

Conservative and Interventional Managements of Grades 3–5 Renal Trauma: A Prospective Comparative Study

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ABSTRACT

Background and Objectives: Non-operative managements have been increasingly favored for high-grade renal traumas. Our aim was to compare the outcomes of conservative and interventional managements of Grades 3–5 renal traumas. **Materials and Methods:** Prospective studying of the patients who presented to our hospital with Grades 3–5 renal trauma between October 2015 and March 2017. They were classified into Group A for conservative management and Group B for interventional management with comparisons for the demographic and clinical variables and outcomes. **Results:** A total of 63 patients presented with Grades 3–5 renal trauma within the duration of the study. Group A and B included 49 and 14 patients, respectively, with comparable demographic characteristics. Blunt trauma was mainly due to motor vehicle accidents (39.7%) and represented >87% of all cases. Distribution of the grades of renal trauma was represented in Group A and B as Grade-3 in 17 and 1 patient(s), Grade-4 in 17 and 7 patients, and Grade-5 in 15 and 6 patients, respectively. Conservative management was successful in 43 cases (87.8%), while it failed in six cases which indicated surgical interventions up to nephrectomy. In Group B, interventions included nephrectomy, renorrhaphy, angioembolization for persistent hemorrhage, JJ stent insertion, and combined JJ stent with nephrostomy tube insertion for the drainage of collection in 6 (42.9%), 3 (21.4%), 2 (14.3%), 2 (14.3%), and 1 (7.1%) patient(s), respectively. Blood transfusion rate was significantly higher in Group B (0.57 ± 0.89 vs. 2.07 ± 1.00 ; $P = 0.000$), while hospital stay was insignificantly longer in Group A ($P = 0.066$). **Conclusions:** Conservative management could be applied successfully for significant proportions of high Grades 3–5 renal trauma in the hemodynamically stable patients with significant reduction of the rate of nephrectomy. However, surgical interventions are still warranted for certain indications with relatively high possibilities of nephrectomy.

Key words: Conservation, grades 3–5, contrast CT, nephrectomy, renal trauma, renorrhaphy, surgical intervention

INTRODUCTION

Renal traumas represent about 5% of all traumas and 10% of abdominal traumas.^[1,2] They have been classified into five grades by the American Association for the Surgery of Trauma (AAST) kidney injury severity scale.^[3,4] Renal trauma is more commonly seen in young males. In the majority of cases, they are minor and self-limiting or treated conservatively. However, high-grade renal traumas are usually serious and life-threatening. They are mostly blunt

trauma and caused by motor vehicle accidents.^[4,5] However, penetrating traumas may represent >20% and mostly are due to firearm injuries and stab wounds. They are usually of high grade and more likely to require surgical management. This could be attributed to its association with other abdominal injuries requiring laparotomy which may indicate direct intraoperative staging and management.^[6] Recently, treatment strategies of renal trauma have been considerably changed. Conservative management showed improved outcomes and gained a wide popularity among surgeons. However,

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consensus and specific guidelines regarding management of high-grade renal traumas are still lacking with a few papers providing recommendations without support by relevant grades of evidence.^[4,7-9]

In the present study, we evaluated the clinical characteristics and outcomes of management approaches in the patients who presented with Grades 3–5 renal trauma. Our aim was to further refine the applicability and outcomes of the conservative management for these traumas.

MATERIALS AND METHODS

A prospective comparative study was carried out in our hospital from October 2015 to March 2017 for conservative and interventional managements of Grades 3–5 renal traumas. Grades of renal trauma were defined according to the classification of AAST based on contrast-enhanced computed tomography (CECT).^[4,5] Conservative treatment was defined as the treatment of renal trauma by observation and monitoring of the clinical (vital signs and hemodynamic state) and laboratory parameters, and medications with serial examination, testing, and reimaging while being ready for potential surgical interventions. Interventional management included minimally invasive therapeutic maneuvers and open surgical exploration. Patients who had been explored by trauma surgeons without proper urologic assessment were excluded from the study. Our protocol for the evaluation of renal trauma included initial abdominal ultrasonography, then abdominopelvic CECT which was done when the suspicion of renal trauma was raised. Laboratory works up included serum creatinine, hemoglobin and hematocrit values, urine analysis, and blood gases if indicated.

According to the approach of management, patients were classified into two groups. Group A included the patients who were treated by conservative management. Regardless of trauma grade, all patients who were hemodynamically stable after resuscitation were considered candidates for conservative treatment in the form of complete bed rest, broad-spectrum antibiotic, hydration, analgesic, serial monitoring of the hemodynamics, vital signs, urine color, serial hemoglobin and hematocrit values, and reimaging in the form of serial abdominal ultrasonography follow-up for the size of hematoma in all cases, and CECT was repeated in certain cases on discharge and in the late follow-up. Patients 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 in the 1st month, then every month for at least 3 months. In each visit, history of recurring hematuria, loin pain, or fever is taken with follow-up ultrasonography for tracing of the residual hematoma. Follow-up CECT was done in some cases with major kidney laceration or massive extravasation or those with persistent symptoms or hematomas.

Group B included the patients who indicated immediate interventional management for renal trauma in the form of angioembolization for hemorrhage, 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 serial measurement of hemoglobin and hematocrit values.

Statistical analysis was done using the SPSS version 21. $P < 0.05$ was considered statistically significant. 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

A total of 63 patients were included in study with a mean age of 19.22 ± 15.77 years. Demographic and clinical characteristics and variables of both groups are demonstrated in Table 1. There were no significant differences between both groups in all variables, except the rate of blood transfusion and the final outcome represented by the rate of nephrectomy. Different surgical interventions were done for the patients in Group B and included surgical exploration with nephrectomy in six patients, partial nephrectomy in one patient, and renorrhaphy in five patients. Angioembolization was done for two patients. Conservative management was completed in 43 patients. However, delayed interventions were required in six of the patients in Group A after variable duration of conservation due to complications of renal trauma, either before or after their discharge. One patient needed pigtail insertion due to infected urinoma, while two patients needed angioembolization for secondary hemorrhage after 10 and 13 days from the initial hospital admission. However, exploration and renorrhaphy were done in two patients. The first one was explored by the general surgeons due to associated peritonitis, while he was under conservative management. The second patient was explored after 5 days due to persistent hematuria and fever. Moreover, one patient had nephrectomy due to persistent hematuria, progression of the size of perinephric hematoma, and persistent high-grade fever, in spite of the conservative treatment for 1 week [Figures 1 and 2].

The final outcomes of both lines of treatment in our study were successful conservative management in 43 patients in Group A (77% of total cases). However, 23% of patients including all patients of Group B and patients with failed conservative management in Group A indicated intervention. Surgical exploration resulted in high rate of nephrectomy (42.9%) among the primarily explored patients [Figures 2 and 3].

Follow-up duration was variable as 3–6 months after discharge, where the resolution of the perinephric hematoma was observable in all cases of the conservative management.

Table 1: Demographic and clinical characteristics of the patients

Characteristics/variables	Conservation <i>n</i> =49 (%)	Intervention <i>n</i> =14 (%)	<i>P</i> value*
Age range (mean)/years	2–70 (18±15.8)	3–55 (23.5±15.5)	0.145
Gender			0.192
Male	31 (63.3)	12 (85.7)	
Female	18 (36.7)	2 (14.3)	
Type of trauma			0.573
Blunt	43 (87.8)	12 (85.7)	
Penetrating	6 (12.2)	2 (14)	
Etiology			
Motor vehicle accidents	21 (42.9)	4 (28.6)	
Fall from height	20 (40.8)	5 (35.7)	
Animal kick	2 (4.1)	3 (21.4)	
Stab wound	4 (8.2)	1 (7.1)	
Firearm injury	2 (4.1)	1 (7.1)	
Grade of trauma			0.132
Grade 3	17 (34.6)	1 (7.1)	
Grade 4	17 (34.6)	7 (28.6)	
Grade 5	15 (30.8)	6 (64.3)	
Hematuria			0.066
At presentation	25 (51%)	11 (78.6%)	
At discharge	0 (0%)	0 (0%)	
Blood pressure (mmHg)			
At presentation			
Systolic	115.10±11.57	109.29±10.72	0.153
Diastolic	71.02±10.26	67.14±9.94	0.508
At discharge			
Systolic	114.69±10.43	115.38±8.77	0.784
Diastolic	73.67±7.55	73.85±7.68	0.769
Blood transfusion (units)	0.57±0.89	2.07±1.00	0.000
Hematological parameters			
HB level (g/dl)			
At presentation	9.62±2.07	10.21±1.75	0.001
On discharge	10.84±1.09	10.51±1.10	
HCT value			
At presentation	30.59±6.66	33.79±6.85	
On discharge	34.20±3.58	35.36±5.00	0.000
Hospital stay (days)	10.53±3.98	9.50±7.68	0.066
Outcome/nephrectomy	1 (2)	6 (42.9)	0.001

**P* value for the hematological parameters represented significant improvement between presentation and discharge in the same group and not the difference between both groups. HB: Hemoglobin, HCT: Hematocrit

DISCUSSION

The management of high-grade renal trauma represents a matter of controversy. Advances in the imaging and reproducible staging of renal trauma resulted in a considerable

shift in treatment strategies with the reduction of surgical interventions and increase of the renal preservation. However, consensus about the indications and techniques of renal exploration is mostly absent. Goals of refined staging of the renal trauma are to provide the tools for maximizing



Figure 1: A 28-year-old male patient with Grade 5 left renal trauma due to motor car accident treated successfully by conservative approach. Abdominopelvic contrast-enhanced computed tomography showed shattered lower pole of the left kidney with extravasation and perinephric hematoma. (a) At presentation: Note the associated large intravesical hematoma. (b) On discharge. (c) Follow-up after 3 months



Figure 2: A 27-year-old male patient presented with penetrating renal trauma and received conservative management which failed and recurred with secondary hemorrhage after 13 days of discharge to be treated by angioembolization. Serial contrast-enhanced computed tomography is presented: (a) At presentation. (b) At the second presentation. (c) 1 month after angioembolization

the preservation of renal function and minimizing the complications.^[5,10]

Renal trauma is common in populations aged 15–45 years, where it is considered the leading cause of death among them.^[11] Males are more common than female mostly due to higher exposure to accidents,^[12] in our study, the relevant demographics correlate to these findings and the high rate of road traffic accidents.^[13]

Regarding the mechanism of trauma, blunt trauma is usually common, because the common etiology is the motor vehicle accidents.^[14,15] Similar to the age of incidence of renal trauma, blunt trauma mechanism represented the majority of cases in our study, which may reflect also the high rate of road traffic injuries in our country.^[13] Distribution of the grades of trauma in many studies revealed lower numbers of Grade 5 which usually indicates immediate intervention with a relatively higher rate of nephrectomy.^[4,16,17] However, our study had a

relatively high number of Grade 5 traumas which could be attributed to the aggressiveness of the traffic injuries.

Advances of the radiological and endovascular techniques and enhanced critical care management for trauma patients have been favorably reflected on the management of renal traumas.^[14] Accordingly, conservative management and minimal invasive interventions have been significantly facilitated and become favorable approaches in many trauma centers.^[4,15,17] It has been strongly recommended as the main initial approach of treatment even for the high grades of renal traumas. However, Grade 5 traumas are still representing matters of concern and controversy about their candidacy for conservation. These controversies have been raised due to the mere presence of seriously injured and hemodynamically unstable patients with Grade 5 traumas.^[4] We provided conservative management for all the hemodynamically stable patients including significant proportions with Grade 5 trauma who had successful managements. It is different from earlier studies which reported exploration rate up to 100% of Grade 5 traumas.^[7]

Conservative management mandates implementation of a strict protocol of close observation and monitoring of the hospitalized patients within time-scheduled regular measurements of vital signs, monitoring of signs of bleeding, hemoglobin and hematocrit values, reimaging, and preparations for potential surgical intervention.^[14]

Hemoglobin level is an important predictor for success of conservation. Although our results for hemoglobin levels at presentation and on discharge showed insignificant differences between conservative and interventional groups, patients of the conservative group showed significant improvement. It could be attributed to the avoidance of blood loss with surgical intervention. These findings are similar to other results in the literature.^[15,18] Hematocrit value is also used as a predictor for successful management or deterioration of the patients.^[14] Furthermore, values of hematocrit were not significantly different between both groups initially or on discharge. This could be attributed to the resuscitation and corrections by blood transfusion. However, they were significantly improved with conservative management.

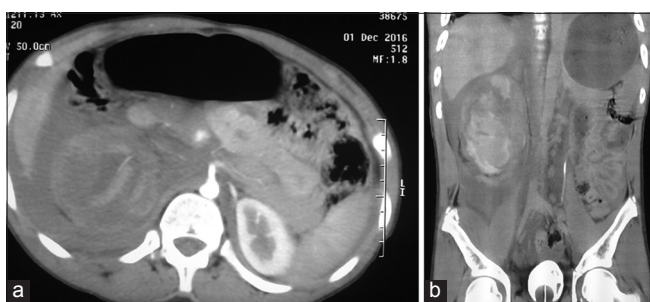


Figure 3: A 17-year-old male patient presented with a renal trauma due to motor car accident and he was hemodynamically unstable. Contrast-enhanced computed tomography revealed Grade 5 right renal trauma. (a) Transverse section. (b) Coronal section. Immediate exploration and total nephrectomy were done

Hematuria is an indicator of active bleeding and failure of conservation and the need of interventional management. It may not be the presenting symptom of renal trauma, where significant proportions of those patients present with clear urine.^[14,19] In the current study, only 57.1% of cases presented with hematuria, while 42.8% had clear urine at presentation. Furthermore, size of the perinephric hematoma is an indicator for surgical intervention during initial conservation and during follow-up. Accordingly, with resolution of hematoma and renal laceration in follow imaging, grade of trauma could be up or downgraded.^[10]

Vital signs are an important predictor of surgical intervention and represent the core of monitoring in the conservative management.^[15,20] Blood pressure is usually low in the patients of high-grade renal traumas. Moreover, those patients who indicate urgent intervention are usually hemodynamically unstable.^[4] However, resuscitation may resolve these states in the patients of conservative management.

In our study, intervention was carried out due to progressive increase of the size of perinephric hematoma, secondary hemorrhage, and relapse of the hemodynamic instability. They were similar to the previously reported indications. Many other indications have been reported for surgical intervention in the cases of failed conservative treatment such as persistent hematuria, fever or sepsis related to the trauma, urinary leakage, and compartment syndrome.^[18]

There are different methods of intervention in the management of renal trauma itself or its complication including nephrectomy for severely damaged and devitalized kidneys or those with irreparable vascular injuries.^[4] Renorrhaphy is usually the targeted technique that is hopeful to be achieved when a surgeon explores a traumatized kidney. Minimally invasive and endoscopic interventions included angioembolization for secondary hemorrhage, and JJ stents and percutaneous pigtail tubes for renal obstruction and urinary extravasation and leakage.^[4] We employed all

these approaches to resolve complications of conservative management. Rate of nephrectomy in the interventional management is variable as 11–100%.^[4,12] This variability could be attributed to considering the laparotomies which are done for coexisting abdominal traumas or not.^[12] Furthermore, renal preservation rate in the high-grade renal traumas has been significantly in favor of the non-operative management approaches. It reaches up as 84–100%, while it is variably low with surgical exploration as 0–82%.^[4]

Conservative management has the advantages of the reduction of blood transfusion which is more predictable in high-grade renal traumas.^[18,20] Our results were in concordance with these findings. There was no statistically significant difference between the two groups regarding the duration of hospital stay. These results may ameliorate the concern that conservative management could prolong the hospital stay in comparison to surgical interventions.^[4,21]

In our study, surgical intervention after failed trials of conservation included minimally invasive maneuvers in three cases, while surgical exploration resulted in nephrectomy in one case of the explored cases. These indications and outcomes may refer to the importance of the non-operative managements for complications of the conservative approach.^[4,19]

Regarding the final outcomes in our study, conservative management was successful in 77% of all patients of the whole study which represent 87.8% of the patients who received it as the primary management. However, only 23% of patients had interventional management with high rate of nephrectomy up to 42.9% of patients. Neither renal trauma-related mortality was recorded among the patients of both groups during hospitalization nor during follow-up. This may be attributable to low sample size. However, renal trauma-related mortality rate seemed to be low and widely variable (0–21%) in most of the studies which have reported this outcome among the high-grade renal traumas.^[4]

The current study targeted the management of high-grade renal traumas which may be difficult to enroll them in prospective comparative studies due to the obligatory indications for intervention, especially in Grade 5 traumas.^[4] Accordingly, small sample size of the current study and, especially in Group B, was the main limitation toward drawing a solid conclusion. Furthermore, long-term follow-up for the effect of renal trauma on the kidney function was lacking. There was a difficulty to perform serial CECT follow-up in many cases to assess the progression of the extravasation and the size of hematoma due to economic reasons.

CONCLUSIONS

Surgical intervention may be associated with high rate of nephrectomy in high-grade renal traumas. However,

conservative management can be applied successfully in most of the hemodynamically stable patients, regardless of the grade of trauma. Furthermore, conservative treatment could limit the indication of surgical intervention to the minority of cases, in which it seems to be inevitable, with the reduction of these high possibilities of nephrectomy.

ETHICAL APPROVAL

Written consents were not amenable to be taken from high-grade trauma patients. The study protocol was approved by the ethical committee of the faculty of medicine in our university.

AUTHORS' CONTRIBUTIONS

Mohammed Ragab Taie and Rabea Ahmed Gadelkareem contributed in data collection, statistical analysis, writing, approval, and submission. Mahmoud Mohammed Shalaby and Abdelfatah Ibrahim Ahmed contributed in writing, revision, supervision, and approval of the manuscript.

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REFERENCES

- Baverstock R, Simons R, McLoughlin M. Severe blunt renal trauma: A 7-year retrospective review from a provincial trauma centre. *Can J Urol* 2001;8:1372-6.
- Meng MV, Brandes SB, McAninch JW. Renal trauma: Indications and techniques for surgical exploration. *World J Urol* 1999;17:71-7.
- Bruce LM, Croce MA, Santaniello JM, Miller PR, Lyden SP, Fabian TC, *et al.* Blunt renal artery injury: Incidence, diagnosis, and management. *Am Surg* 2001;67:550-4.
- Sujenthiran A, Elshout PJ, Veskimae E, MacLennan S, Yuan Y, Serafetinidis E, *et al.* Is nonoperative management the best first-line option for high-grade renal trauma? A systematic review. *Eur Urol Focus* 2017;S2405-4569:1-11.
- Keihani S, Xu Y, Presson AP, Hotaling JM, Nirula R, Piotrowski J, *et al.* Contemporary management of high-grade renal trauma: Results from the American association for the surgery of trauma genitourinary trauma study. *J Trauma Acute Care Surg* 2018;84:418-25.
- Lloyd GL, Slack S, McWilliams KL, Black A, Nicholson TM. Renal trauma from recreational accidents manifests different injury patterns than urban renal trauma. *J Urol* 2012;188:163-8.
- Shariat SF, Trinh QD, Morey AF, Stage KH, Roehrborn CG, Valiquette L, *et al.* Development of a highly accurate nomogram for prediction of the need for exploration in patients with renal trauma. *J Trauma* 2008;64:1451-8.
- Santucci RA, Wessells H, Bartsch G, Descotes J, Heyns CF, McAninch JW, *et al.* Evaluation and management of renal injuries: Consensus statement of the renal trauma subcommittee. *BJU Int* 2004;93:937-54.
- Hommel M, Navsaria PH, Schipper IB, Krige JE, Kahn D, Nicol AJ, *et al.* Management of blunt liver trauma in 134 severely injured patients. *Injury* 2015;46:837-42.
- Malcolm JB, Derweesh IH, Mehrzin R, DiBlasio CJ, Vance DD, Joshi S, *et al.* Nonoperative management of blunt renal trauma: Is routine early follow-up imaging necessary? *BMC Urol* 2008;8:11.
- Thornley S, Kool B, Marshall RJ, Ameratunga S. Alcohol intake, marijuana use, and sleep deprivation on the risk of falls occurring at home among young and middle-aged adults: A case-crossover study. *N Z Med J* 2014;127:32-8.
- Ząbkowski T, Skiba R, Saracyn M, Zieliński H. Analysis of renal trauma in adult patients: A 6-year own experiences of trauma center. *Urol J* 2015;12:2276-9.
- Puvanachandra P, Hoe C, El-Sayed HF, Saad R, Al-Gasseer N, Bakr M, *et al.* Road traffic injuries and data systems in Egypt: Addressing the challenges. *Traffic Inj Prev* 2012;13 Suppl 1:44-56.
- Erlich T, Kitrey ND. Renal trauma: The current best practice. *Ther Adv Urol* 2018;10:295-303.
- May AM, Darwish O, Dang B, Monda JJ, Adsul P, Syed J, *et al.* Successful nonoperative management of high-grade blunt renal injuries. *Adv Urol* 2016;2016:3568076.
- Henderson CG, Sedberry-Ross S, Pickard R, Bulas DI, Duffy BJ, Tsung D, *et al.* Management of high grade renal trauma: 20-year experience at a pediatric level I trauma center. *J Urol* 2007;178:246-50.
- Elashry OM, Dessouky BA. Conservative management of major blunt renal trauma with extravasation: A viable option? *Eur J Trauma Emerg Surg* 2009;35:115.
- Lanchon C, Fiard G, Arnoux V, Descotes JL, Rambeaud JJ, Terrier N, *et al.* High grade blunt renal trauma: Predictors of surgery and long-term outcomes of conservative management. A prospective single center study. *J Urol* 2016;195:106-11.
- Prasad NH, Devraj R, Chandriah GR, Sagar SV, Reddy CR, Murthy PV, *et al.* Predictors of nephrectomy in high grade blunt renal trauma patients treated primarily with conservative intent. *Indian J Urol* 2014;30:158-60.
- McGuire J, Bultitude MF, Davis P, Koukounaras J, Royce PL, Corcoran NM, *et al.* Predictors of outcome for blunt high grade renal injury treated with conservative intent. *J Urol* 2011;185:187-91.
- Hampson LA, Radadia KD, Odisho AY, McAninch JW, Breyer BN. Conservative management of high-grade renal trauma does not lead to prolonged hospital stay. *Urology* 2018;115:92-5.

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