

# Prospective comparative study between conservative and interventional managements of high-grade renal trauma: Our experience in a tertiary care hospital



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## ABSTRACT

**Background:** Trauma is the leading cause of morbidity and mortality globally, with blunt abdominal trauma more common than penetrating injuries. Renal injury accounts for 5% of all trauma cases and 24% of abdominal solid organ injuries. Advances in imaging, hemodynamic monitoring, and management techniques have enabled successful conservative management strategies for renal preservation. **Aims and Objectives:** This study aims to assess clinical presentation, demographic profiles, mechanisms of injury, complications, management, and outcomes in renal trauma cases. **Material and Methods:** This retrospective study included 62 patients diagnosed with renal trauma between December 2022 and July 2024. Patients were divided into two groups: Conservative management (Group 1) and interventional management (Group 2). Clinical variables, management strategies, and outcomes were analyzed. The study followed ethical standards approved by the responsible committee. Statistical analysis was performed using SPSS version 21, with  $P < 0.05$  considered significant. The Chi-square test was used for categorical variables and Student's t-test for numerical variables. **Results:** Blunt trauma (90.3%) was the most common, primarily due to motor vehicle accidents (46.8%). Hematuria was present in 85.5% of cases. Most injuries were Grade IV (43.5%) and Grade V (9.7%). Of Grade IV injuries, 77.8% were managed conservatively. Complications included urinary tract infection, hematuria, hypertension, and urinoma, all classified as Clavien grade 1-3. The success rate of conservative management was 100% for Grade III, 84% for Grade IV, and 66.7% for Grade V injuries. **Conclusions:** Conservative management is effective for most renal injuries, even in Grade IV and V cases, reducing the need for nephrectomy and hospital stay, while minimizing morbidity and mortality.

**Key words:** Conservation; Blunt trauma; Renal trauma; Contrast computed tomography; Nephrectomy

## INTRODUCTION

Renal injuries are the most common injuries of the urinary system.<sup>1</sup> The kidneys are located high up in the retroperitoneum. The kidney is well protected and

cushioned by the peritoneum and abdominal viscera anteriorly and heavy musculoskeletal structures of posterior abdominal wall posteriorly. Fractured ribs and transverse vertebral process may penetrate the renal parenchyma or vasculature. Most injuries occur from automobile accidents

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or sporting mishaps, chiefly in men and boys. Kidneys with existing pathologic conditions such as hydronephrosis or malignant tumors are more readily ruptured from mild trauma.<sup>2</sup> Size of the perinephric hematoma is an indicator for surgical intervention blunt trauma directly to the abdomen, flank, or back is the most common mechanism, accounting for 80–85% of all renal injuries.<sup>3,4</sup> Trauma may result from motor vehicle accidents, fights, falls, and contact sports. Vehicle collisions at high speed may result in major renal trauma from rapid deceleration and cause major vascular injury. Gunshot and knife wounds cause most penetrating injuries to the kidney; any such wound in the flank area should be regarded as a cause of renal injury until proved otherwise. Associated abdominal visceral injuries are present in 80% of renal penetrating wounds. About 95–98% of isolated renal injuries are considered minor injuries and are managed conservatively because they usually heal spontaneously without complications. The most widely used and accepted classification of renal trauma is that of the American Association for the Surgery of Trauma's Organ Injury Scaling Committee (AAST), as shown in Table 1.

Based on accurate grading made possible by contrast-enhanced computed tomography (CT), the AAST injury severity scale is a powerful and valid predictive tool for clinical outcomes in patients with renal trauma. Majority of blunt renal traumas are of low-grade, and 80–85% of these are treated with conservative management.<sup>5</sup> Conservative management has become the standard

of care in hemodynamically stable, well-staged patients with AAST Grade I to III renal injuries, regardless of mechanism. Even high-grade injuries of Grade IV and V can be managed without renal operation if carefully staged and selected. The selective application of this approach to penetrating renal injuries has also become the standard of care in stable patients. This evolution in the management of renal injury has been made possible by advances in both imaging and minimally invasive techniques.<sup>6-10</sup> The conservative management of renal trauma consists of one or more of the following methods: Strict bed rest with closely observation and monitoring, ureteric stenting, percutaneous drainage, and embolization.<sup>6-10</sup>

The purpose of this study was to analyze the demographic characteristics, conservative management of renal trauma, complications of renal trauma, and their managements.

### Aims and objectives

The objective of this study was

1. To assess the complications in renal trauma.
2. To manage the complications in renal trauma.

## MATERIALS AND METHODS

After taking Institutional Ethics Committee clearance (Registration No. EC/NEW/INST/2023/3404), we conducted a prospective study for conservative and interventional management of Grades 3–5 renal traumas with analysis of data on patients who have admitted and

**Table 1: American association for the surgery of trauma organ injury severity scale for the kidney**

Grade	Type of injury	Description of injury (1989)	2018 revised
I	Contusion	Microscopic or gross hematuria, urologic studies normal	
	Hematoma	Subcapsular, non-expanding without parenchymal laceration	Subcapsular hematoma and/or parenchymal contusion without laceration
II	Hematoma	Non-expanding perirenal hematoma confined to renal retroperitoneum	Perirenal hematoma confined to Gerota fascia
	Laceration	<1 cm parenchymal depth of renal cortex without urinary extravasation	Renal parenchymal laceration ≤1 cm depth without urinary laceration
III	Laceration	>1 cm parenchymal depth of renal cortex without collecting system rupture or urinary extravasation	Renal parenchymal laceration >1 cm depth without collecting system rupture or urinary extravasation Any injury in the presence of a kidney vascular injury or active bleeding contained within Gerota fascia
	Laceration	Parenchymal laceration extending through renal cortex, medulla, and collecting system	Parenchymal laceration extending into urinary collecting system with urinary extravasation Renal pelvis laceration and/or complete ureteropelvic disruption
IV	Vascular	Main renal artery or vein injury with contained hemorrhage	Segmental renal vein or artery injury Active bleeding beyond Gerota fascia into the retroperitoneum or peritoneum Segmental or complete kidney infarction (s) due to vessel thrombosis without active bleeding
	Laceration	Completely shattered kidney	Main renal artery or vein laceration or avulsion of hilum
V	Vascular	Avulsion of renal hilum, devascularizing the kidney	Devascularized kidney with active bleeding Shattered kidney with loss of identifiable parenchymal renal anatomy

diagnosed with renal trauma in our institution, from January 2019 to December 2022. Grades of renal trauma were defined according to the classification of AAST based on CECT. Imaging was classified by radiologists. Conservative approach was defined as the treatment of renal trauma by observation and monitoring of clinical (vital signs and hemodynamic stability) and laboratory parameters, and medications with serial examinations, testing, and reimaging while being ready for potential surgical interventions. Intervention management included open surgical procedures. Variables were analyzed according to age, sex, mechanism of injury, degree of renal trauma, associated organ injury, laboratory and radiology results, management, and outcome. According to the approach of management, patients were classified into two groups. Group 1 included the patients who were offered to conservative management. Regardless of renal trauma grade, all the patients who were hemodynamically stable after resuscitation were considered candidate for conservative management in the form of absolute bed rest, hydration, broad-spectrum antibiotics, analgesic, serial monitoring of the hemodynamics, vital signs, urine color, serial hemoglobin (Hb) and hematocrit (HCT) values, and reimaging in the form of serial abdominal ultrasound follow-up for the size of hematoma in all cases, and CECT was repeated in certain cases on discharge and follow-up. Patients with conservative management stayed in the hospital for strict monitoring until there were stable vital signs, clear urine, regression, or absence of the perinephric hematoma. After discharge, patients had a follow-up every 2 weeks for 1<sup>st</sup> month and then every month for at least 3 months. In every visit, a history of recurring hematuria, loin pain, or fever is taken with follow-up ultrasonography for observing of the residual, reappeared hematoma or urinoma. Follow-up CECT was done in some cases with major kidney laceration or massive extravasation or those with persistent symptoms or hematomas. Group 2 included the patients who required immediate interventional management for renal trauma for hemorrhage, in the form of repair of renal tears, and partial or total nephrectomy. Post-operative follow-up included strict observation of vital signs and urine color, abdominal ultrasonography, and measurement of Hb and HCT values.

Statistical analysis was done using the SPSS version 21. P<0.05 was considered statistically significant. The Chi-square test was used for categorical variables, Student's t-test was used to test numerical variables, and Fisher's exact test was used when indicated.

## RESULTS

In our study, we are able to get information of 62 patients. All the patients' characteristics are presented in Table 2. We

**Table 2: Demographic and clinical characteristics of the patients**

Variables	Conservation n=54	Intervention n=8	P-value
Age range (mean)/years	8–65 (27.3±9)	13–63 (21±8.7)	0.158
Gender			
Male	43 (79.6)	6 (75)	
Female	11 (20.4)	2 (25)	
Type of trauma			
Blunt	50 (92.6)	6 (75)	0.627
Penetrating	4 (7.4)	2 (25)	
Etiology			
Motor vehicle accidents	26 (48.1)	3 (37.5)	
Fall from height	24 (44.4)	3 (37.5)	
Stab wound	3 (5.6)	1 (12.5)	
Firearm injury	1 (1.9)	1 (12.5)	
Grade of injury			
Grade 3	30 (55.6)	0 (0)	0.151
Grade 4	21 (39)	6 (75)	
Grade 5	4 (7.4)	2 (25)	
Hematuria			
At presentation	44 (81.5%)	7 (87.5%)	0.068
At discharge	0 (0%)	0 (0%)	
Blood pressure (mm of Hg)			
At presentation			
Systolic	114.23±12.37	107.14±11.46	0.163
Diastolic	68.24±11.35	63.28±8.76	0.612
At discharge			
Systolic	116.37±11.78	112±9.69	0.754
Diastolic	71.67±8.98	72.42±8.38	0.736
Blood transfusion (units)	0.63±0.78	2.24±0.93	0.001
Hemoglobin level			
At presentation	9.35±2.21	9.84±1.53	0.001
At discharge	10.63±1.19	10.32±1.08	
HCT value			
At presentation	30.43±5.87	32.62±5.95	0.001
At discharge	33.56±3.64	34.65±4.79	
Hospital stay (days)	11.47±3.69	10.32±6.56	0.067
Outcome (%)			
Nephrectomy	2 (4)	4 (50)	0.001

HCT: Hematocrit

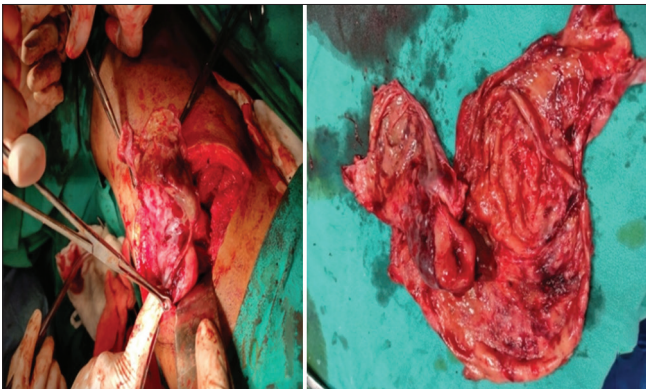
found that 79% (49 of 62) of patients were male and only 21% (13 of 62) were female. The age at presentation was 27.3±0.9 years (range 8–65 years), and with an age group of 21–30 years were the largest age group. Blunt renal trauma was the most common type 90.3% (56 of 62) and road traffic accidents 46.8% (29) were responsible for the majority of mechanisms of injury. Left sided kidney is involved about 56.5% (35 of 62) of patients. Hematuria (microscopic or gross) was found in 82.3% (51 of 62) of patients. Table 3 summarize the grades of injury in all cases and the line of management given were analyzed. Most cases 43.5% (27 of 62) had Grade IV renal trauma, and 77.8% (21 of 27) of them were managed conservatively with complete bed rest, broad-spectrum antibiotic, hydration, analgesic, serial monitoring of the hemodynamics, vital signs, urine color, serial Hb and HCT values, and reimaging in the

**Table 3: Number of patients belonging to various grades of renal injury, management, and outcomes**

Grade of renal injury	Number of patients	Initial conservative management (%)	Initial operative management (%)	Failure of conservative management (%)	Overall operative management (%)
Grade III	29	29 (100)	0	0	0
Grade IV	27	25 (92.6)	2	4 (16)	6 (22.2)
Grade V	6	4 (66.7)	2	0	2 (33.3)
Total	62	58 (93.5)	4 (6.4)	4 (6.4)	8 (12.9)



**Figure 1:** A 32-years-old male patient with Grade 4 right renal trauma due to road traffic accident treated conservatively initially developed urinoma and non-functioning kidney after 1 month required nephrectomy



**Figure 2:** Operative picture and specimen of nephrectomy of non-functioning kidney

form of serial abdominal ultrasonography follow-up for the size of hematoma in all cases, and CECT was repeated in certain cases on admission, discharge and in the late follow-up. These patients were subsequently discharged after hematuria subsided and/or improved clinically. High-grade renal injury is often accompanied by injury to other intra-abdominal organs. In our study, most cases 75.8% had isolated renal injury, and remaining 24.2% have multiple trauma involving other major organs. Twenty-seven patients were found to have Grade IV renal injuries, out of which two cases underwent immediate exploration and nephrectomy due to hemodynamic instability. The rest was given a trial of conservative management. After 24 h, 2 Grade IV cases were taken up for exploration in view of deteriorating clinical parameters and hemodynamic

instability. After 5–7 days two patients explored, one patient required partial nephrectomy and one patient renorrhaphy for midpole laceration. After 1 month, two patients required nephrectomy due to non-functioning kidney with urinoma formation as shown in Figures 1 and 2. Out of six cases of Grade V injuries, 2 (33%) were managed with nephrectomy, rest were managed conservatively. Most common complication seen was urinary tract infection in eight patients, persistent hematuria in two cases, hypertension three cases, persistent urinoma two cases, and prolonged ileus in three cases. Angioembolization was required in two patients due to persistent hemorrhage, two patients required J-J stent insertion and one patient required pigtail insertion due to infected urinoma. All complications were Clavien grade 1, 2, or 3 with no mortality. Overall, the success rate of conservative management in our study was 100% in Grade 3, 84% in Grade IV, and 66.7% in Grade V injuries. All patients were followed up for a minimum of 3–18 months with a median follow-up of 6 months.

## DISCUSSION

The kidney is the third most injured solid organ after blunt trauma, and the second most affected after penetrating trauma.<sup>11</sup> Renal trauma is common in populations aged 15–45 years, where it is considered the leading cause of death among them.<sup>12</sup> Males are more common than female mostly due to higher exposure to accidents.<sup>13</sup> In our study, the relevant demographics correlate to these findings and the high rate of road traffic accidents. The conservative management of blunt renal trauma was first proposed in the 1940 and it is extended to the management of hemodynamically stable penetrating injuries. The benefits of this approach have become increasingly apparent in terms of reduction in nephrectomy rate, complications, and length of hospital stay. High rate of nephrectomy in the patients undergoing immediate exploration can be attributed to motive of exploration being “damage control” and not “renal salvage.” Conventionally, penetrating renal injuries were managed with exploration, renorrhaphy, partial nephrectomy, or nephrectomy.<sup>14,15</sup> The approach to renal gunshot wounds was still more prudent and careful, with surgical exploration and repair considered

mandatory treatment. In 2006, some authors showed that non-operative management was successful in 50% of isolated penetrating kidney injuries.<sup>16</sup> Mingoli et al.,<sup>17</sup> in their meta-analysis of over 13,000 renal trauma cases found that non-operative management was the most prevalent strategy used in 82.4% of renal trauma patients versus 17.3% who underwent operative management.<sup>3</sup> Advances of the radiological, endovascular techniques and well-equipped critical care management for renal trauma patient changes scenario of the management of renal traumas. Conservative management and minimal invasive procedures have been strongly recommended as the main initial approach of high-grade renal traumas in most of the centers. We provided conservative management for all the hemodynamically stable patients including significant proportions with Grade 5 trauma with successful managements. It is different from earlier studies which reported exploration rate up to 100% of Grade 5 traumas.<sup>18</sup> Conservative management mandates implementation of a strict protocol of close observation and monitoring of hospitalized patients within time-scheduled regular measurements of vital signs, monitoring of signs of bleeding, Hb and HCT values, reimaging, and preparations for potential surgical intervention.<sup>19</sup> Hb level is an important predictor for the success of conservative management. Although our results for Hb levels at presentation and on discharge showed insignificant differences between conservative and interventional groups, patients of conservative group showed significant improvement. It could be attributed to the avoidance of blood loss with surgical intervention. HCT value is also used as a predictor for successful management or deterioration of the patients.<sup>19</sup> Furthermore, values of HCT were not significantly different between both groups initially and on discharge. This could be attributed to the resuscitation and corrections by blood transfusion. However, they were significantly improved with conservative management. Hematuria is an indicator of active bleeding and failure of conservation and need of interventional management. It may not be the presenting symptom of renal trauma, where a significant proportion of those patients present with clear urine.<sup>18,19</sup> In our study, only 85.5 (53) % of patients presented with hematuria, while 14.5 (9%) had clear urine at presentation. Furthermore, the size of the perinephric hematoma is an indicator for surgical intervention.<sup>19</sup> Vital signs are an important predictor of surgical intervention and represent the core of monitoring in the conservative management.<sup>19,20</sup>

#### Limitation of the study

The study was conducted in a single center with sixty-two patients over a period of 20 months. It would be better if it was a multicentric one with bigger sample size over a longer period of follow-up.

## CONCLUSIONS

Conservative approach is the mainstay of management in renal trauma, even Grade IV and Grade V renal injuries if patients are hemodynamically stable. It does not only reduce treatment burden, manpower management, resource allocation, and hospital stay but also reduces morbidity and mortality and especially significant reduction of rate of nephrectomy. However, continuous vigilance is necessary for early detection of instability of patient condition and timely intervention. In our study, success rate of conservative management was 100% in Grade 3, 84% in Grade IV, and 66.7% in Grade V injuries.

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**Authors' Contributions:**

**PPM**- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission of article, literature survey and preparation of figures; **SMD**- Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision, coordination and manuscript revision; **RSM**- Design of study, statistical analysis and interpretation, review of manuscript; **AM**- Review manuscript.

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