

## Predictors of Nephrectomy in High Grade Renal Trauma Patients Treated Primarily with Conservative Intent

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Abstract:

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**Purpose:** the aim of our study is to assess the characteristics of perinephric hematoma and other prognostic factors of surgical intervention for high grade renal trauma independent of AAST OIS (American association for the surgery for trauma organ injury scale). **Materials and methods:** A total of 119 patients with high grade renal trauma from January 2005 to September 2021 were identified for analysis. Hospital records and diagnostic imaging were reviewed to identify the need for surgical intervention, including total and partial nephrectomy. Factors examined include patient age, gender, ISS (Injury severity score), AAST-OIS, laceration location, length and number, perinephric hematoma characteristics, intravascular contrast extravasation and devitalised segment status. Descriptive statistics and binary logistic regression were performed as appropriate. **Results:** Mean patient age was 31, 39 and mean ISS was 22, 80. A total of 24 surgical intervention were required (20%) including partial and total nephrectomy. On univariate analysis, hypotension on admission, hematoma diameter, degree of devitalised fragment superior of 25% and AAST OIS grade were associated with the need of surgical intervention. On multivariate analysis, only hypotension on admission (OR:0,296, 95% CI 0,099-0,885, p: 0,029), hematoma diameter greater than 3,5 cm ( OR:0,253, 95% CI 0,070-0,815, p:0,021) and AAST-OIS grade ( OR: 0,256, 95% CI 0,09-0,72, p: 0,010 ) remained independently associated with surgical intervention. **Conclusions:** Perinephric hematoma size remains among prognostic factors for surgical intervention that allow better stratification of renal lesions and its study allows a better management of high-grade renal trauma.

**Key Words:** kidney, perinephric hematoma, prognostic factors.

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### INTRODUCTION:

Kidneys are the most commonly injured genitourinary organ [1]. High grade renal trauma is defined by the American association for the surgery of trauma by the presence of grade III, IV and V, they are rarer and found in 5% of cases on average [2].

Over the past decades, the management of kidney trauma has evolved with a clear transition to a minimally invasive conservative approach This due to development of minimally invasive treatment techniques such as angioembolization and endourology, improving imaging modalities, mainly computed tomography and means of admission in emergencies and resuscitation [3].

According to the patient's initial clinical assessment on admission, his hemodynamic assessment as well as the grade of his trauma, the course of action to be taken will be decided [4].

The aim of our study is to assess perinephric hematoma size as a strong prognostic factor of need of surgical intervention in high grade renal trauma.

### MATERIALS AND METHODS:

**Study Design:**

This descriptive and analytical retrospective single center study was conducted between January 2005 and September 2021 inclusive, data were collected from adult patients with high grade renal trauma defined as AAST grades III – V diagnosed and graded using computed tomography CT, treated in a conservative way in our structure.

Patients who underwent immediate surgery without prior imaging were excluded. Data were gathered on demographics, injury characteristics, radiologic variables, and management.

**Definitions:**

Hypotension was defined as blood systolic blood pressure <90 mmHg anytime during the first 4 hours from admission.

Vascular contrast extravasation (VCE) was defined as presence of contrast accumulation outside of the renal parenchyma demonstrated on arterial or venous phase CT scan.

Hematoma rim distance (HRD) was measured on the axial CT planes and was defined as the longest perpendicular distance from the renal parenchymal border to the hematoma border within the boundaries of superior and inferior kidney margins.

Percentage of parenchymal devascularization was estimated based on the extent of persistent parenchymal infarcts seen as segmental or global lack of enhancement on contrast trauma CT scans and was dichotomized as <25% or ≥25% as suggested in previous studies.

Management options were categorized as expectant, conservative/minimally invasive, and open operative. Bleeding interventions included: nephrectomy, partial nephrectomy, renorrhaphy.

Conservative treatment consisted of admission of the patients to a medical facility, with bed rest, hydration, antibiotic prophylaxis and analgesics if needed, monitoring of clinical and biological parameters and CT scan at J3, J8 combined with all non-surgical interventions preserving the renal unit including transfusions...

Failure of conservative treatment was defined by the need for invasive surgical interventions: total or partial nephrectomy.

**Data extraction:**

The studied parameters included age, sex, laterality, mechanism of occurrence, associated lesions, ISS, clinical and laboratory signs at patient admission, blood transfusion, AAST grade, characteristics of perinephric hematoma, presence of vascular contrast extravasation, parenchymal devascularization, treatment, duration of hospitalization and evolution.

We took into consideration to assess the abundance of the perirenal hematoma and compare our patients, the hematoma rim distance on CT scan.

**Statistical analysis:**

Statistical analysis was performed using SPSS software version 19.0.

Values are reported as percentages for categorical variables and mean or median for continuous variables as appropriate.

In the bivariate analysis, comparison of categorical variables used the Chi2 test and comparison of continuous variables used the Student t test. Multivariate analysis using binary logistic regression was used to model prognostic factors for failure of conservative treatment of high-grade renal trauma. The variable of interest was (failure of conservative treatment of high-grade renal trauma).

## RESULTS:

Of the 131 traumas that presented during the study period, 119 met study inclusion criteria (table 1). Mean patient age was 31,  $39 \pm 13$ , 28 years, 85% of the patients were male and mean ISS was 22, 80. Injuries were classified by AAST grade as grade III in 56 of the 119 patients (47%), grade IV in 54 (45%) and grade V in 9 patients (8%) (Table 1). The average size of the perinephric hematoma was  $47.03 \pm 44.22$  mm the most common injury mechanisms were traffic accident in 37% of cases followed by stabbing assaults in 29% and a fall from a height in 23%.

Of the patients 20% underwent a total of 24 surgical interventions (table1). 3 patients (2%) classified as grade III, 14 patients (12%) grade IV and 9 patients (6%) classified as grade V. The most common surgical intervention was total nephrectomy in 22 cases followed by partial nephrectomy in 2 cases.

On univariate analysis the need for surgical intervention was associated with hypotension at admission (OR: 5,87, 95% CI 2,25-15,30, p: 0,001), hematoma diameter greater than 3,5 cm (OR:6,22, 95%CI 2,13-18,13, p: 0,001), AAST OIS grade (OR: 2,33 95% CI 1,66-4,16, p: 0,001) and the presence of devitalized fragment superior of 25 % (OR: 27,90, 95% CI 5,48-141,87, p: 0,004 ) (table 2).

However, after multivariate binary logistic regression analysis only hypotension on admission (OR:0,296, 95% CI 0,099-0,885, p: 0,029), hematoma diameter greater than 3,5 cm ( OR:0,253, 95% CI 0,070-0,815, p:0,021) and AAST-OIS grade ( OR: 0,256, 95% CI 0,09-0,72, p: 0,010 ) remained independently associated with surgical intervention (table 3).

Descriptive statistics showed that a hematoma diameter 3,5 cm or less vs 3,5 cm or greater resulted in an intervention rate of 8 % vs 35% ( p = 0,021).

**Table 1: Demographics of patients in high grade renal trauma cohort and outcomes and interventions**

No. pts		119
Mean ± SD pt age (range)		31.39 ± 13,28 (15 - 68)
No. male (%)		101 (85%)
No. female (%)		18 (15%)
Sex ratio		5.6
Mean ± SD Injury Severity Score		22,80 ± 11,48 (9 - 59)
Injury mechanism	Traffic accident	44 (37%)
	Fall from a height	27 (23%)
	Stabbing assault	35 (29%)
	Work accident	7 (6%)
	Fight	4 (3%)
	Sport accident	2 (2%)
No. blunt trauma (%)		84 (71%)
No. penetrating trauma (%)		35 (29%)
No. AAST-OIS grade (%) :	Grade III	56 (47%)
	Grade IV	54 (45%)
	Grade V	9 (8%)
Mean ± SD perinephric hematoma diameter (cm):		4.70 ± 4.42 (0.4 -23)
No. perinephric hematoma location (%) :	upper pole	16 (13%)
	lower pole	63 (53%)
	mid-kidney	40 (34%)
No. devitalized fragment (%) :		11 (9%)
Mean days hospital stay (range) :		16.1 (6 -75)
No. pts requiring surgical intervention (%) :		24 (20%)

**Table 2: Univariate associations relating to need for surgical intervention**

	OR (95% CI)	p Value
Age	0.99 (0.96 - 1.03)	0.82
Injury mechanism	1.87 (0.21 - 2.04)	0.89
Injury Nature	1.25 (0.48 - 3.28)	0.63
hypotension on admission	5.87 (2.25 - 15.30)	0.001*
Injury Severity Score	1.95 (0.91 - 2.05)	0.33
Associated Injuries	2.51 (0.97 - 6.47)	0.051
AAST grade	2.33 (1.66 - 4.16)	0.001*
Hematoma Diameter greater than 3.5 cm	6.22 (2.13 - 18.13)	0.001*
Hematoma Location	3.45 (2.76 -3.98)	0.59
Medial laceration	1.62 (0.64 - 4.08)	0.29
Devitalized fragment sup of 25%	27.90 (5.48 - 141.877)	0.004*
*Significant (p <0.05)		

**Table 3: Multivariate analysis relating to need for surgical intervention**

	OR (95% CI)	p Value
Hypotension on admission	0.296 (0.099 - 0.885)	0.029*
AAST grade	0.256 (0.090 - 0.720)	0.010*
Hematoma Diameter greater than 3.5 cm	0.253 (0.070 - 0.815)	0.021*
Devitalized fragment sup of 25%	0.321 (0.025 - 4.201)	0.387
*Significant (p <0.05)		

## DISCUSSION:

Since its introduction in 1989, AAST OIS has proven to be valid for predicting patients requiring urological intervention, especially with the transition to conservative attitude [5], [6].

European guidelines recently, defined the conservative management of renal trauma as all measures consisting of bedrest, clinical observation, laboratorial and radiological monitoring [7]. This attitude is considered as a standard of management of severe kidney trauma with a success rate that varies between 80% and 100% [5], [6], [8].

To make AAST OIS more practical and accurate for making management decisions in high grade renal trauma, Dugi et al [9] proposed to update this classification scheme, mainly for grade IV into grade IV low risk if 0 or 1 risk factor is present and grade IV high risk if 2 or 3 risk factors are present. They have included in the update as risk factors for surgical intervention: perinephric hematoma size greater than 3.5cm, vascular contrast extravasation and the presence of medial laceration.

Figler et al [10], approved this sub stratification, in a study published in the American college of surgeons in 2013 with a sensitivity of 71% and a specificity of 89%.

Perinephric hematoma is one of the important CT features that quantify the active bleeding of the kidney and its evolution over time. It is considered as a prognostic factor of failure of conservative treatment of high grade renal trauma according to several studies [2], [9], [11], [12].

Ichigi et al [12] considered that the size of the hematoma is a good index to quantify the bleeding and assess the degree of vascular damage better than the AAST OIS, this latter is frequently dissociated from the intensity of the bleeding. Hematomas with a maximal diameter greater than 4 cm were associated with the need for urological surgical intervention.

Our study shows the same results, since the size of the perinephric hematoma greater than 3.5 cm was associated with nephrectomy in the univariate analysis (P value= 0.001) and multivariate analysis (p= 0.021, OR: 0.253, 95% CI: [0.070 - 0.815]) with a surgical intervention rate of 35% versus 8% for an hematoma diameter of 3,5 cm or greater vs 3,5 cm or less.

However, the exact size that determines the need for surgery differs between studies: several groups found that haematoma size greater than 3.5 cm was associated with an intervention rate of 25.5% to 27%, while haematoma size below 3.5 cm was associated with an intervention rate of 3% to 4% [9], [10].

Zemp et al [13], in a study published in 2017 in The journal of urology, concluded that the size of the hematoma greater than 6 cm provides better discrimination of patients requiring intervention (31.1% vs. 1.6%) compared to a smaller size of 4 cm (16.2% vs. 1.7%). This confirms that the size of the perirenal haematoma is a crucial element for decision making in renal trauma.

More recently Keihani et al [14] concluded that vascular contrast extravasation and perinephric hematoma are two CT indices that can be used to decide the need for surgical intervention and can thus be incorporated into a revision of the AAST OIS for a better management of high grade renal trauma.

In their last edition (2021) of guidelines, the American association of urology [15] recommends surgical intervention in non-hemodynamically stable high grade renal trauma with perinephric hematoma size greater than 4 cm and /or vascular contrast extravasation.

Our study is limited because of its retrospective nature. In addition, patients were followed in hospital only and were unaware of any complications that might have required care beyond the acute hospital stay.

## CONCLUSIONS:

Perinephric hematoma size remains among prognostic factors for surgical intervention that allow better stratification of renal injuries. It should be incorporated into a revised AAST-OIS grading system for a better management of high-grade renal trauma.

**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  
OR = Odds Ration  
CI = Confidence Interval

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