in grade V cases. However, surgeons should consider nephrectomy with the onset of any suspicious symptoms.

Key Words: kidney; wounds and injuries; endoscopy; embolization, therapeutic

Nonoperative management of the most severe renal injuries has expanded greatly during the last decade, along with improvement in resuscitation techniques and interventional radiology, allowing for bleeding and unstable cases to be treated primarily nonoperatively.

The consensus in the literature now seems to be a recommendation of

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nonoperative management as standard care for all grade I to III renal traumas, and an increasing number of studies are being published supporting this approach in grade IV or even V cases.[1–6]

Nonetheless surgery remains a valid option in certain situations and the current challenge is promptly identifying which patients should be treated surgically. Our level 1 trauma center has longtime experience with renal trauma and involvement in nonoperative management, with the belief nephrectomy can often be avoided. We hypothesize that the initial nonoperative management of even severe blunt renal trauma, provided there is close monitoring, will not endanger patients, and will most often be successful, leading to favorable outcomes with long-term renal function.

PATIENTS AND METHODS

Patients admitted to our level 1 trauma center for a major blunt renal trauma (grade IV and V) between January 2004 and March 2015 were included in the study. Data on demographics and clinical outcomes were prospectively collected. Approval from our institutional ethics committee was obtained for this study (CECIC Rhône-Alpes-Auvergne, Grenoble, IRB5891).

Data Assessment

Patients were divided into 2 groups according to operative or nonoperative renal management. NOM was considered achieved in the absence of renal related surgery during hospital stay, regardless of the need for embolization or endoscopic treatment. Data were collected in both groups, including demographics, circumstances and mechanism of trauma, hemodynamic status and hemoglobin on hospital admission, renal injury grade, CT findings, initial hospital management (surveillance, angioembolization, endoscopic treatment), length of hospital stay and, when applicable, time to surgery.

Renal injury was graded according to the AAST Organ Injury Scale based on CT findings on hospital admission.[7] Grade IV injuries were defined as laceration through the parenchyma into the urinary collecting system, or main renal artery or vein injury with contained hemorrhage. Grade V trauma included completely shattered kidneys and avulsion of renal hilum. Renal devascularization was evaluated by trained radiologists from our institution based on renal reconstructions from CT on hospital admission.

Management Protocol and Followup

Our institutional first line nonoperative treatment protocol was applied to all admitted patients. If there was active bleeding on admission CT, patients were referred to radiologists for immediate angioembolization regardless of hemodynamic status. Emergency surgery was only performed in the event of nonefficient resuscitation and failed embolization.

In all other cases NOM was initiated, consisting of bed rest, hydration, analgesia and close monitoring. Retrograde ureteral stent placement was performed secondarily in patients with symptomatic ureteral clot obstruction or significant urine leakage on subsequent CT. Angioembolization and endoscopic treatment without secondary renal surgery were considered successful nonoperative management.

Followup CT was systematic 3 to 5 days after the trauma, or earlier in cases of persistent pain, fever or a low hemoglobin count. Causes of delayed surgical treatment were analyzed. Long-term renal function assessment based on serum creatinine and DMSA renal scintigraphy was performed 4 to 6 months after the trauma in patients with successful NOM.

Statistical Analysis

Patients were compared according to the necessity of renal related surgery. Continuous variables were reported using median values with interquartile ranges and compared using the independent Mann-Whitney U test. Categorical variables were reported as counts and proportions, and compared using the chi-square test or the Fisher exact test as appropriate.

Multiple logistic regression was performed to identify independent predictors of surgery, angioembolization and ureteral stent placement in patients with high grade renal trauma (grades IV and V). Variables attaining $p \leq 0.05$ on univariate analysis or considered clinically relevant were included in the multivariate analysis.

Multiple linear regression was used to study predictors of long-term relative renal function in patients with grade IV trauma treated conservatively. Statistical analysis was performed with SPSS® version 18.

RESULTS

In the study period 306 patients were admitted to our institution for a renal trauma, of whom 151 were identified with a high grade injury, including 124 (82%) grade IV and 27 (18%) grade V. The majority of cases were accidents due to a physical activity (77%), generally winter sports, and occurred in men (82%) with a median age of 24 (IQR 19–37). Demographic data, trauma characteristics and patient outcomes are listed in the supplementary table (http://jurology.com/).

Operative Versus Nonoperative Management

Nonoperative management was initiated in 148 (98%) of the 151 patients (see figure). Three patients required emergency surgery on the day of hospital admission, including 2 with associated ruptured spleens and 1 with liver lacerations requiring abdominal packing. All 3 had grade V injuries and nephrectomy was performed. Overall NOM was successful in 124 (82%) patients, despite frequent associated lesions (47%) and urinary extravasation (70%). The success rate of nonoperative management was higher in grade IV than grade V trauma cases (89% vs 52%, $p < 0.001$). Angioembolization and ureteral stent placement were necessary for 22 (18%) and 21 (17%) nonoperative cases, respectively (supplementary table, http://jurology.com/).