Original Research Article

Our experience with traumatic injuries of the upper urinary tract

Ravi Jahagirdar[1], Ravi Chander[2*], K. Kishore[3], K. Gopikanth[4], Rajesh Singh[5], Vinay Jahagirdar[6]

[1]Professor, [2]Associate Professor and I/C HOD, [3,4,5]Post Graduate
Department of Urology, Gandhi Medical College and Hospital, Secunderabad, Telangana, India
[6]Medical Student, Gandhi Medical College and Hospital, Secunderabad, Telangana, India
[*]Corresponding author email: **urology.gh@gmail.com**

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Abstract

Introduction: The kidneys are the most common genitourinary organs injured from external trauma, whereas ureteric trauma is rare, accounting for less than 1% all urological trauma. ureteric injury from blunt trauma is extremely rare. Advances in radiographic staging, improvements in hemodynamic monitoring, validated renal and ureteric injury scoring systems, and essential details about the mechanisms of injury allow successful conservative management strategies for renal preservation. The main purpose of this study was to suggest that conservative management will suffice in high grade renal injury also, if the patient is hemodynamically stable, and it will increase the chance renal conservation, avoiding unnecessary nephrectomies.

Aims and objectives: The main aim of this study was to evaluate and stage blunt upper urinary tract injury and also assess management outcomes in such patients.

Materials and methods: All the patients with blunt upper urinary tract injury diagnosed radiologically from February 2017 to January 2019 were admitted and the injuries were graded by using American association for the surgery of trauma grading. Stable patients had conservative management and operative management for unstable patients. All the patients followed up for a min of 3-18 months with a median of 6 months.

Results: In our study, out of total 43 cases, 3 (6.9%) cases required emergency intervention in view of hemodynamic instability. In these 3 cases 2 underwent total nephrectomy (both are grade V injuries) and one case required renorrhaphy (grade IV injury). In remaining 40 cases kept on conservative

management 2 cases required delayed intervention. One case required nephrectomy and the other one required partial nephrectomy.

Conclusion: In Renal trauma of all the grades conservative management is a good option in hemodynamically stable patients whereas unstable patients need laparotomy. Conservative management enables us to save as much renal function as possible which should be our aim.

Key words

Traumatic, Injury, Upper urinary tract.

Introduction

The kidneys are the most common genitourinary organs injured from external trauma, whereas ureteric trauma is rare, accounting for less than 1% all urological trauma. ureteric injury from blunt trauma is extremely rare.

Advances in radiographic staging, improvements in hemodynamic monitoring, validated renal and ureteric injury scoring systems, and essential details about the mechanisms of injury allow successful non operative management strategies for renal preservation.

On the basis of 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 upper urinary tract trauma.

Assessment of clinical history and physical examination findings combined with imaging studies provides maximal guidance for treatment decisions.

Proper staging is essential for non-operative management of renal injuries.

The main purpose of this study was to prove conservative management will suffice in high grade renal injury also, if the patient is hemodynamically stable, and it will increase the chance renal conservation, avoiding unnecessary nephrectomies.

Renal trauma

Renal injuries are relatively uncommon and are present in about 1% of hospitalized patients after traumatic injury [1, 2, 3]. Of all genitourinary trauma, however, the kidneys are by far the most commonly injured organs [2, 4].

Multiple studies have shown that high-grade renal trauma can be successfully managed in most cases conservatively [5], provided they have under gone appropriate radiological imaging, and have adequate renal injury staging [6].

The absolute indications for renal exploration are life-threatening hemorrhage from vascular injury; uretero-pelvic junction avulsion; and urinoma un-responsive to minimally invasive procedures.

The relative indications for exploration are laparotomy for other abdominal injuries, concomitant pancreatic [7] or bowel injury [8] and large devascularized segments of kidney [9].

The important of non-operative management of renal injury is avoiding laparotomy and more importantly avoiding iatrogenic or unnecessary nephrectomy. American Association for the Surgery of Trauma Organ injury Severity Scale for the Kidney was as per **Table – 1**.

Management of renal injuries often directly relates to the grade of injury at diagnosis.

While the management of low-grade injuries is more straightforward, there is uncertainty over the management of higher-grade injuries, particularly regarding the role of conservative

management. Over the last decade there has been a trend towards conservative management of high-grade renal injuries, which helps in preserving the renal function. Here we lay out an updated approach to management of patients presenting with renal trauma based on up-to-date evidence.

Immediate Management

On presentation to the emergency department, trauma patients are assessed and resuscitated following the principles of Advanced Trauma Life Support (ATLS). When obtaining the history, possible indicators of renal injury in blunt trauma include rapid deceleration or direct blow to the flank [10].

Table – 1: American Association for the Surgery of Trauma Organ injury Severity Scale for the Kidney.

Grade	Type	Description
I	Contusion hematoma	Microscopic or gross hematuria, urologic studies normal Subcapsular, nonexpanding without parenchymal laceration
II	Hematoma laceration	Nonexpanding perirenal hematoma confined to renal retroperitoneum <1 cm parenchymal depth of renal cortex without urinary extravasation
III	Laceration	>1 cm parenchymal depth of renal cortex without collecting system rupture or urinary extravasation
IV	Vascular laceration	Segmental arterial and venous injury Laceration to the renal pelvis or pelviureteric junction. Shattered kidney
V	Vascular	vascular injury (arterial or venous), *i.e*., laceration, avulsion or thrombosis

Table – 2: American association for the surgery of trauma (AAST) Classification for Ureteral Injuries.

Grade	Description of Injury
I	Hematoma only
II	Laceration < 50% of circumference
III	Laceration > 50% of circumference
IV	Complete tear < 2 cm of devascularization
V	Complete tear > 2 cm of devascularization

Table – 3: Reconstructive options of ureter based on location.

Upper third	Uretero-ureterostomy
	Ureteropyelostomy
Middle third	Uretero-ureterostomy
	Transuretero-ureterostomy
	Anterior wall bladder flap (Boari)
Lower third	Ureteroneocystostomy (direct reimplantation)
	Ureteroneocystostomy (psoas hitch)

Evaluation and Investigations

When a trauma patient arrives in the emergency department, a rigorous systematic evaluation is performed including sending a full set of blood tests. When renal trauma is suspected, some of these laboratory tests are particularly important including full blood count and serum creatinine measurement to aid baseline assessment and follow up of their renal function. A urine sample should also be collected to look for any gross or microscopic hematuria.

Further investigation often depends on the haemodynamic stability of the patient. If the patient is unstable despite adequate resuscitation, there is often a need for emergency exploratory laparotomy and the patient is transferred to the operating theatre. IVP has largely been superseded by contrast CT scan as the investigation of choice for diagnosing renal injuries. It provides greater anatomical detail and associated injuries to any intra-abdominal organs and is the only imaging modality that can provide information required to grade renal injuries as part of the AAST renal injury grading system and the functional status.

Indications for renal imaging in blunt trauma

- All blunt trauma with gross hematuria
- All blunt trauma with microscopic hematuria and hypotension (defined as a systolic pressure of less than 90mm Hg at any time during resuscitation)
- All pediatric cases with greater than 5RBC/HPF
- All blunt trauma with significant acceleration /deceleration mechanism of injury, specifically rapid deceleration as would occur in a high speed motor vehicle accident or a fall from heights

Open Intervention

Open surgery and exploration rates vary widely although there has been a trend towards conservative 'wait and see' management or minimally invasive techniques [11].

Nephrectomy rates up to 22% have been quoted [12].

Hemodynamic instability despite adequate resuscitation measures remains an absolute indication for surgical exploration of trauma patients. Pulsatile or expanding perinephric haematoma identified at laparotomy is also quoted as an absolute indication for renal exploration by most centres. When a stable renal hematoma is identified at exploratory laparotomy, this should be left alone to avoid disrupting Gerota's fascia and releasing the tamponade effect.

Depending on the underlying injury, various reconstruction techniques have been used including primary renorrhaphy, omental flap, partial nephrectomy and vascular repair [14].

The primary aims during exploration and reconstruction are debridement of non-viable tissue, ligation of bleeding vessels and water tight collecting system repair.

Grade V injuries need more packed red cell transfusions during resuscitation predicted the need for emergency operative intervention [15]. Following blunt trauma, repair of grade V vascular injuries is seldom possible and should only be attempted if it is a solitary kidney.

Minimally Invasive Intervention: Angioembolisation

In a stable patient with persistent bleeding, angiography can allow selective arterial embolisation. This can prevent the need for surgical exploration, particularly in sole renal injuries. The selective technique also enables potential preservation of renal parenchyma without procedure related decline in renal function [16].

Use of embolisation as a first line treatment is mostly for active arterial bleeding (particularly branching renal arteries), arteriovenous fistula or pseudoaneurysm. It has also been used as a second line management in patients with declining hemodynamic status after failed conservative management or active bleeding on repeat CT scanning.

'Wait and See' Conservative Management

Patients with Grade I renal injuries and without gross hematuria can be safely discharged without any need for further imaging [14]. Patients with grades II and III renal injuries should be observed for the first 24 hours on bed rest [13]. It is suspected that the highest risk of bleeding occurs during the first 24 hours so monitoring

and bed rest is often recommended until gross haematuria has resolved.

Serum creatinine measurement is also important in these patients. Post-traumatic AKI can be caused by multiple factors including the renal injury, hemodynamic instability, rhabdomyolysis and contrast medium. Although many trauma patients are young with minimal co-morbidities, the previous history of the patient can also contribute.

Follow Up

It is recommended that first follow-up be scheduled for three months following hospitalization. Ideal follow up should involve physical examination, urinalysis, blood pressure, renal function blood tests with individualized imaging.

Ureteric trauma

Ureteral injuries are uncommon, accounting less than 1% of all urological trauma. However, a missed ureteral injury can result in significant morbidity and mortality.

When a ureter is damaged by penetrating or blunt trauma, peristalsis beyond the injury ceases. Tonus is decreased in the ureter, proximal to the injury, due to stretching from the increased volume of urine in this segment. This increased volume of urine is the result of detrusor action being halted at the damaged (inert) segment of the ureter [20]. Thus, urine volume, diuresis and distension are the main modulators of peristalsis along with the sympathetic and parasympathetic nervous system; however, prostaglandins and tachykinins also play a role.

Diagnosis and management

In diagnosing ureteral injuries from trauma, the most important factor is a high index of suspicion. Typically there are no classic signs or symptoms for ureteral injuries, but should be suspected in all cases of blunt deceleration trauma, particularly in children in whom the kidney and renal pelvis can be torn from the ureter, secondary to their hyper-extensible vertebral column [21]. CT scan with delayed excretory phase images have the benefit of not only showing extravasation of contrast media from the ureteral injury, which may be subtle, but can also illustrate accompanying lesions, particularly involving the kidney [19]. In the delayed setting, a CT may also diagnose missed ureteral injuries (i.e. ascites, urinomas, hydronephrosis and contrast extravasation). American association for the surgery of trauma (AAST) Classification for Ureteral Injuries was as per **Table – 2**.

The primary objective of ureteral repair is preservation of renal function. Hence, the most important factor in the management of these injuries is to maintain drainage of urine from the kidney and to prevent the formation of urinoma and abscess [20].

Successful repair methods for acute ureteric injuries are based on certain principles: ureteric debridement and careful mobilization, spatulated, tension-free, water-tight anastomosis over a stent (5-0 absorbable suture under magnification), isolation of the ureteric repair from associated injuries and adequate drainage of the retroperitoneum [22]. Reconstructive options of ureter based on location was as per **Table – 3**.

Special considerations

In the event of a complete loss of the ureter, the various surgical options have been well documented; these include an appendiceal interposition (children - delayed), an ileal segment interposition (delayed), or autotransplantation [23, 24].

Aim and objectives

- To evaluate and stage blunt upper urinary tract injury.
- To evaluate management outcomes in blunt upper urinary tract trauma.

Materials and methods

Inclusion criteria

All patients who presented to casualty, with blunt injury abdomen, and ultrasound or computed tomography suggestive of renal and (or) ureteric injury.

Exclusion criteria

- Patients refusing consent for treatment protocol.
- Patients with penetrating injuries.
- Patients with renal injuries associated with other intra-abdominal injuries requiring emergency laparotomy.

Period of study: February 2017 to January 2019

Methodology

All the patients with blunt upper urinary tract injury diagnosed radiologically were admitted and the injuries were graded by using American association for the surgery of trauma grading.

A total of 43 patients, with blunt injury abdomen, graded using AAST, and were included in the study.

Renal injuries were categorized by AAST grade as grade 1, grade 2, grade 3, grade 4, grade 5.

Ureteric injuries AAST grades are grade 1, grade 2, grade 3, grade 4, grade 5.

Patients were stratified according to initial management in to 2 groups of

1) Open surgery (partial nephrectomy, renorrhaphy, auto transplant, nephrectomy, nephrotomy, double j stenting, ureteric reimplantatio, ureteroureterostomy, boari's flap, psoas hitch)
2) Conservative management
    - Absolute bed rest
    - Appropriate fluids and blood transfusion
    - Serial Hb%, hematocrit, CUE evaluation
    - Prophylactic antibiotic coverage and
    - Careful continuous observation (vitals, abdominal examination)

Indications for laparotomy in renal injury cases

- Hemodynamic instability after initial resuscitative measures
- Deterioration with conservative management
- Delayed surgical management for selected cases which were hemodynamically stable initially

The success of each initial management strategy was examined and analyzed.

Conservative management was defined as not undergoing a procedure during the hospitalizations.

Patients who did not required active urological intervention during the index hospitalization were specifically noted.

If the patient is hemodynamically unstable initially, such patients underwent exploratory laparotomy, and required procedure done.

If the patient is initially stable, and become unstable after 24-48 hours underwent exploratory laparotomy, delayed nephrectomy or required procedures done.

All patients followed up for a min of 3-18 months with a median of 6 months

- Clinical history
- Recording of BP
- Local examination
- CUE, hematocrit, Serum Creatinine
- IMAGING; USG, CECT.

This study was done using descriptive analysis.

Results

Sex distribution was as per **Table – 4**. Age distribution was as per **Table – 5**. Mechanism of injury was as per **Table – 6**. Clinical presentation was as per **Table – 7**. Grade of renal injury was as per **Table – 8**. Grade wise management was as per **Table – 9**. Complications were as per **Table – 10**.

Table - 4: Sex distribution.

Males	38
Females	5
Total	43

Table - 5: Age distribution.

Age group (Years)	Number of patients
1-10	1
11-20	12
21-30	15
31-40	8
41-50	5
Above 50	2

Table - 6: Mechanism of injury.

Mechanism of injury	Number of patients
Motor vehicle crash	33
Fall from height	6
Assault	4

Table - 7: Clinical presentation.

Signs and symptoms	No. of patients
Gross hematuria	10
Gross hematuria+ Shock	6
Microscopic hematuria + Shock	4
Microscopic hematuria, No shock	16
No hematuria, No shock	7
Local signs	10

Table - 8: Grade of renal injury.

Grade of renal injury	Number of patients
Grade 1	9
Grade 2	14
Grade 3	5
Grade 4	9
Grade 5	6

Table - 9: Grade wise management.

Grade of renal injury	Total cases	Conservative management	Operative management
Grade 1	9	9	-
Grade 2	14	14	-
Grade 3	5	5	-
Grade 4	9	6	3
Grade 5	6	4	2
Total	43	38	5

Table - 10: Complications.

Complications	Number of cases
UTI with fever	6
Persistent hematuria	3
Hypertension	2
Persistent urinoma	2
Prolonged ileus	2

Complications

MC was UTI with fever - 6 cases, treated with suitable antibiotics and ICU care. Persistent hematuria - 3 cases, treated conservatively with absolute bed rest and blood transfusions. Hypertension - 2 cases, managed by medical treatment. Persistent urinoma - 2 cases, managed with dj stenting. Prolonged ileus - 2 cases (**Figure – 1 to 8**).

Discussion

Managing higher grades of renal trauma by operative or non-operative methods has been a subject of discussion for more than 2 decades.

In our study, out of 43 cases 28(65%) cases are grade I to III renal injuries according to AAST grading which does not require any surgical intervention and all are managed conservatively.

Figure – 1: Grade 1 injury, right kidney.

Figure – 2: Grade 2 injury, left kidney.

Figure – 3: Grade III injury, Lt kidney.

Figure – 4: Grade 4 injury, right kidney.

Figure – 5: Grade 5 injury, left kidney.

In grade IV renal injuries out of 9 cases, 8 kept on conservative management initially and in only one case required emergency intervention in view of hemodynamic instability in which renorrhaphy done. In conservative group of 8 cases, 2 cases required delayed intervention with hemodynamically instability later on. In these 2 cases, one case required nephrectomy and in other case partial nephrectomy done. Remaining 6(66.6%) cases does not require any surgical intervention and managed conservatively.

In grade V renal injuries out of 6 cases emergency nephrectomy done in 2(33%) cases due to hemodynamic instability. Remaining 4 cases managed conservatively and no delayed intervention required later on.

In our study out of total 43 cases, 3 (6.9%) cases required emergency inervention in view of hemodynamic instability. In these 3 cases 2 underwent total nephrectomy (both are grade V injuries) and one case required renorrhaphy (grade IV injury). In remaining 40 cases kept on conservative management 2 cases required delayed intervention. One case required nephrectomy and the other one required partial nephrectomy.

The literature affirms that conservative management of blunt renal parenchymal injuries of Grade I–III in the absence of exsanguinations from the kidney may be treated expectantly.

Figure – 6: Renorraphy for GR IV injury.

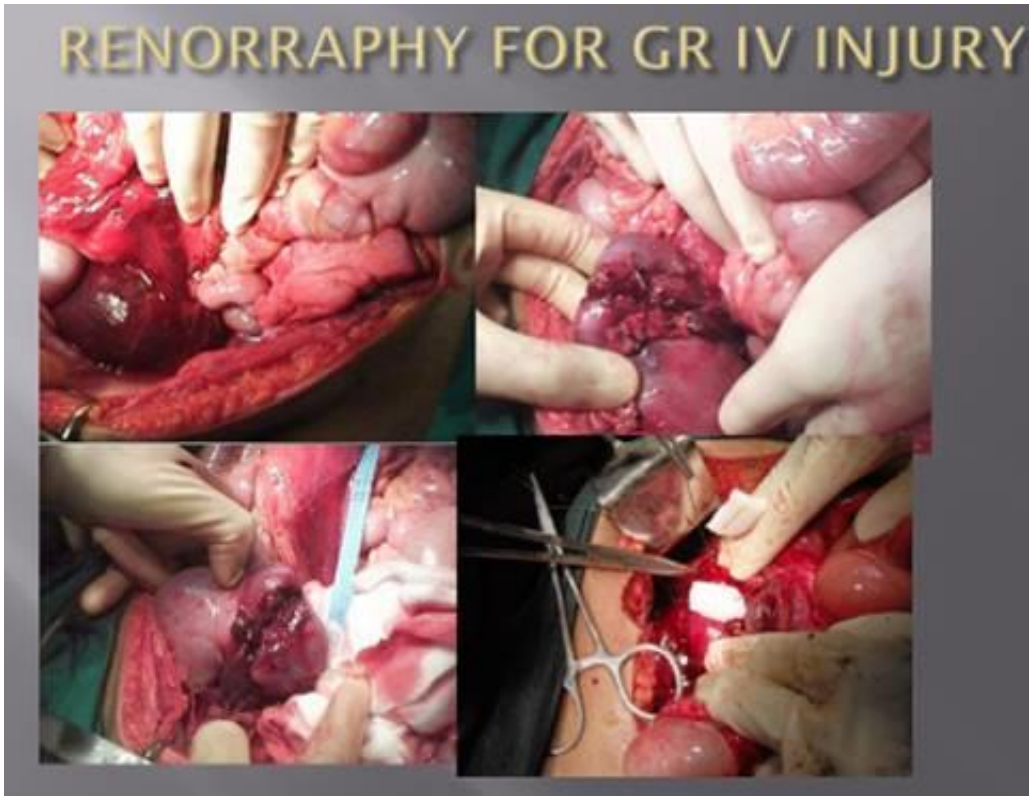
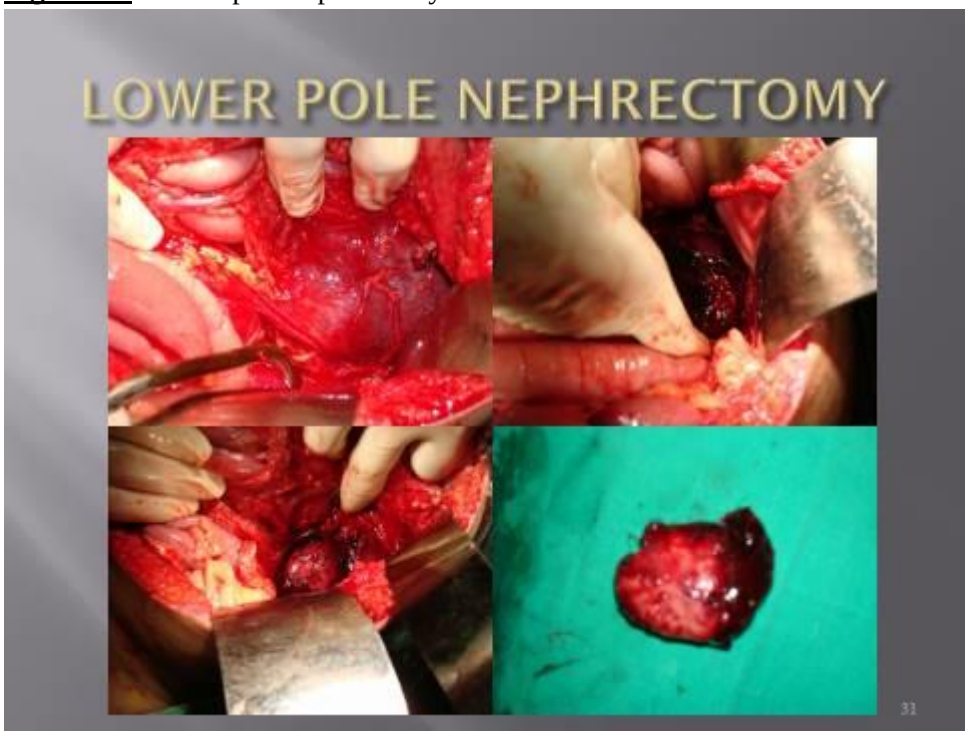


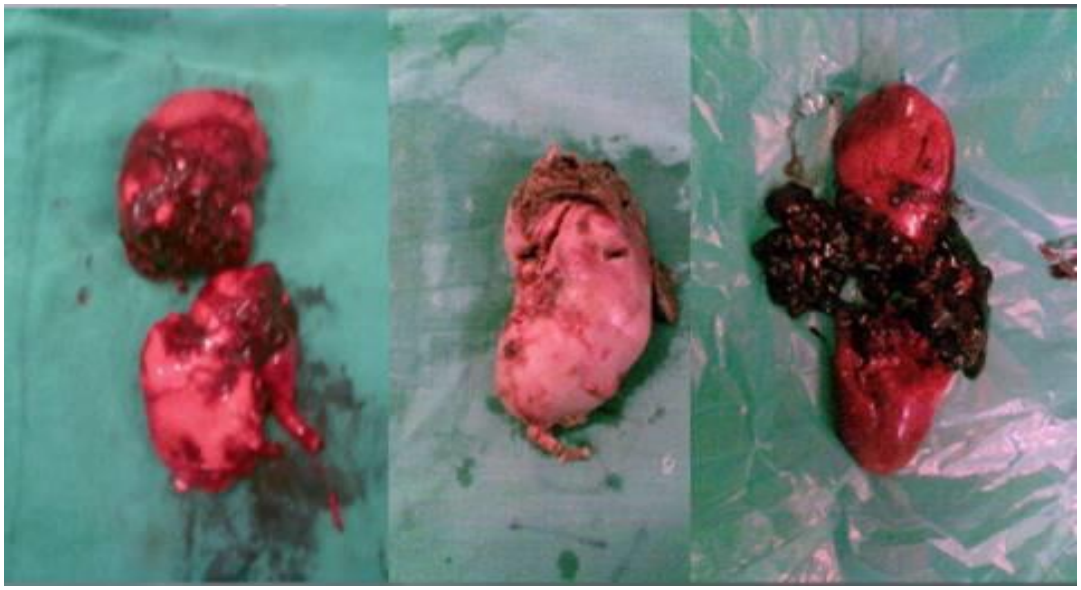
Figure – 7: Lower pole nephrectomy.



Increasingly, reports of successful non-operative treatment of blunt Grade IV injuries and even Grade V are being published.

The literature seems to support at least a trial of conservative therapy, if possible, in these patients.

Figure – 8: Nephrectomy specimens.



Grade V -vascular injuries will still likely require a speedy nephrectomy.

Our study demonstrates that conservative management is associated with low morbidity.

High rate of nephrectomy in cases of GR V in our study was probably because of severity of injury. Patients followed up carefully for any complications specially Hypertension.

Emergency renal exploration was done in 3 cases, 1 case grade 4 injury, 2 cases grade 5 injury.

Delayed renal exploration was done in 2 cases, all belong to grade 4 injury and were hemodynamically unstable

GR I TO GR III

- 28 Cases
- All patientts managed conservatively
- Review USG after 48-72 hours
- Monitoring by CUE, serum creatinine, serial hematocrits.
- Discharged after hematuria subsided (1-2 weeks).

GR IV injuries

- 9 cases
- All patients except 1case were kept on conservative management, in that one case renorrhaphy done for hemodynamic instability.

Delayed surgical management (24-48 hours): Done in 2 cases because of haemodynamic instability, 1 case nephrectomy done, 1 case partial nephrectomy – for lower pole laceration

Indication for exploration –hemodynamic instability with significant non-viable tissue

GR V injuries

- 6 cases
- 2 cases nephrectomy done immediately
- 4 cases kept on conservative treatment

In our study, 3 patients (6.97 %) underwent immediate surgical intervention because of hemodynamic instability, which is comparable to 5.4% in Toutouzas, et al. [17] study.

In our study, 2 patients (4.65%) underwent delayed surgery because of hemodynamic instability, which is comparable to 9.67% in Toutouzas, et al. [17] study.

In our study 40 patients who were kept on conservative management, in 2 patients (5.0 %)

delayed surgery done because of hemodynamic instability, other 38 patients (95.0 %) were managed non-operatively which is comparable to 84 % of patients managed non-operatively who were kept on conservative management in Toutouzas, et al. [17] study.

The renal salvage rate was 93% for the entire population and 97.5% among patients selected for non-operative management, which is comparable to 76.2% and 90.3% in Van Der Wilden GM, et al. [18] study.

In our study period of 2 years ureteric injuries associated with blunt abdominal trauma are not seen.

Conclusion

- For patients that are stable, CT scanning is the gold standard mode of investigation for grading renal injuries.
- In grades I-III blunt renal trauma cases conservative modality of management is suffice unless there is hemodynamic instability is there.
- In grade IV and V blunt renal trauma patients, if they are hemodynamically stable conservative management is the safe treatment option where there is close observation and immediate surgical intervention facilities are available. In these cases nephrectomy can be avoided.
- In renal trauma patients, if they remain unstable despite resuscitation, laparotomy remains the first line investigation and management strategy.
- An absolute indication for renal exploration is hemodynamically instability.
- Subsequent management can then be based upon the clinical status often begins with a 'wait and see' strategy.
- Follow-up or 'delayed' CT scans are no longer recommended unless there is deterioration in the clinical picture.
- Ureteric injuries associated with blunt injury is rare

Success rate of our study in terms of conservative management

- GR I to GR III injuries – 100%
- GR IV injuries - 6/9 -66.6%
- GR V injuries - 4/6 - 66.6 %

References

1. Wright JL, Nathens AB, Rivara FP, et al. Renal and extra renal predictors of nephrectomy from the National Trauma Data Bank. J Urol., 2006; 175(3): 970-5.
2. Wessells H, Suh D, Porter JR, et al. Renal injury and operative management in the United States: results of population – based study. J Trauma, 2003; 54(3): 423-30.
3. Bariol SV, Stewart GD, Smith RD, et al. An analysis of urinary tract trauma in Scotland: impact on management and resource needs. Surgeon, 2005; 3(1): 27-30.
4. Paparel P, N'Diaye A, Laumon B, et al. The epikdemiology of trauma of the genitourinary system after traffic accidents: analysis of a register of over 43,000 victims. BJU Int., 2006; 97(2): 338-41.
5. Broghammer JA, Fisher MB, Santucci RA. Conservative management of renal trauma: a review. Urology, 2007; 70(4): 623-9.
6. Voelzke BB, McAninch JW. Renal gunshot wounds: clinical management of outcome. J Trauma, 2009; 66(3): 593-600.
7. Rosen MA, McAninch JW. Management of combined renal and pancreatic trauma. J Urol., 1994; 152(1): 22-5.
8. Wessells H, McAninch JW. Effect of colon injury on the management of simultaneous renal trauma. J Urol., 1996; 155(6): 1852-6.
9. Moudouni SM, Patard JJ, Manunta A, et al. A conservative approach in major blunt renal lacerations with urinary extravasation and devitalized renal segments. BJU Int., 2001; 87(4): 290-4.

10. Alsikafi NF, Rosenstein DI. Staging, evaluation, and non-operative management of renal injuries. UrolClin North Am., 2006; 33: 13-19.
11. Bonatti M, Lombardo F, Vezzali N, Zamboni G, Ferro F, et al. MDCT of blunt renal trauma: imaging findings and therapeutic implications. Insights Imaging, 2015; 6: 261-272.
12. Breyer BN, Kovell C, McGeady JB, Tasian GE. Renal Trauma. AUA Update Series, 2014; 33: 1-12.
13. Buckley JC, McAninch JW. Pediatric renal injuries: management guidelines from a 25-year experience. J Urol., 2004; 172: 687-690.
14. Buckley JC, McAninch JW. The diagnosis, management, and outcomes of pediatric renal injuries. UrolClin North Am., 2006; 33: 33-40.
15. Prasad NH, Devraj R, Chandriah GR, Sagar SV, Reddy ChR, et al. Predictors of nephrectomy in high grade blunt renal trauma patients treated primarily with conservative intent. Indian J Urol., 2014; 30: 158-160.
16. Tait CD, Somani BK. Renal trauma: case reports and overview. Case Rep Urol., 2012; 2012: 207872.
17. Toutouzas KG, Karaiskakis M, Kaminski A, Velmahos GC. Non operative management of blunt renal trauma: a prospective study. Am Surg., Dec 2002; 68(12): 1097-103.
18. Van der wilden GM, Velmahos GC, Joseph DK. Successful non-operative management of the most severe blunt renal injuries: a multicentre study of the research consortium of new England centers for trauma. JAMA Surg., 2013; 148(10): 924-31.
19. Srinivasa RN, Akbar SA, Jafri SZ, Howells GA. Genitourinary trauma: a pictorial essay. Emerg Radiol., 2009; 16(1): 21-33.
20. Pumphrey JD, Joslin AH, Lich R Jr. Missile wounds of the ureter. J Trauma, 1962, 2: 89-95.
21. Kotkin L, Brock JW. Isolated ureteral injury caused by blunt trauma. Urology, 1996; 47(1): 111-3.
22. Elliott SP, McAninch JW. Ureteral injuries: external and iatrogenic. Urol Clin North Am., 2006; 33(1): 55-66, VI.
23. Dagash H, Sen S, Chacko J, Karl S, Ghosh D, Parag P, Mackinnon AE. The appendix as ureteral substitute: a report of 10 cases. J Pediatr Urol., 2008; 4(1): 14-9.
24. Seiler RK, Filmer RB, Reitelman C. Traumatic disruption of the ureteropelvic junction managed by ileal interposition. J Urol., 1991; 146(2): 392-5.