EVALUATION OF EPIDEMIOLOGY AND MANAGEMENT OF RENAL TRAUMA IN A TERTIARY CARE TRAUMA CENTRE

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DECLARATION

I solemnly declare that this dissertation ***"EVALUATION OF EPIDEMIOLOGY AND MANAGEMENT OF RENAL TRAUMA IN A TERTIARY CARE TRAUMA CENTRE"*** was prepared by me in the Department of Urology, Government Madras Medical College and Hospital, Chennai under the guidance & supervision of Prof.R.JEYARAMAN,M.S. MCh., Professor & Head of the Department, Department of Urology, Government Madras Medical College, Chennai

This dissertation is submitted to the TamilNadu Dr. MGR Medical University, Chennai in partial fulfillment of the University requirements for the award of degree of MCh Genitourinary surgery.

Place : Chennai

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Certificate

This is to certify that this dissertation entitled "**EVALUATION OF EPIDEMIOLOGY AND MANAGEMENT OF RENAL TRAUMA IN A TERTIARY CARE TRAUMA CENTRE**" submitted by **Dr.G.VIVEKANANDAN**, appearing for **M.Ch (Urology)** degree examination in August 2008 is a bonafide record of work done by him, under my guidance and supervision in partial fulfillment of requirement of the Tamilnadu Dr.M.G.R. Medical University, Chennai. I forward this to the Tamil Nadu Dr.M.G.R. Medical University, Chennai, Tamilnadu, India.

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CONTENTS

INTRODUCTION

Trauma is non-discriminatory and affects children, adolescents, young adults, pregnant women and the elderly. Trauma is the second leading cause of years of life lost for all people and the leading cause of death and disability for youth and young adults. Despite advances in the technology of motor vehicle safety, motor vehicle collision remains the most common cause of abdominal trauma in this country. Other less frequent sources of blunt trauma to the abdomen includes fall from a height, assaults, bicycle accidents and horse back riding injuries.

Of all the genitourinary organs, the kidney is the most likely to be injured in cases of external trauma and injuries to atleast one kidney occur in as many as 10% of abdominal trauma cases. Up to 80% of renal injuries are caused by blunt trauma, mostly motor vehicle accident and most significant renal injuries are associated with other major organ injuries [1,2].

The epedemiologic data for renal trauma are highly variable. The variability can be partly attributed to the different etiologies of renal injury. A German study reported that of 385 patients who suffered urogenital trauma ,83% were males. The principal

aetiologies were road traffic accidents (41%), other accidents (26%), sexual activities (8%) and violence (6%). Renal injuries accounted for 51% of cases, while the remaining injuries were evenly divided between the bladder, urethra, penis, and scrotum and its contents.

In a study from Iran, 284 (5%) out of 57367 trauma victims had genitourinary injuries. Males with a frequency of 92% (258 p4) were the most injured group. The most commonly injured organ was kidney (3.3%) and the least one was ureter. 101 patients had associated injuries to other organs [3].

The mechanism of vsiceral damage in blunt force injuries can be explained by 3 mechanisms.

The first is when rapid deceleration causes differential movement among adjacent structures. As a results, shear forces are created and cause hollow, solid, visceral organs and vascular pedicles to tear, especially at relatively fixed points of attachment. For instance, the distal aorta is attached to the thoracic spine and decelerates much more quickly than the relatively mobile aortic arch. As a result, shear forces in the aorta may cause it to rupture.

Similar situation can occur at the renal pedicles, leading to vascular thrombosis and renal infarction.

The second is when intra-abdominal contents are crushed between the anterior abdominal wall and the vertebral column or posterior thoracic cage. This produces a crushing effect, to which solid vicera (e.g. spleen, liver, kidneys) are especially vulnerable.

The third is external compression forces that result in a sudden dramatic rise in the intra-abdominal pressure and culminate in the rupture of a hollow visceral organ (in accordance with the principles of Boyle's law).

This retrospective analysis attempts to decipher the epidemiological pattern of renal injury in trauma victims (both blunt and penetrating abdominal trauma) and also other variables like associated organ injuries, the method of presentation etc. The sensitivity and specificity of various investigatory modalities including biochemical and radiological are also evaluated. Finally, the outcome of the management pattern of renal injuries in Govt. General Hospital, Chennai and the mortality and morbidity data are critically analysed.

AIMS AND OBJECTIVES

1. To study the epidemiology of renal injuries occurring in trauma victims admitted in a tertiary care trauma centre.

2. To analyse the mode of trauma and pattern of renal and associated organ injuries.

3. To evaluate the sensitivity and specificity of various imaging modalities available for studying renal trauma.

4. To evaluate the outcomes of various methods of management of traumatic renal injuries

5. To study the complications, early and late, associated with renal trauma.

6. To study the morbidity and mortality pattern in renal trauma victims.

REVIEW OF LITERATURE

The kidney is the most commonly injured urologic organ and may be the most challenging to treat. Although most renal injuries may be treated successfully without operative intervention, it is important and yet sometimes confusing to delineate which cases should be managed with intervention and which may be observed. The common teaching that blunt renal injuries may be observed and penetrating injury must be explored may be true in most cases, but in select cases this dogma can be misleading and lead to poorer outcomes.

EVALUATION OF A TRAUMA VICTIM:

When the trauma patient enters the trauma bay, a thorough evaluation and treatment protocol ensues led by the emergency department (ED) physician or the surgical trauma team. The purpose of these maneuvers is to collect and assess clinical information and the likelihood of traumatic injuries. An assessment of clinical history, physical examination findings and radiologic findings all help form the presumptive diagnoses and treatment plan.

Clinical history

The mechanism of injury is helpful in determining likelihood of traumatic injuries. A distinction should be made for blunt versus penetrating trauma. For blunt injuries, a history of rapid deceleration (eg, motor vehicle accident or fall from heights) or a direct blow to the flank are important indicators of potential renal trauma. For penetrating trauma, location of entrance and exit wounds may help determine the likelihood of renal injury. Additionally, the type of firearm and the caliber and velocity of the bullet (high versus low) are important determinants of blast injury. In stab wounds, the length of the knife should be ascertained as it would help determine the likelihood and degree of penetration into the kidney or other abdominal organs.

In many of these injuries, concomitant abdominal injuries are likely and must be evaluated. In penetrating injuries, nearly all patients with renal gunshot wounds and up to 60% of patients with renal stab wounds have injury to adjacent organs [4]. The management of other abdominal injuries affects appropriate management of the renal injury.

Clinical evaluation

In adult renal trauma especially, the two most important indicators for significant injury are hematuria, defined as more than five cells per high power field (HPF) as seen from the first aliquot of urine of a catheterized specimen, and hypotension, defined as a systolic blood pressure less than 90 mm Hg at anytime before resuscitation. The first aliquot of urine is important and intravenous (IV) resuscitation dilutes the urine. Additional indicators for possible renal injury include the presence of a flank hematoma, abdominal or flank tenderness, rib fractures, and penetrating injuries to the low thorax or flank.

Hematuria is important as it may represent significant urologic injury. In most cases, a low correlation exists between severity of renal injury and degree of hematuria [5]; however, in cases of an isolated flank injury (especially in isolated penetrating trauma), the presence of any degree of hematuria carries a significant risk for renal parenchymal injury. Additionally, hypotension is important as it may signify significant hemorrhage from the renal parenchyma or renal pedicle. Hematuria is absent frequently in renal pedicle

injuries. Interestingly, hematuria is not seen in up to 36% of renal pedicle injuries and in 24% of renal artery occlusions [6].

Hematuria and hypotension also are important variables in determining which renal trauma patients need to undergo radiologic imaging. In a large study from San Francisco General Hospital, no significant renal injuries were missed in adult blunt renal trauma patients without gross hematuria. hypotension, or significant mechanism (rapid deceleration, high falls) [7]. This study concluded that these select patients safely may avoid imaging for staging purposes. These patients often have minor renal injuries that may be treated with observation. In the rare patient who sustains a significant renal injury, concomitant abdominal injuries always occur, that necessitate radiologic evaluation for staging. In those with gross hematuria or microscopic hematuria and shock, a higher incidence of significant renal injuries exists, necessitating imaging for staging purposes.

Radiographic evaluation

The criteria for radiologic imaging include 1) all penetrating trauma patients with a likelihood of renal injury (abdomen, flank, or low chest) who are hemodynamically stable, 2) all blunt trauma with significant mechanism of injury, specifically rapid deceleration as would occur in a motor vehicle accident or a fall from heights, 3) all blunt trauma with gross hematuria, 4) all blunt trauma with hypotension defined as a systolic pressure of less than 90 mm Hg, and 5) all pediatric patients with greater than 5 red blood cell (RBC)/HPF in urine [8] . Patients who are hemodynamically unstable after initial resuscitation require surgical intervention. Delaying definitive therapy to obtain a preoperative imaging study in an unstable patient is not warranted and may compromise resuscitative efforts.

Computerized tomography

The single best radiologic modality for diagnosing renal injury is computerized tomography (CT) [9]. CT is rapid, is widely-available in trauma centers, gives excellent three-dimensional data, and accurately can diagnose urinary extravasation, renal contusions,

depth of renal lacerations, nonviable tissue, and renal pedicle injuries [10]. CT's ability to provide anatomic and functional data when used with IV contrast is useful in staging renal injuries. Additionally, CT is useful in diagnosing concomitant abdominal injuries.

Because of the increased use of rapid spiral CT scans, an adequate renal assessment cannot be made without delayed images. On the first set of images, IV contrast does not have enough time to fill the collecting system and, as a result, urinary extravasation and collecting system injuries may be missed. A second series of delayed films must be obtained 5 to 10 minutes after the initial IV bolus of contrast to visualize adequately most parenchymal and collecting system injuries with acceptable accuracy.

Findings on CT scan that suggest major injury include (1) medial hematoma, especially with extravasation on the early phase implying renal vascular injury; (2) medial extravasation on the delayed films suggesting renal pelvic injury or disruption of the proximal ureter; and (3) any lack of parenchymal contrast on the early phase suggesting arterial injury.

Intravenous pyelogram

Formerly the most commonly used modality for imaging renal trauma was the IV pyelogram (IVP). It was proved to be less effective in diagnosing significant renal injury than CT. In one study, urinary extravasation and non-function are seen in less than 50% of patients with major parenchymal or vascular injuries [11]. In another study, 82% of patients who sustain significant renal injury had an indeterminate IVP, whereas CT provided a definitive diagnosis in all patients [12]. Additionally, IVP is time-consuming and labor-intensive and only visualizes the urinary tract. In short, CT has a higher sensitivity and specificity in the evaluation of blunt renal trauma as compared with IVP and is the imaging modality of choice [13]. A limited role exists for intraoperative IVP in the surgical staging of an unstable patient, which is discussed later.

MRI

MRI equals CT in correctly grading blunt renal injuries and particularly in detecting the presence and size of perirenal hematomas. An advantage of MRI is its ability to differentiate old hematoma from a more recent hematoma by differences in signal

intensity. Although MRI can replace CT in patients with iodine allergy and may be helpful in patients with equivocal findings on CT, it should be reserved for selected patients because of increased cost and increased imaging time [14].

Angiography

In penetrating injuries, angiography is the second study of choice behind CT because reliably it can stage significant injury and offers the possibility of embolization. In a stable patient who presents with persistent bleeding, angiography may allow selective arterial embolization, which may obviate the need for surgical exploration [15].

Ultrasound

Although ultrasonography has gained popularity in the rapid diagnosis of intraabdominal injuries in the trauma setting, its efficacy in diagnosis of renal trauma is lacking. Several studies have documented its inferiority, including one study in which 78% of known renal injuries were read as negative [16]. Despite being quick, available, transportable, and inexpensive, ultrasonography is agreed upon not to be the modality of choice.

Surgical evaluation

Surgical staging of renal injuries is performed in patients who are too unstable to undergo a complete clinical or radiologic evaluation. These patients have often undergone life-threatening injuries and are rushed to the operating room for definitive treatment before adequate radiologic assessment may be performed. In these cases, after the patient is explored and stabilized by the trauma surgeon, an effort to stage the renal injury is performed. In these cases a one-shot IVP is performed 10 minutes after IV infusion of 2mg/kg of contrast material. The main purpose of the one- shot intraoperative IVP is to assess the presence of a functioning contralateral kidney and to radiographically stage the injured side. The one-shot IVP may also be used in the setting of an unexpected retroperitoneal hematoma and may help to determine if the kidneys are injured and how well they function. In a recent review [17], a normal intraoperative one-shot IVP obviated the need for renal exploration.

If the IVP findings are not normal, renal exploration should be performed and the injuries assessed. Before opening the

retroperitoneal space early vascular control should be considered. The need for early vascular control is debatable as some studies conclude that it is a time-consuming maneuver with no change in nephrectomy rate [18], while others claim benefit [19]. After the kidney is exposed on all sides and is examined, if the injury is significant and the patient is stable, renorrhaphy should be performed. If the patient is unstable, the injury is irreparable, or the injury would simply take too much time to repair in a time-critical situation, nephrectomy should be considered.

Staging of renal injuries

The most widely accepted classification used to stage renal trauma was developed by the American Association for Surgery of Trauma (AAST) Organ Injury Scaling Committee. It stages renal injuries with five different grades.

Grade I is classified as a renal contusion or a small, nonexpanding, subcapsular hematoma. Grade II is defined as a renal laceration confined to the cortex of the kidney (<1 cm) without urinary extravasation or a nonexpanding perirenal hematoma. Grade III injuries are lacerations which extend into the medulla (>1 cm)

without evidence of urinary extravasation. Grades IV and V each have a parenchymal and a vascular component. In Grade IV injuries, the parenchymal injury extends through the cortex and medulla into the collecting system with evidence of urinary extravasation, whereas the vascular component includes a main renal arterial or venous thrombosis or injury with a contained hematoma. Grade V parenchymal injuries include a shattered kidney, indicating multiple Grade IV lacerations, whereas the vascular component includes complete pedicle avulsion. No mention is made in the classification for segmental vascular injuries.

The AAST kidney injury scale has been validated by several studies. In the largest study, an analysis of greater than 2500 renal injuries from a single institution was reviewed retrospectively and showed that the scale correlates with the need for kidney repair or removal [20].

Nonoperative management

In determining whether a renal injury needs to be explored, several factors must be considered. These factors include (1) the presence of concomitant injuries and their management, (2) the

presence of continued hemodynamic instability after initial resuscitation, and (3) the stage and mechanism of the renal injury.

From a practical point of view, the management of concomitant injuries often dictate the ultimate approach used to treat renal injuries. If a patient is going to the operating room for associated abdominal injures or profound instability, the urologist should be present. After initial stabilization and exploration is complete, at the discretion of the trauma surgeon, the urologist should stage the renal injury adequately (if it has not been done preoperatively) with a one-shot intraoperative IVP or with operative exploration. Based on these findings, the urologist determines whether the kidney must be explored, repaired, or observed. Exploration should ensue in settings of an expanding or pulsatile retroperitoneal hematoma or no visualization of injured the kidney on the one-shot IVP. Exploration should be considered in settings of incomplete staging, urinary extravasation outside of Gerota's fascia, or devitalized tissue especially in the setting of pancreatic injury or fecal spillage as higher rates of postoperative infected urinomas and perinephric abscesses are more common. In times when hemodynamic instability is ongoing and the source of the blood loss

is from the kidney or its pedicle, nephrectomy may be necessary. In the hands of urologists clearly nephrectomy more often is performed because of irreparable injury rather than the patient's hemodynamic instability [21].

In patients who have less severe or no other abdominal injuries after evaluation from the trauma surgeon and do not go for immediate abdominal exploration, the presence of hemodynamic instability and the degree and mechanism of the renal injury guides the urologists' management. Hemodynamic instability in these cases often is from the kidney, and bleeding, hematoma, urinary extravasation, and devascularized tissue should be ascertained from postinjury imaging. In situations of mild hemodynamic instability and parenchymal injury after a penetrating injury, such as in an isolated renal stab wound, renal angiography with embolization may be a viable treatment option. In cases of more extensive injury, operative exploration of the kidney may be necessary.

In hemodynamically stable patients with penetrating injuries who are completely staged, select patient cohorts may be treated nonoperatively. Limited renal injuries are more suitable for this approach. In one study, Grade – I and II injuries fared well when

treated nonoperatively. In this study, some Grade III and IV injuries also were managed nonoperatively. Although most resolved uneventfully, delayed renal bleeding occurred in 23.5% of these patients. Some of these delayed bleeds may have been amenable to angioembolization afterward.

In patients with blunt trauma, most injuries initially may be managed nonoperatively. Even in settings of urinary extravasation and nonviable tissue, bluntly injured kidneys seem to heal well when managed conservatively. In a series of over 2900 blunt renal injuries from San Francisco General Hospital renal trauma database, only 2.6% of patients were managed operatively with less than a 0.7% nephrectomy rate. In most cases, urinary extravasation resolves without consequence, and in those that do not, placement of a ureteral stent or a percutaneous nephrostomy tube may be necessary for resolution, especially in injuries which involve the renal pelvis.

Renal injuries with nonviable segments also may be managed conservatively, though the complication rate and need for delayed surgical intervention is higher. One study suggests that there is an increase in patient morbidity in those with nonperfused renal

segments versus those without in terms length of hospital stay, need for blood transfusions, and need for delayed surgical intervention. In this study, six patients (30%) ultimately needed an open procedure for an infected urinoma, a perinephric abscess, or a delayed bleed. Another study, which examined the effect of nonviable renal segment between 25% and 50%, showed that nonoperative management yielded only a 6% nephrectomy rate, though 85% of patients sustained urologic complications amenable to salvage endourologic or percutaneous procedures. These complications included persistent urine leaks, infected urinoma, and perinephric abscesses.

Even Grade V shattered but perfused kidneys in hemodynamically stable, bluntly injured patients also have been treated successfully without surgery. In a series of six shattered but perfused kidneys, four (66%) kidneys functioned before discharge as determined by CT scan, and none of these patients subsequently developed hypertension though patient follow-up was poor [22].

Postinjury, all patients who are managed non- operatively are placed on bed rest until their gross hematuria resolves. Additionally, all patients who present with urinary extravasation or nonviable

tissue are imaged periodically while as an inpatient to monitor for injury resolution. Follow- up imaging also is performed to document renal function 3 months following injury.

Operative Management of Renal Injuries: Parenchymal and Vascular

Of all genitourinary organs, the kidney is the most likely to be injured in cases of external trauma and injuries to at least one kidney occur in as many as l0% of abdominal trauma cases. Today, most of these injuries can be managed by the urologist without requiring an operation thanks to advances in staging techniques resulting from increased use of CT scanning, as well as increased awareness, based on outcomes research, of the kidney's capacity for healing. Nonetheless, in certain cases, severely injured kidneys are best managed by exploration and reconstruction, with nephrectomy reserved for life-threatening hemorrhage or for kidneys that have been injured beyond repair. Ultimately, the objective of managing patients with severe kidney injuries is to prevent significant hemorrhage and retain enough functioning nephron mass to avoid end-stage kidney failure. A secondary goal is to avoid complications specifically attributable to the traumatized kidney.

Indications for surgical exploration

Most renal injuries are contusions or minor lacerations (AAST Grade I or 2 injuries), and may thus be managed nonoperatively if adequately staged. Appropriate radiographic staging has also permitted selective nonoperative management of major lacerations in both blunt and penetrating trauma. In a recent series of Grade 4 lacerations at San Francisco General Hospital, 22% were successfully managed nonoperatively. Penetrating injuries more commonly require laparotomy because of associated injuries or hemodynamic instability. In the San Francisco General Hospital experience, however, 55% of stab wounds and 24% of gunshot wounds were successfully managed expectantly through careful selection and complete clinical and radiographic staging [23]. If expectant management is selected in the setting of a major renal laceration, close monitoring with serial hematocrit measurements and liberal use of repeat imaging, especially at 36 to 48 hours, is indicated.

The absolute indications for surgical exploration in renal trauma are persistent, life-threatening hemorrhage believed to be from renal injury, renal pedicle avulsion, and expanding, pulsatile, or uncontained retroperitoneal hematoma. Patients with such injuries often present in severe shock. Thus, rarely have these patients undergone radiographic staging before emergency laparotomy[24]. In the setting of renal pedicle avulsion or severely shattered kidney, reconstruction may be impossible, and nephrectomy may be required to save the patient's life.

Relative indications for renal exploration include incomplete staging,, devitalized renal parenchyma, vascular injury, and urinary extravasation [25]. In a hemodynamically unstable patient, radiographic assessment is not possible before laparotomy and an unexpected retroperitoneal hematoma may be found at the time of laparotomy in the trauma patient. At this time, if the patient's clinical condition permits, a single abdominal radiograph (imaging the kidneys, ureter and bladder) taken 10 minutes after the bolus administration of 2 cc/kg of intravenous contrast, delivered as a

bolus (“one-shot” intravenous pyelogram (IVP)), in a normotensive patient, is helpful. This film is most helpful for confirming the presence of a normally functioning contralateral kidney and may occasionally help to diagnose the injury in the affected renal unit. All patients with penetrating trauma and incomplete preoperative staging and a retroperitoneal hematoma require exploration. Although the one-shot IVP may be indeterminate, a recent study found that it successfully obviated renal exploration in 32% of patients in whom it was required. Furthermore, this approach has not been found to increase the rate of unnecessary nephrectomy. The initial laparotomy is the best time for any required renal reconstruction. Delayed exploration has resulted in nephrectomy rates as high as 50%.

Operative technique

The main steps related to exploring an injured kidney and, if necessary, reconstructing a kidney include staging the injury, controlling renal hemorrhage, preserving maximal renal parenchyma, and reducing potential complications attributable to the injured kidney. Historically, renal exploration in the trauma setting usually resulted in total nephrectomy. Today, however, through a

refined approach to proximal vascular control and a meticulous approach to reconstruction, most injured kidneys requiring surgical exploration can be salvaged [26,27].

Importance of proximal vascular control

Unplanned nephrectomy in the trauma setting stems from uncontrolled hemorrhage. While the literature shows disagreement about the need for proximal control [28], the prudent course is to routinely obtain proximal vascular control before opening the retroperitoneal hematoma. While temporary vascular occlusion is rarely necessary (approximately 17% of renal explorations at San Francisco General Hospital), no accurate method has been found to determine which kidneys will require this maneuver during subsequent reconstruction. Some researchers have suggested that pedicle control can be safely obtained following release of the perinephric hematoma. However, their reports about such cases have shown nephrectomy rates approximately three times higher than those with early vascular control[29].

The traumatized kidney should be explored through a midline transperitoneal incision extending from the xiphoid process to the

pubic symphysis. The cephalad extent of the incision must be as large as possible so that the renal injury can be easily seen. Except in cases of renal pedicle avulsion, all associated intra-ahdominal injuries (ie, injuries to spleen, liver, pancreas, small and large intestine) should be addressed before renal exploration. This method allows Gerota's fascia to maintain its natural tamponade effect on the hematoma.

Operative technique

The approach to the injured kidney begins with proximal vascular control. If enough personnel are available, handheld retractors, such as Richardson or Deaver retractors, can be deployed rapidly and are sufficient to impart visualization. If not, then a self-retaining retractor, such as a Bookwalter retractor, should be used. Following visualization, the transverse colon should be wrapped in moist laparotomy sponges and placed on the chest. Then the small intestine should be placed in a bowel bag or moist sponges and retracted superiorly onto the right chest.

This exposes the root of the mesentery and the ligament of Treitz and the underlying great vessels. The retroperitoneal incision

should be made over the aorta superior to the inferior mesenteric artery, and extending up to the ligament of Treitz . If a large retroperitoneal hematoma obviates easy palpation of the aorta at the level of the ligament of Treitz, the incision may be made medial to the visualized inferior mesenteric vein. This vein is an important guide, running a few centimeters left of the aorta. The vein is easily identifiable, even in the presence of a large hematoma. Dissection should be carried superiorly along the anterior wall of the aorta until the left renal vein is identified crossing anterior to the aorta. The left renal vein is encircled but not occluded with a vessel loop, allowing for retraction. Now, the left renal vein serves as a guide to the remaining renal vessels, each of which is then secured with vessel loops in the following order: Left renal vein, left renal artery, right renal vein, right renal artery. The average time for this proximal renal vascular control, even at a training institution, is 12 minutes. These vessels are all left unoccluded unless heavy bleeding is encountered during the renal dissection. Temporary renal vascular occlusion should be kept below 30 minutes to minimize warm ischemic damage. After vascular control has been successfully achieved, the injured kidney may be exposed by mobilizing the

ipsilateral colon along the white line of Toldt and reflecting it medially. Gerota's fascia is then incised along the lateral aspect of the kidney to completely expose the kidney. Care should be taken to maintain the integrity of the renal capsule as the kidney is mobilized to decrease hemorrhage and preserve the capsule for later closure.

Parenchymal injuries

Significant amounts of devitalized renal parenchyma are often best managed by early surgical debridement. Expectant management of patients with devitalized fragments and associated intraabdominal injury may lead to a higher rate of abscess and infected urinoma formation as well as delayed complications. Data indicate that immediate exploration in this setting reduces the post-trauma complication rate from 82% to 23% [30]. This result suggests that major renal lacerations with devitalized fragments and associated intra-abdominal injuries should be immediately repaired, particularly if a laparotomy is already planned by the trauma surgeon. Additionally, patients with a major devitalized fragment associated with urinary extravasation and a significant hematoma are ultimately best treated by early exploration and reconstruction, even without

concomitant intraperitoneal injury. However, the nonoperative approach in this situation may be more prudent for the urologist who rarely undertakes renal exploration in the trauma setting, as the chance of unnecessary nephrectomy is increased.

Urinary extravasation signifies collecting system violation secondary to a major renal laceration, but does not specifically mandate surgical repair. The collecting system may be disrupted at a fornix. a minor or major calyx, or even through the renal pelvis and ureteropelvic junction (UPJ). While the majority of lacerations into fornices and minor calyces will seal spontaneously, larger degrees of extravasation may leak for a prolonged period and are less likely to resolve spontaneously. Serial CT scans are critical in the management of patients with large degrees of extravasation. The first scan should be obtained at approximately 36 to 48 hours post-injury to rule out the development of significant new complications. Intervention is indicated in the setting of sepsis, ongoing leakage, or significant urinoma formation. In these cases, placement of an indwelling ureteral stent or even a nephrostomy tube may speed resolution of extravasation. Lacerations of the renal pelvis usually do not resolve spontaneously and should be surgically repaired.

Similarly, UPJ avulsion mandates surgical repair. These unusual injuries are more commonly found in the setting of deceleration injury or in children, but may also take place in adults with an undiagnosed congenital anomaly, such as ureteropelvic junction obstruction. CT findings that suggest UPJ avulsion include nonvisualization of the ipsilateral ureter and medial extravasation of contrast material [31]. The urologist should also maintain a low threshold for repair of an extravasating kidney associated with a gunshot wound. These wounds are often associated with significant devitalized parenchyma secondary to blast effect, especially when a high-velocity missile has been used.

Principles of reconstruction

For all renal reconstructions, eight general steps apply:

1. The entire kidney must be broadly exposed.

2. Measures for temporary vascular occlusion must be taken to stop bleeding not arrested by manual compression of the parenchyma.

3. Nonviable parenchyma must be sharply debrided.

4.Hemostasis must be established and meticulously maintained.

5. The collecting system closure must be made watertight.

6. After renorrhaphy, the parenchymal defect must be covered by reapproximation of the parenchymal edges.

7. The omental interposition flap must be placed to separate the reconstructed kidney from surrounding pancreatic, colonic, or vascular injuries.

8. The retroperitoneal drain must be put in place.

The kidney should be debrided sharply back to viable, bleeding parenchyma. Approximately 30% of one normally functioning kidney is required to avoid dialysis. This rule of thumb may serve as a guide in determining whether renal salvage should be undertaken. Major polar injuries are best managed with partial nephrectomy , while lacerations to the mid-kidney should undergo renorrhaphy . For hemostasis, the arterial vessels should be individually suture-ligated with 4-0 chromic sutures. To assist hemostasis, place hemostatic agents, such as thrombin-soaked absorbable gelatin sponge bolsters, between the cut parenchymal edges. Then inspect the collecting system for obvious tears. To better find any openings, inject 2 to 3 cc methylene blue into the renal pelvis using a 27-gauge needle. Tears are then overseen with

running 4-0 chromic suture. A stent is placed only in cases of significant renal pelvis or ureteral injuries, but not in simple calyceal injuries. For a deep, slit-like parenchymal laceration from a knife or sword, the thin parenchymal defect will not permit easy access to the collecting system, and urologists rely on closure the overlying parenchyma to seal the collecting Stem.

If the renal capsule is intact and viable, it should be used without tension as the primary means to close the parenchymal defect. If the capsule has been destroyed or the defect is too large to close primarily without causing ischemia, an omental flap can be used. The omentum, once guided through the paracolic gutter to reach the kidney, can be sutured to the defect. If the omentum is not available, the defect may be covered with perinephric fat or a peritoneal free graft. However, these are less desirable options. In the case of a shattered kidney or multiple deep lacerations, the kidney may be placed in an envelope of Vicryl mesh to stabilize the repair.

Following reconstruction involving the collecting system, a Penrose drain is placed adjacent to the kidney and connected to a urostomy bag to drain any leak if necessary. Alternatively, a suction

drain may be used, as long as it is not connected to suction because suction prolongs urinary drainage. These drains are typically removed after 48 to 72 hours unless output is high. in which case the drainage creatinine should be measured. If the creatinine value suggests a urine leak, the drain should be left in place for a longer period. Placement of an indwelling ureteral stent may help to expedite sealing of a persistent urine leak.

Vascular injuries

Renovascular injuries are uncommon. In a survey of patients over a 16-year period at six major trauma centers, only 89 patients were found to have renovascular injury [32]. Most injuries are to the renal artery only (60%), followed by the renal vein (30%), followed by a combination of arterial and venous injury (l0%) [33]. Physical examination is not usually specific. Major injury to the main renal artery or vein almost invariably requires operative management. Unlike parenchymal lacerations, renovascular injuries are frequently impossible to repair, and may result in nephrectomy. Proximal vascular control is particularly critical in these cases and, indeed, temporary vascular occlusion can be accomplished without any resultant negative sequelae in 90% of patients. These patients have

higher rates of complications, renal loss, and mortality when compared with those with nonvascular renal injuries.

Arterial injury

CT findings consistent with main renal artery injury include lack of renal enhancement or abrupt cut-off of an enhancing artery. Segmental arterial injuries typically appear as wedge-shaped infarcts with the apex facing the renal hilum. Injuries to the main renal vein typically appear as central or large hematomas, which may displace the kidney anteriorly. Vascular injuries typically occur secondary to deceleration trauma causing the disruption of the inelastic intimal layer with subsequent irreversible parenchymal ischemia and infarction.

Despite the ongoing advances in trauma care, successful renal salvage after major renovascular injury only occurs in 25% to 35% of cases, at best. Time to reperfusion is the major factor in determining the outcome. Renal function is significantly impaired following 3 hours of total and 6 hours of partial ischemia[34]. Despite technically successful repair, late hypertension occurs in approximately 50% of renal arterial injuries managed nonoperatively, compared with 57% that were revascularized. Renal

arterial repair should thus be reserved for solitary kidneys, bilaterally injured kidneys, and in the rare situation of detection within 6 hours of injury. Endovascular stenting may have a limited role, as maintaining patency requires anticoagulation, which is rarely possible in the traumatically injured patient, especially with polytrauma to the spleen or liver. If detection of renal artery thrombosis is delayed and laparotomy is otherwise indicated, nephrectomy should be performed. Otherwise, the kidney may be allowed to atrophy, with delayed nephrectomy performed if hypertension develops.

In cases of main renal artery injury, the type of repair indicated relates to the extent and mechanism of injury. Penetrating injuries with incomplete transection may be primarily repaired using 5-0 prolene sutures. Blunt injuries typically require thrombectomy and debridement of the damaged arterial segment. Ideally, a primary tension-free reanastomosis of the injured artery should be undertaken. If this is not feasible, an interposition vascular graft is recommended. Ex-vivo renal reconstruction and autotransplantation into the iliac fossa are rarely indicated in the critically injured patient with multiple associated injuries. However, such procedures are

technically feasible and have been reported [35]. Segmental arterial injuries may be safely ligated, with few complications arising from the subsequently devascularized renal parenchyma. Alternatively, a partially lacerated segmental artery may be repaired with 5-0 or 6-0 prolene suture.

Venous injury

Injury to the main renal vein typically results in significant hemorrhage and may require ligation. If reconstruction is feasible, the partially lacerated vein may be repaired with 5-0 prolene suture following appropriate vascular clamping . Injuries to segmental veins may be safely ligated because of the extensive renal venous collateral circulation.

Postoperative care

A urethral catheter should be maintained until the patient is hemodynamically stable and mobile enough to void. The patient should be kept on bed rest until gross hematuria clears. An abdominal CT scan and a radionuclide renal scan (DMSA scan) at approximately 3 months must be obtained to quantify the function of the injured or reconstructed kidney. In measuring the function of

traumatically injured and subsequently reconstructed kidneys, it was found that the average differential renal function of the repaired kidney was 39%, which corresponds to about two thirds of the full renal function of a single healthy kidney.

Complications of Renal Trauma

Renal trauma occurs in 1% to 3% of all trauma cases. Complications after renal trauma occur between 3% and 33% of these patients [36]. A wide range of reported complications exists in those with renal trauma. In 2001, Blankenship and colleagues reported that one third of conservatively treated renal trauma patients develop one or more urologic complications, whereas other series have had much lower complication rates closer to 5% [37].

The common complications following renal trauma in the short and long term, reported in various series include

1. urinary extravasation
2. urinoma formation
3. impaired kidney function and renal insufficiency
4. perinephric abscess
5. hypertension

6. secondary hemorrhage

7. AV fistula formation

8. post injury hydronephrosis.

Urinary extravasation is the commonest complication of renal trauma and , by definition, is present in all patients with grade 4 injuries.most of them do not need any intervention and can be treated conservatively.

Development of hypertension may occur in upto 5% of renal trauma patients. Hypertension can be caused by three mechanisms:

1. Injury to the renal artery or one of its branches causes arterial stenosis or occlusion.

2. increased pressure on the kidney acutely from hematoma or chronically from scar, decrease renal blood flow , the so called “Page kidney” .

3. Traumatic arterio-venous fistula can result in renal hemodynamic changes, leading to hypertension.

MATERIALS AND METHODS

The statistical details of all trauma patients who were admitted to the emergency trauma ward in the Govt. General Hospital, Chennai.3, during the period between January 2006 to March 2008 were analysed and all the patients who sustained renal trauma confirmed by investigations were included in the study. This included renal trauma due to road traffic accidents, train traffic accidents, fall from height, assault and stab injuries.

EXCLUSION CRITERIA:

1. Critically injured patients who expired within 30 minutes of admission.
2. Patients with incomplete evaluation of their traumatic injuries due to any reason.
3. Patients who were lost even to the first follow up.
4. Iatrogenic renal trauma as in procedures like percutaneous Nephrolithotomy and unintentional injuries caused during surgical procedures.

A total of 38 patients who sustained renal injuries were finally available for the analysis.

The following proforma was used to collect statistical data for analysis in all these patients.

Name :

Age :

Sex :

I.P. No. :

Date and Time of Trauma

Date and Time of Admission to trauma ward

Mode of Injury
- Blunt
- Penetrating

Mode of Presentation :

Symptoms :
- Loin Pain
- Hematuria
- Abdominal Distention

Signs :
- Loin tenderness
- Renal Angle Tenderness
- Flak Ecchymoses
- Rib fractures.

Vital Signs :
- Blood Pressure, Supine and Sitting
- Pulse Rate
- Respiratory rate

Other associated injuries : Visceral
Skeletal

Biochemical Investigations :

1.Complete hemogram

2. Bd. Urea, Sugar, Creatinine

3. Urinalysis for RBC

<u>Radiological Investigations</u>

CXR – PA view

X – Ray KUB

USG Abdomen and pelvis

CT abdomen and pelvis with contrast.

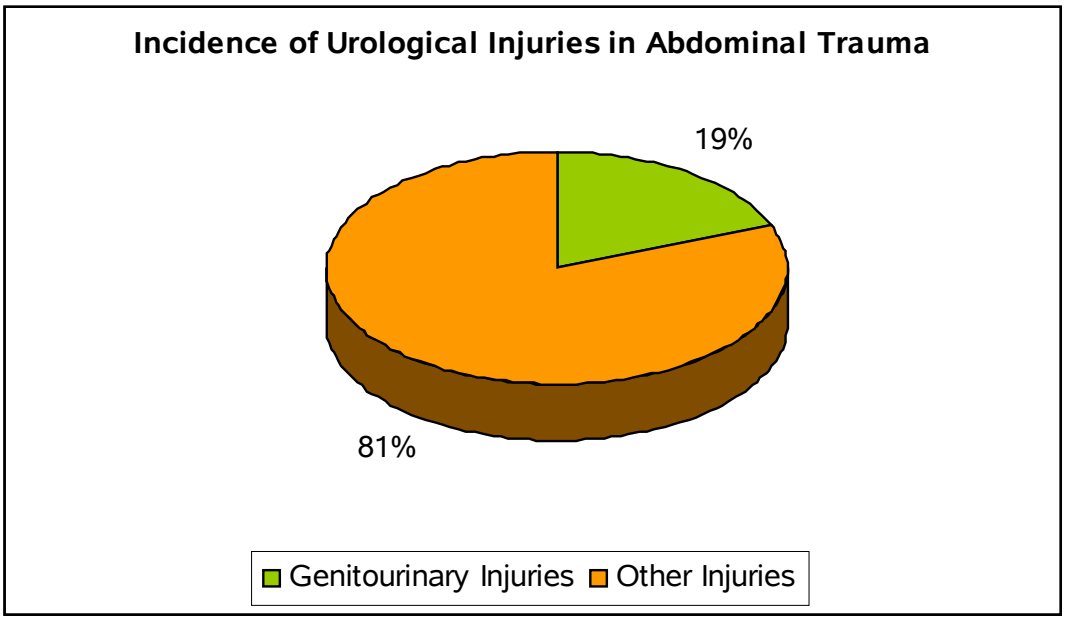
RESULTS

Incidence of Urological injuries in abdominal trauma:

The epidemiology of trauma to the genito-urinary system is unfamiliar to those in emergency services. Wessels et al reported 1.2% renal trauma in 50,000 patients hospitalized for trauma in USA in 1997 and 1998 and Mc Aleer et al reported 3% renal and testicular injuries in 14,763 children who passed through an emergency department in USA.

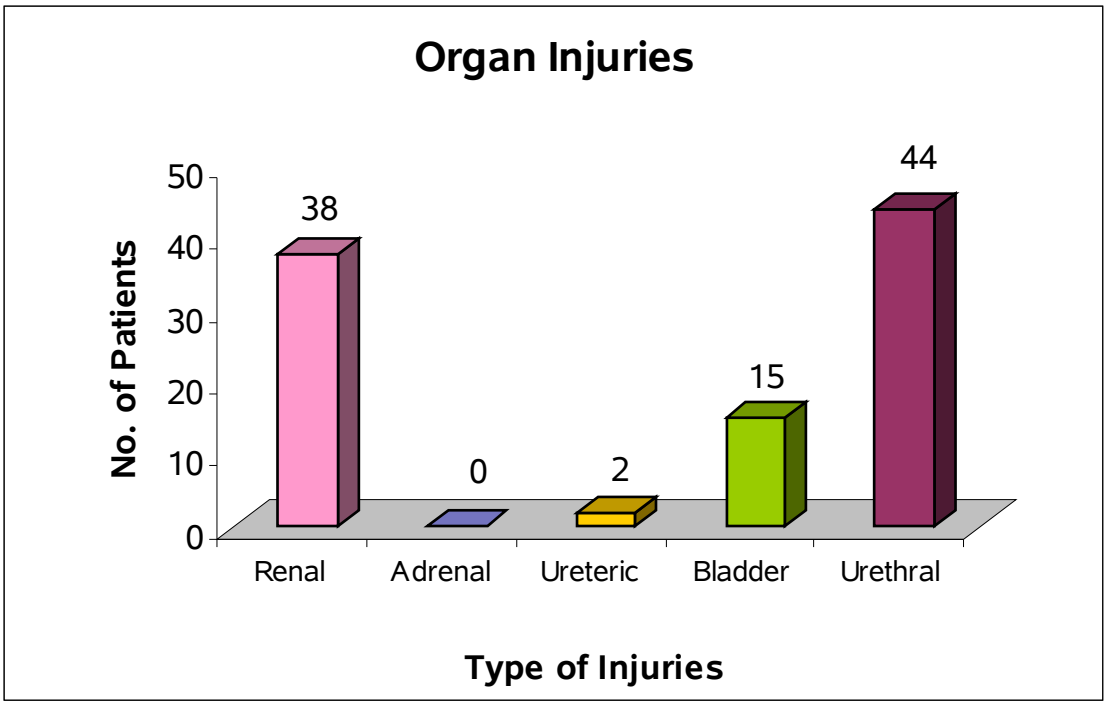
In the present study, out of a total 521 patients admitted with abdominal trauma, 99 had some form of urological injuries (19%).

Total No. of patients admitted With abdominal trauma.	:	521
No. of patients with Urological Injuries.	:	99



Of all the genitourinary organs, contrary to the findings of most other studies, we had an overwhelming number of posterior urethral injuries associated with pelvic fracture. The breakup of various genitourinary organ injuries is as follows:

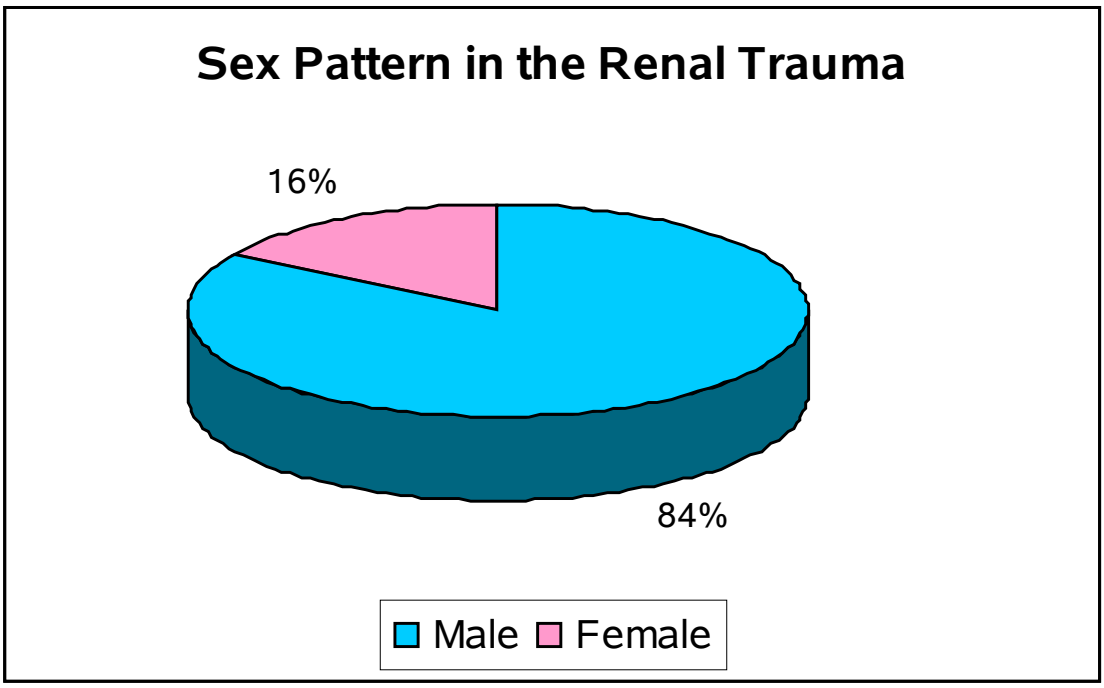
S.No.	Type of Injuries	No. of cases
1.	Renal injuries	38
2.	Adrenal injuries	0
3.	Ureteral Injuries	2
4.	Bladder Injuries	15
5.	Urethral Injuries	44



RENAL INJURIES

Kidney was the second most common genitourinary organ to sustain injury in abdominal trauma in our study.

Of the total of 38 patients who sustained renal injuries, 84% (32 out of 38) were males. Only 6 females (16 %) sustained renal injuries in our series.

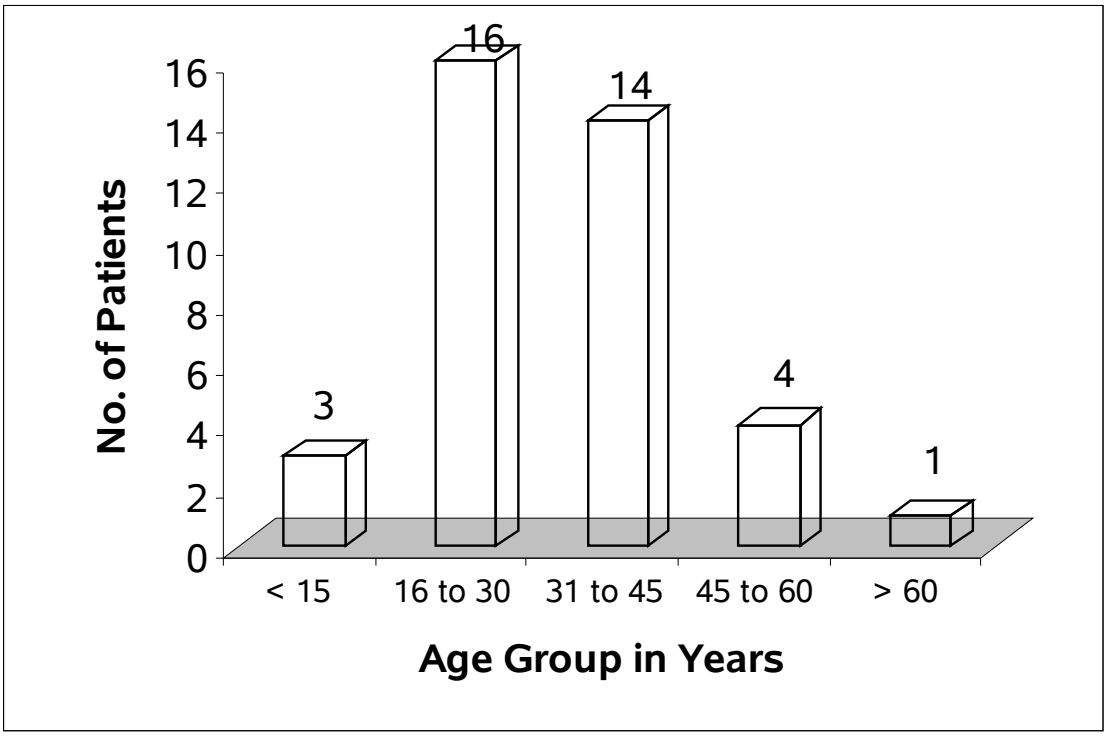


AGE DISTRIBUTION

Young adults in the age group of 16 to 30 years were the most frequent to sustain renal trauma. This is because this is the age group who frequently use two-wheeled motorized vehicles and it has been proved in various studies that traffic accidents prolong two wheelers accent for the vast majority of renal trauma. The reason is, this type of accidents generally occur at high speed and thus high energy. The kidney floats relatively free in its bed, as it is fixed only at two points by the ureter and renal pedicle. In accidents involving frontal impact, major deceleration occurs with the risk of vascular intimal injury. Other mechanisms that explain renal injury are renal fracture

caused by flexion, where the kidney is projected forwards to fracture on the costal margin and crushing injury against the vertebral column. It is estimated that upto 2 million individuals use two wheelers for transport in this city (Chennai).

AGE DISTRIBUTION

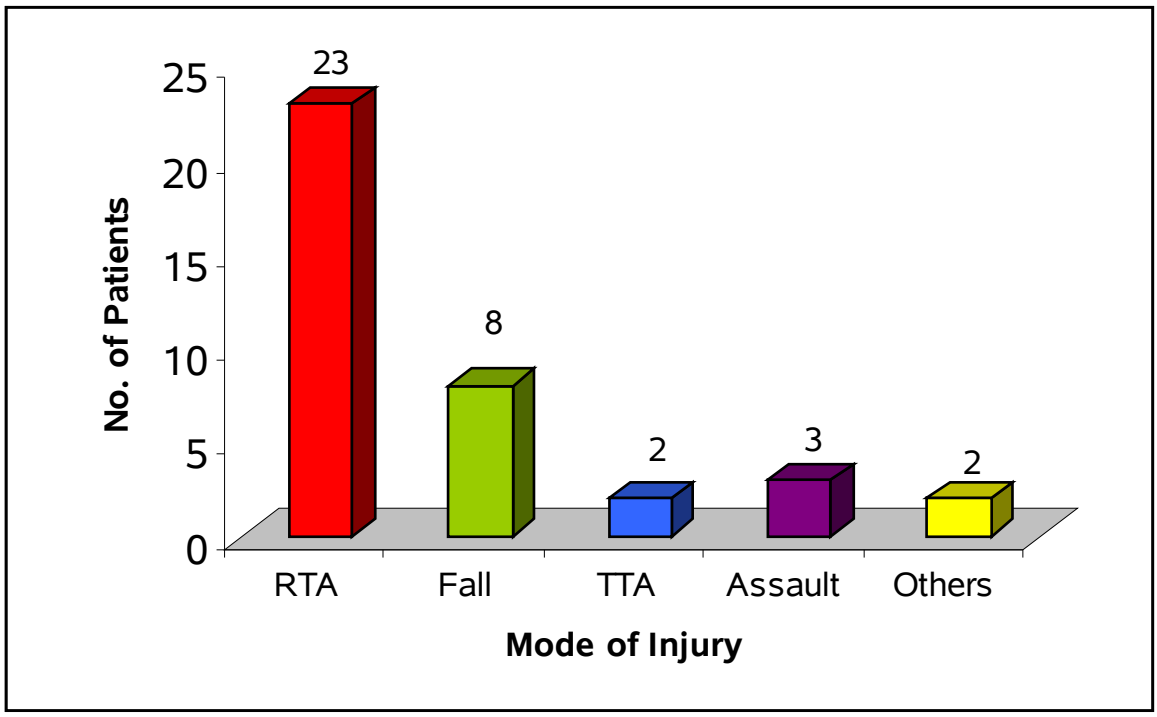


Mode of Injury

As discussed earlier, road traffic accidents were responsible for the vast majority of renal trauma in our series. This finding is similar to that reported by Henry et al, who found that RTA accounted for 48% of severe renal trauma in his series. Zincke et al

also reported similar results. Most of the road traffic accidents involved young people driving two wheelers.

Mode of Injury:

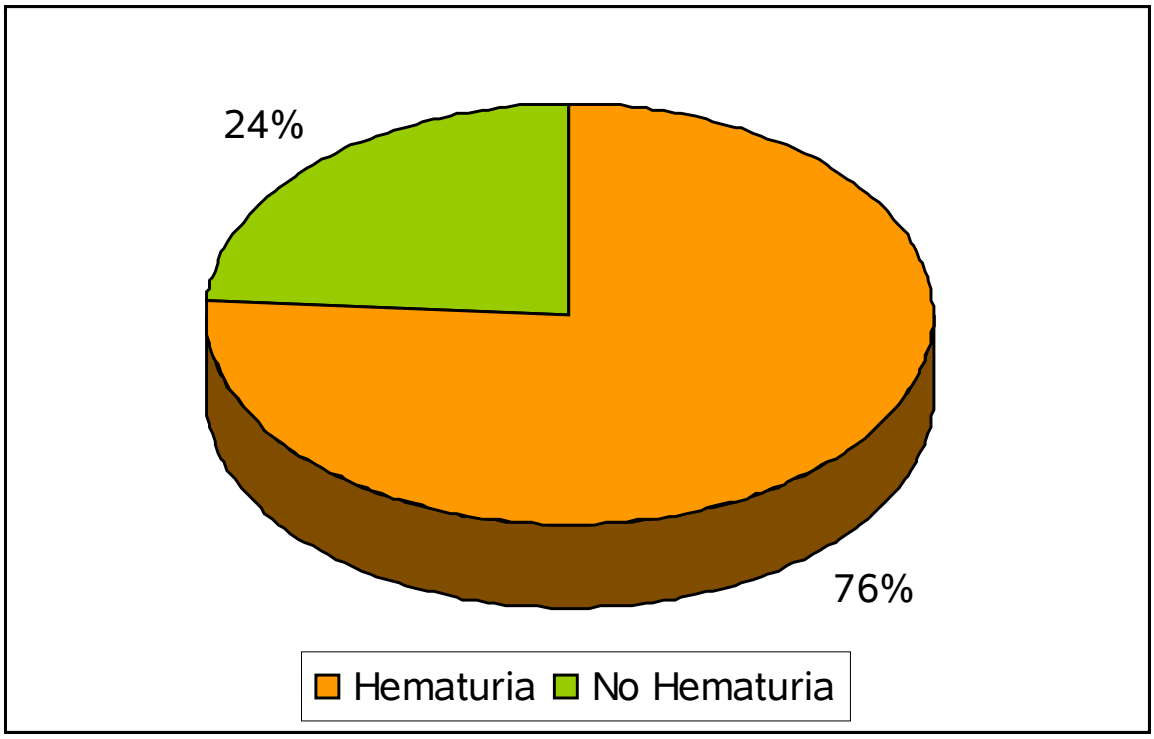


CLINICAL PRESENTATION:

Hematuria is the best indicator of traumatic urinary system injury. The presence of microscopic (> 5 red blood cells / high power field) or gross hematuria is characteristic. However, the degree of hematuria and the severity of renal injury do not correlate consistently. In up to 36% of renal vascular injuries from blunt trauma, hematuria is absent. Also gross hematuria has been observed with renal contusions, although it is more likely to be associated with a significant parenchymal injury.

In the present series, hematuria ,either microscopic or gross was present in 76% of all patients who sustained renal trauma. Of the two patients who had pedicle injury, only 1 had evidence of hematuria.

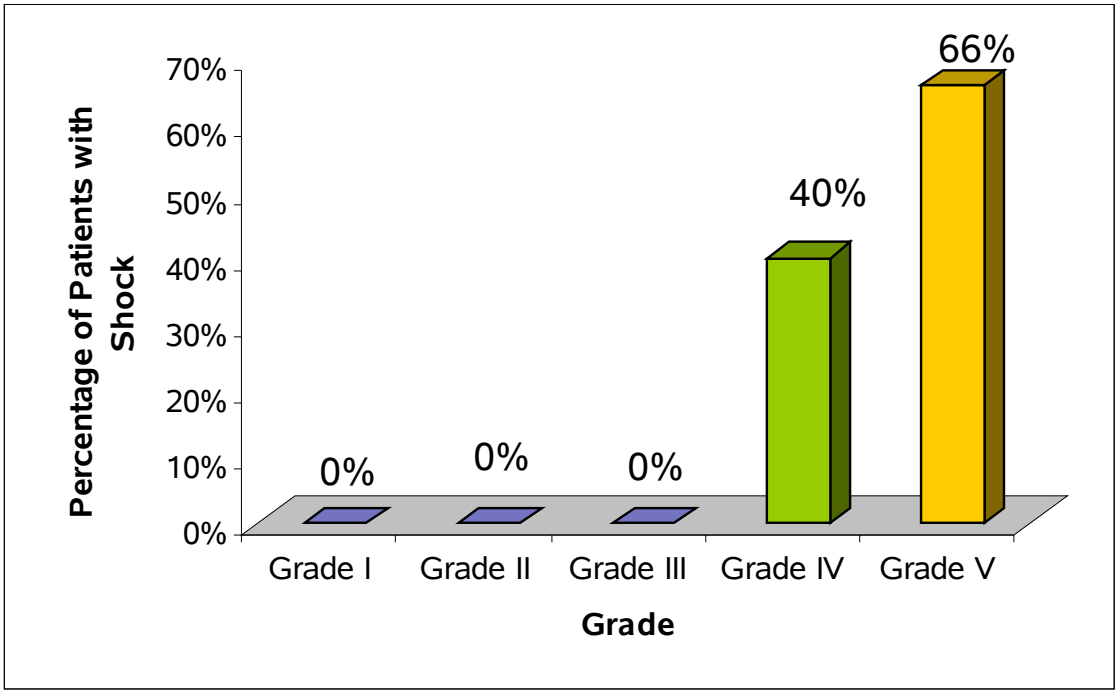
INCIDENCE OF HEMATURIA



In patients with blunt trauma, if shock (systolic blood pressure < 90 mm Hg) is noted with microscopic hematuria, the incidence of significant renal injury increases.

4 out of 6 patients with Gr. V renal injuries and 2 out of 5 patients with Grade IV renal injuries presented with shock at admission.

INCIDENCE OF HYPOTENSION

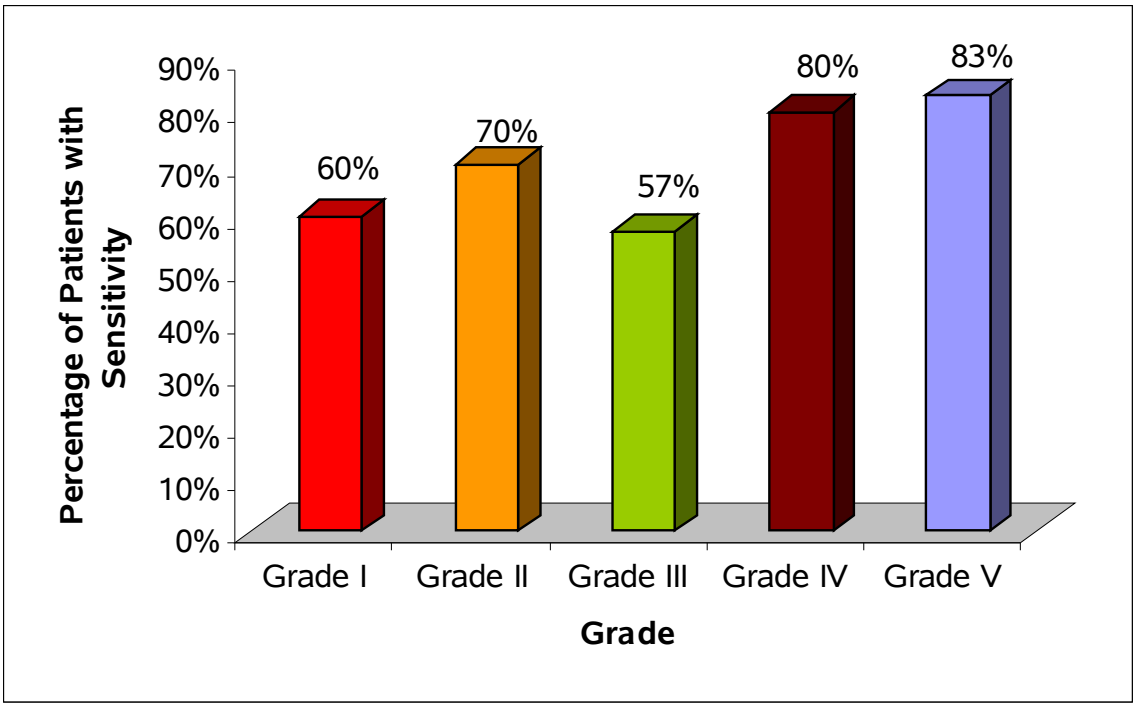


Imaging in renal trauma:

As a part of the hospital protocol, all trauma victims undergo Focussed Abdominal Sonography of trauma (FAST) as immediately as possible after admission if they are haemodynamically unstable or a detailed USG Abdoman and pelvis if stable. The sensitivity of ultrasonography to pick up renal injuries and to accurately characterize them was found to be poor.

The sensitivity of ultrasonogram in terms of grades of renal injuries is illustrated in the following diagram.

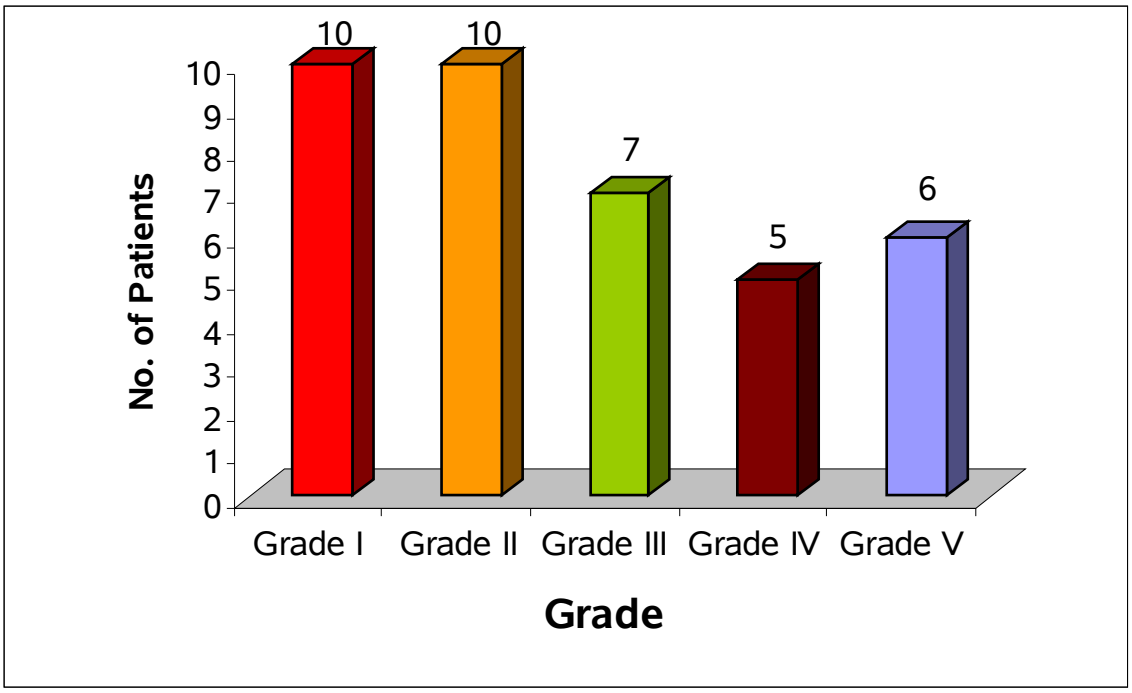
The sensitivity seems to improve with higher grades of injuries.



All blunt trauma patients with gross hematuria and patients with microscopic hematuria and shock (systolic blood presence < 90 mm Hg any time during evaluation and resuscitation) underwent renal imaging with CT with intravenous contrast, as per protocol.

Patients with penetrating injuries with any degree of hematuria also underwent renal imaging with contrast CT.

The information obtained from CFCT was used to grade the degree of renal trauma as per the recommendations of American Association of the surgery of trauma organ injury severity scale for the kidney. Most of the victims in the series had either Grade I or Grade II injuries.

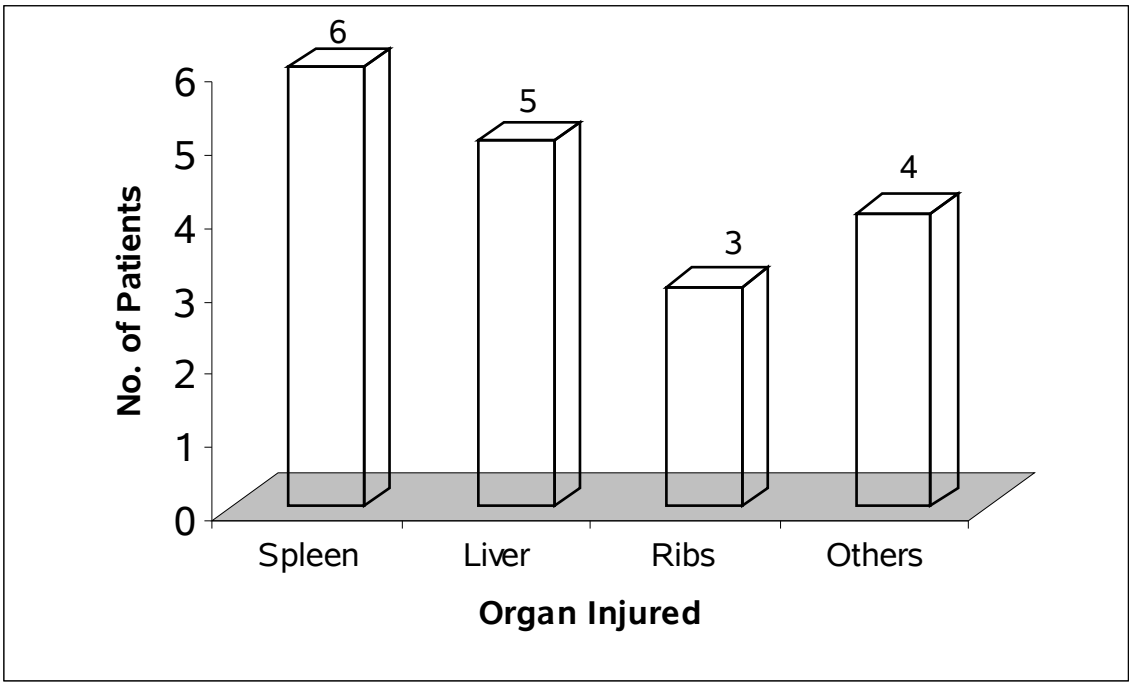


No significant renal injury was missed after CT imaging and the sensitivity of CECT approached 100% in our series.

Concomitant organ injuries :

Approximately 70 to 80% of renal injuries have major associated organ injury that can affect the choice of management of renal injures. In the present series, spleen was the organ most commonly traumatized along with the kidneys. The following bar diagram depicts the associated organs involvement in renal trauma. Spleen was the organ which was most commonly injured concomitantly with renal injury in the present series.

CONCOMITANT ORGAN INJURY



Splenectomy was required in 3 patients and repair of liver lacerations was required in 2 patients, while the rest of the injuries were managed conservatively without intervention.

Presence of coexisting congenital renal anomalies

Upto 6% of renal units sustaining traumatic injuries may have coexisting congenital anomalies like congenital uretero – pelvic junction obstruction, double moiety, polycystic kidney disease etc. One of our patients, an 18 year old male had bilateral PUJ obstruction with hydronephrosis and sustained bilateral pelvic injuries following a fall from tree. Percutaneous drainage and DJ stent placement followed by late repair in the form of pyeloplasty

was done in that patient. Another patient aged 28 years had autosomal dominant polycystic kidney disease and sustained Grade 2 injury to his right kidney following a road traffic accident. Conservative management was successful in that patient. Hence, the incidence of congenital renal anomalies in this renal trauma series is around 5.2%.

MANAGEMENT ASPECTS :

Significant renal injuries requiring intervention are found in only 5.4% of renal trauma cases. A hemodynamically stable patient with an injury well staged by CT can usually be managed without renal exploration. Indeed, 98% of all blunt renal injuries can be managed non-operatively, grade IV and V injuries more often requiring surgical exploration. But even these high grade injuries can be managed without intervention, if carefully staged and selected.

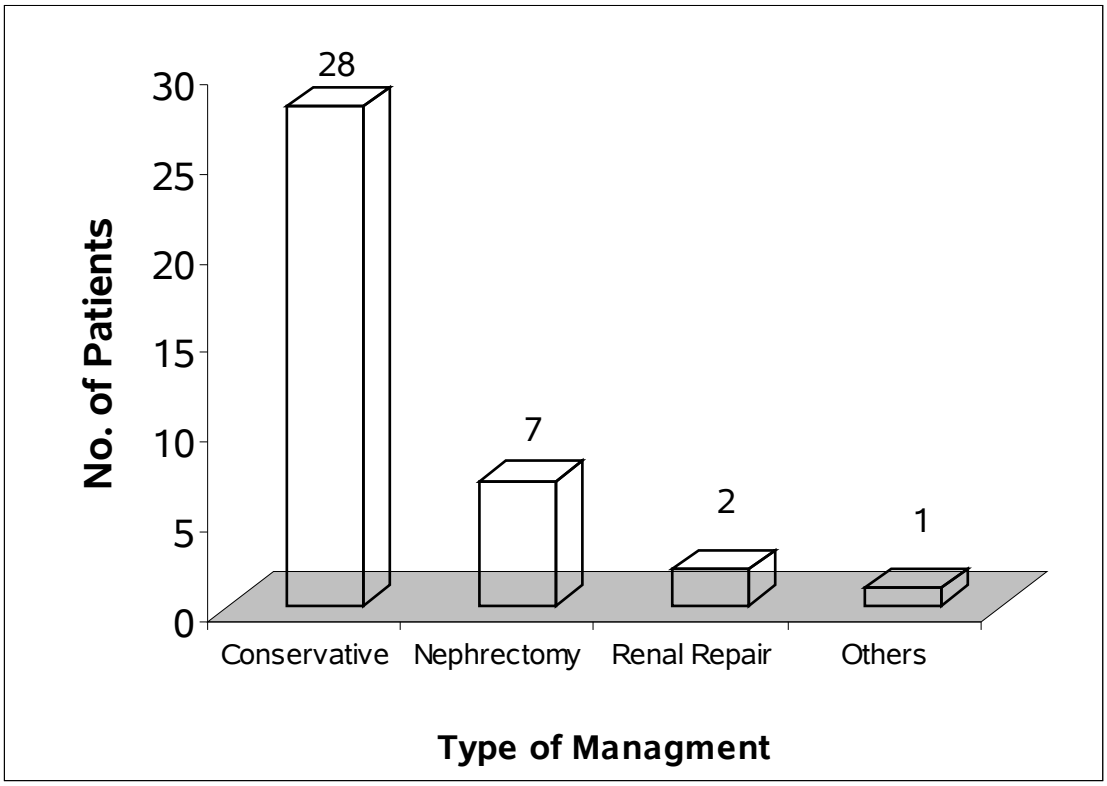
Penetrating trauma from gunshot or stab wounds to the kidney can be managed non operatively if carefully staged with CT. Mc Aninch et al have managed 55% of renal stab wounds and 24% of gunshot wounds in their series without operative interventions.

In the present study 74% of cases were managed conservatively without any surgical intervention and all these patients recovered well. Two patients who had Grade IV renal

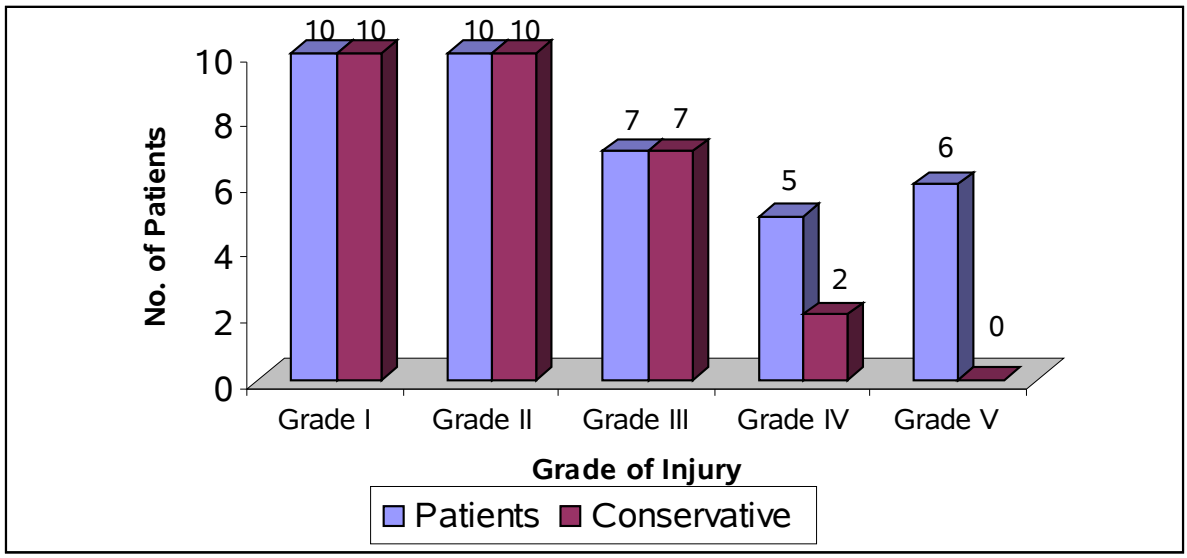
injuries with urinary extravasation required percutaneous drain placement and DJ stent insertion.

Two patients who had extensive grade IV renal injuries with hemodynamic instability required surgical explanation, debridement of devitalised renal tissue and repair.

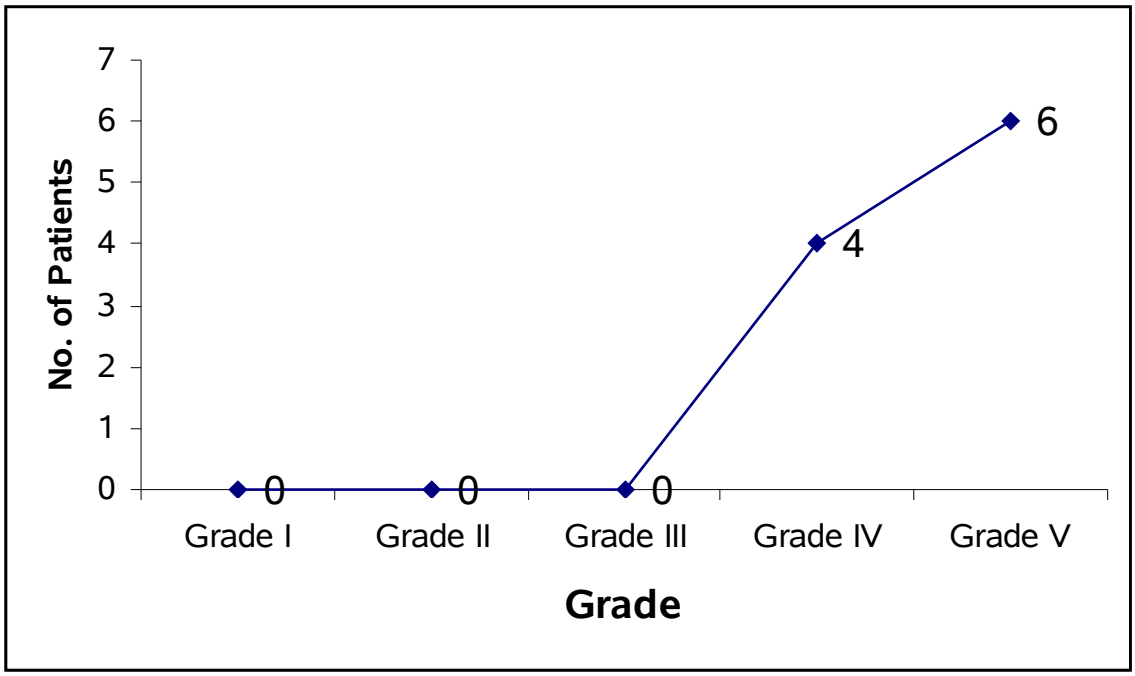
The nephrectomy rate in this study was around 18%. The unexpectedly high rate of nephrectomy in this series was due to the lack of facilities for emergency angio-embolization in some of these patients and also exploration for other life threatening injuries in hemodynamically unstable patients prohibited elaborate renal repairs, necessitating emergent nephrectomy.



SUCCESS OF CONSERVATIVE MANAGEMENT GRADE WISE



REQUIREMENT FOR INTERVENTION GRADE WISE



The following were considered the absolute indications for renal exploration in our institution:-

1) persistent life threatening hemorrhage believed to stem from renal injury.

2) suspected renal pedicle avulsion or vascular thrombosis.

3) expending, pulsatile or uncontained retroperitoneal hematoma resulting from avulsion of renal pedicle or major renal injury.

FOLLOW UP:-

All the patients with renal trauma who were managed conservatively were imaged with repeat CECT – Abdomen 1 week later and with serial hematocrit measurements.

After discharge, the patients were reviewed 1 month and 3 months later and appropriate imaging studies were done as necessary.

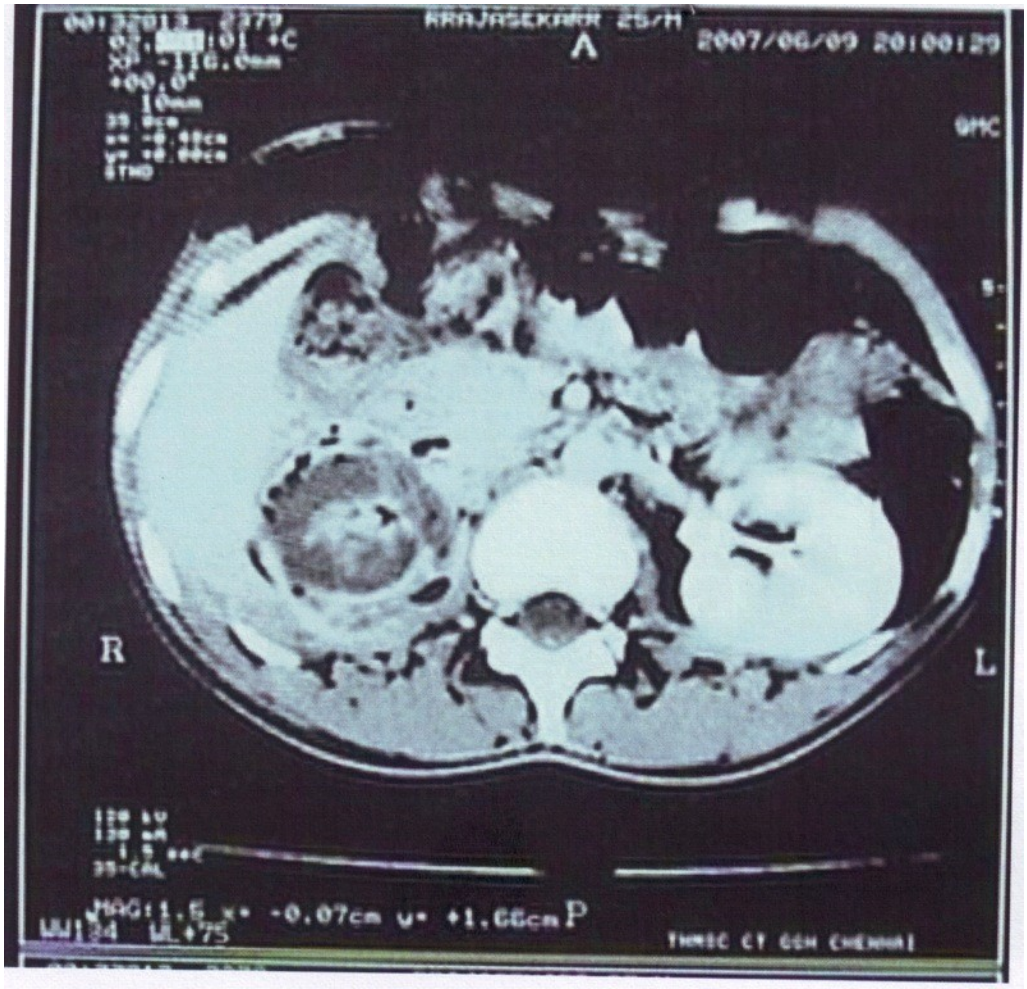
We encountered the following complications in the in-hospital stay and follow up of the patients, which were all managed successfully.

1) Urinary extravasation	4 patients.
2) Urinoma requiring drainage	2 patient
3) Perinephric abscess	1 patient
4) Wound infection (surgical)	2 patients
5) Secondary hamorrhage	2 patients
6) Hypertension	4 patients

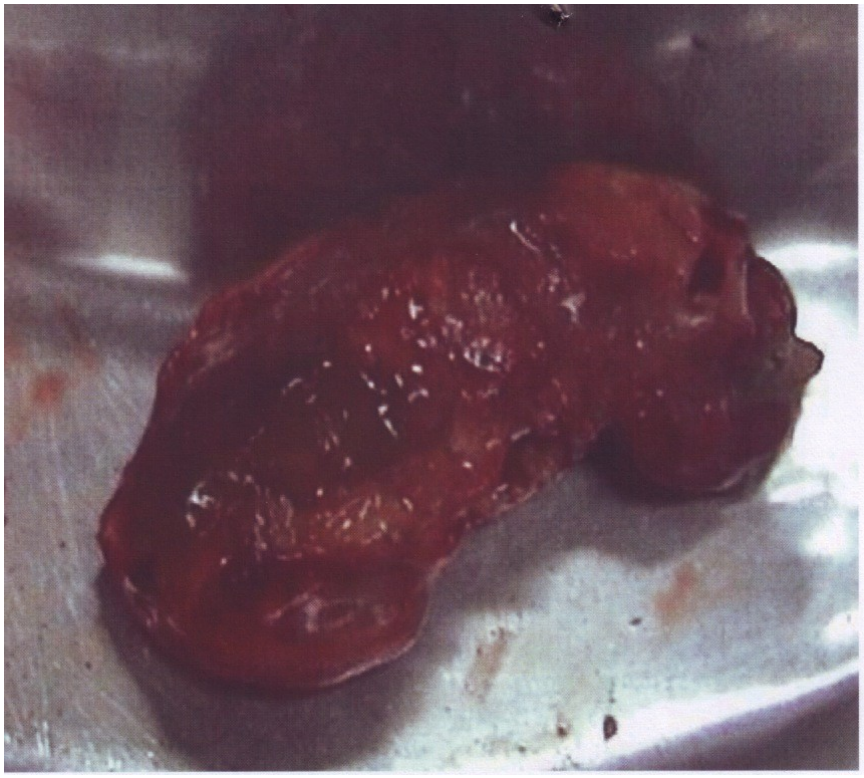
Both the patients who presented with secondary heamorrhage had to undergo emergency nephrectomy because of hemodynamic instability. One patient who developed perinephric abscess required an open drainage.

Mortality Data:-

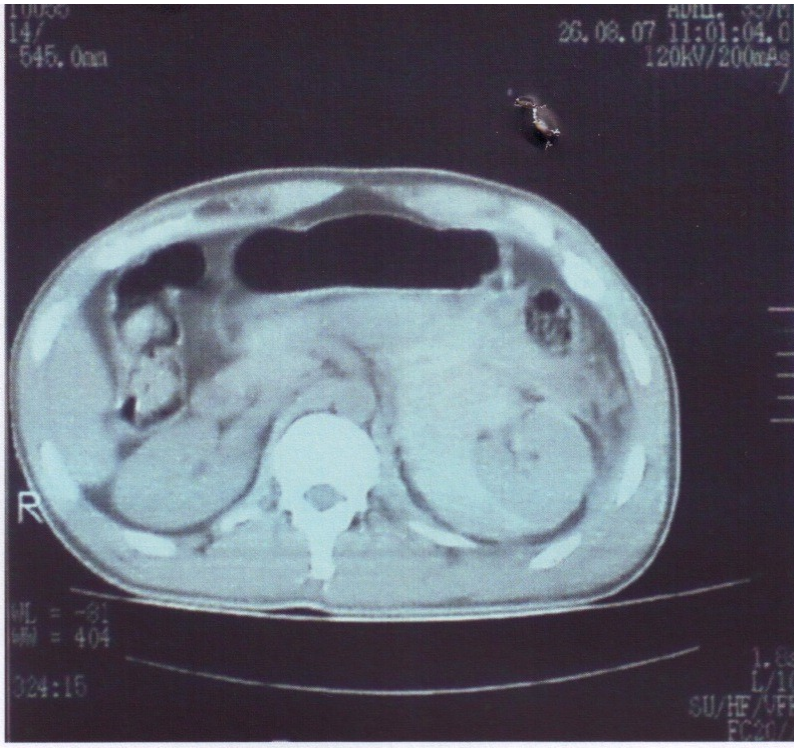
Of the total of 38 patients who sustained renal injuries, 2 patients expired. One of these patients, had associated duodenal injury and the patient's death was attributed to the complications of the bowel injury. Other patient who expired in the series had concomitant major vessel injury involving inferior vena cava, which was the likely cause of his death. Hence no death can be directly attributed to the renal trauma alone, irrespective of the grade of the injury.



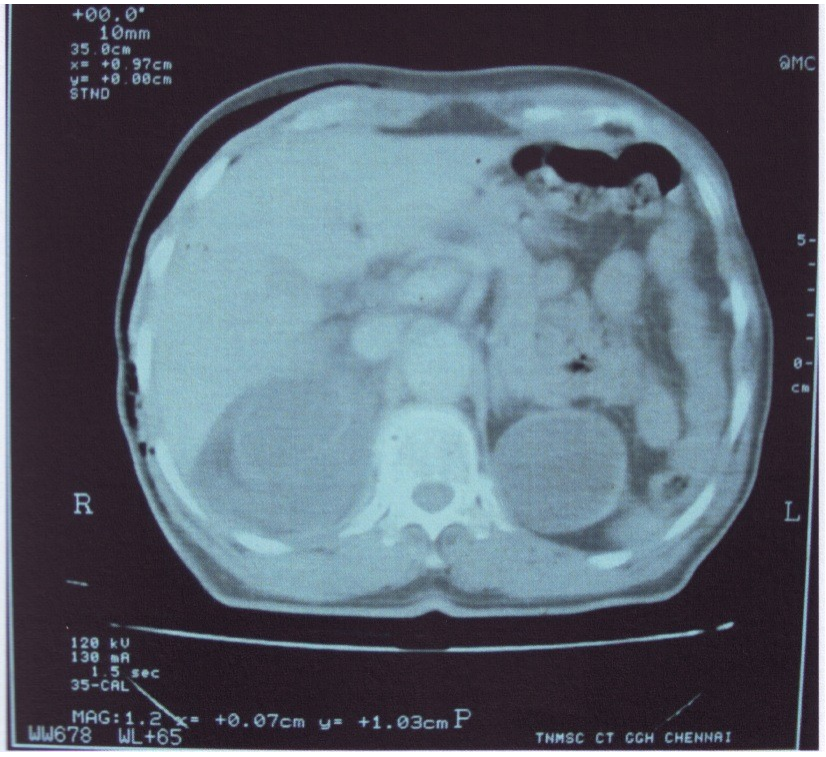
Grade 5 right renal injury; showing lack of contrast enhancement of right kidney, surrounding free air is also seen. The patient had an associated retroperitoneal duodenal injury



Grade 5 renal injury – Infarcted right kidney; nephrectomy specimen



Perirenal Haematoma left kidney



Grade 2 right renal injury

DISCUSSION

Epidemiological pattern of genitourinary trauma.

Bariol et al, recently reported results from the Scottish Trauma Audit Group, where they examined data on patients with severe trauma presenting to all major Scottish hospital. They assessed the data from 24,666 trauma admissions from 1999 to 2002; 362 patients had urological injuries, comprising 1.5% of the trauma population, but only 54% of these traumas were as a result of traffic accident.

The following is a comparative data analysis of various parameters of genitor urinary trauma of our study with a similar series from Scotland and Africa.

COMPARISON WITH LITERATURE

Parameters	Our Study	Olayiuala et al*	S.V. Bariol et al**
Incidence of urological injuries in abdominal trauma	19%	18%	22%
Percentage of renal injuries	38%	56%	67%
Associated Organ Injuries	46%	NA	59%
Mortality in isolated urological injuries	Nil	Nil	Nil
Renal Exploration	23%	29%	10%

* African Journal of Trauma : 2004

** An analysis of urinary tract trauma in Scotland. Impact on management and resource needs; February 2005.

The incidence of urological injuries in trauma had been fairly constant among various authors across different countries, albeit a subtle difference in the predominant genitor-urinary organ injured. Also, the mode of injury seems to vary among different countries.

AGE AND SEX INCIDENCE:-

There was a male predominance in patients with renal injuries in the study. 84% of renal injuries were seen in male patients.

This observation parallels the seen incidence pattern of motor vehicle accident. Motor vehicle accidents are now the most common cause of blunt abdominal trauma and as expected, males were more commonly involved.

Most of the patients involved in the motor vehicle accident and resultant renal injuries were young adults. Majority belonged to the age group of 16 to 30 years. Children and older people are rarely involved in motor vehicle accident. Another significant mode of renal injuries in the study was fall from height. This mechanism seems to involve all people, irrespective of age. The reason for high incidence of renal injuries due to fall from height in this study could be because of insecure working conditions of certain workgroups like construction workers.

CLINICAL PRESENTATION:-

The cardinal signs of urological injuries are hematuria and localized abdominal guarding. Hematuria is important as it may represent a significant urologic injury. In most cases, a low correlation exists between the severity of renal injury and degree of hamaturia. Additionally, hypotension is important as it may signify significant hemorrhage from the renal parenchyma or renal pedicle.

In the present study only 76% of patients with renal injuries had evidence of either microscopic or gross hematuria. In the two patients who sustained renal pedicle injuries, one did not have even microscopic hematuria.

Sensitivity of hematuria for renal injury	:	76%
Sensitivity of hamaturia in renal pedicle injury	:	50%

Shock defined by a systolic blood pressure of less than 90 mm Hg at the time of admission was present in 8 out of 38 patients (21%). Most of these patients had grade 4 and 5 renal injuries which required renal exploration, because of poor response to resuscitative measures and presence of concomitant life threatening other visceral injuries.

ROLE OF IMAGING MODALITIES IN RENAL INJURIES

At our institution, all the patients admitted with abdominal trauma undergo focused abdominal sonography for trauma (FAST), if they are unstable or a complete ultrasonography abdomen and pelvis if they are stable.

The criteria for radiological imaging include

1) All penetrating trauma victims with a likelihood to renal injury who are hemodynmically stable.

2) All blunt trauma victims with significant mechanism of injury specifically rapid deceleration, as would occur in a motor vehicle accident or a fall from height.

3) All blunt trauma patient with gross hematuria

4) All blunt trauma patients with shock

5) All paediatric patients with either gross or microscopic hematuria

The use of abdominal ultrasound in trauma patients continues to be controversial. USG is able to detect free fluid in the abdomen, but it cannot distinguish between extravasated urine, blood and other types of fluid. US is less sensitive at depicting solid organ injury,

especially of the kidney, depicting as few as 22% of renal injuries. In the present study, ultrasonography was able to identify 26 out of 38 renal injuries showing a sensitivity of 68%. However the exact characterization and grading or renal injuries was not possible with this modality.

CT with intravenous contract is the most comprehensive diagnostic tool available for the evaluation of the victim of blunt abdominal trauma. The trend toward greater non – operative management of traumatic abdominal injuries can be attributed in large part to successful staging of injuries by CT. In the present series, contrast enhanced CT scan was 100% sensitive in identifying renal injuries and no significant injury was missed. Also exact grading of the injuries was possible in all 38 patients.

Types of Renal Injuries

Most of the renal injuries in the study were minor ones. Grade I injury was found in 10 patients and grade 2 injuries were found in another 10 patients. Only 28% of the injuries belonged to grade 4 to 5. The higher grade injuries were more commonly associated will

other intra abdominal organ injuries, contributing to significant morbidity and mortality

Associated organ injury	No. of cases
Spleen	06
Liver	05
Duodenum	01
Vascular	02

Most patients with low grade injuries did not have any associated soft tissue injuries. Hence conservative line of management was highly successful in these patients.

Non Operative management

The general approach to patients with blunt renal trauma is non surgical because upto 90% have minor injuries. Conservative management consisted of regular monitoring of vital signs, abdominal symptoms and signs, hemoglobin and hamatocrit. Strict bed rest was maintained until clinical signs had been stable for a few

days and macroscopic hematuria had cleared. Patients were advised to avoid strenuous physical exertion for atleast 6 weeks.

Although renal lacerations caused by blunt trauma is an uncontaminated injury, antibiotics were given in the presence of urinary extravasation and extensive tissue devitalisation to avoid infections.

In the series, 28 our of 38 patients were managed successfully with non operative management.

SURGICAL INTERVENTIONS :

10 out of 38 patients (26%) needed surgical intervention in the form of renorrhaphy, percutaneous drainage, DJ stent insertion or nephrectomy. The need for surgical internvention escalates with higher grades of renal injury.

Grade of injury	No. of interventions
I	0 / 10
II	0 / 9
III	0 / 7
IV	4 / 06
V	6 / 06

The intervention rates in the higher grade (Grade 4 and 5) renal injures was more than 90%. The reasons were two fold.

1) Most of these higher grade injuries were associated with other life threatening visceral injuries, which required exploration.

2) Most of these patients were hemodynamically unstable and hence when the patients is explored for other organ injuries, simultaneous renal exploration resulted in nephrectomies very often, because time consuming renal repairs would otherwise prove detrimental in these patients.

CONCLUSIONS

From the retrospective analysis of this short renal injuries series, though major generalization is not possible ,some valuable facts transpire.

1. Urological injuries are present in upto 20% of patients admitted with abdomainl trauma, hence urologist has a key role in the management of trauma victims.

2. Contrary to the findings of most other studies, posterior uretheral disruption injuries seem to predominate among genitourinary trauma in our study.

3. Young adults in the age group of 16 to 30 years are the most vulnerable to sustain renal injuries. This is due to increasing number of this productive age group’s preference for driving two wheelers.

4. CT scan is the most comprehensive imaging tool to identify and characterize the renal injuries.

5. Non operative management has proven to be successful in majority of the patients sustaining renal trauma

6. The need for surgical intervention seems to increase with increasing grade of renal injuries

7. Even penetrating renal trauma, when properly staged can be managed successfully with conservative approach. In this series 2 out of 3 patients with penetrating renal trauma were managed non operatively

8. The nephrecotmy rate are high when a patient with poly trauma is explored for other concomittant organ injuries.

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MASTER CHART

S.No.	Name	Age / Sex	Mode	Type of Renal Injury	Ass. Organ Injury	Treatment
1	Adhi	33 / M	RTA	Gr.1 (L)	Splenic laceration	Nephrectomy
2	Sengalwarayan	70/M	RTA	Gr.3 (L)	Rib Fracture	Conservative
3	Rajasekar	25 / M	RTA	Gr.4 (R)		Renorrhaphy
4	Venkatesan	35/M	RTA	Gr.2 (R)		Conservative
5	Jeeva	60 / M	RTA	Gr.1 (R)		Conservative
6	Manimegalai	30 / F	RTA	Gr.1 (R)		Conservative
7	Murugan	50 / M	RTA	Gr.3 (R)		Conservative
8.	Sethumeena	16/F	RTA	Gr.3 (R)		Conservative
9.	Narasimalu	45/M	RTA	Gr.5 (L)	Rib #, Splenic Injury	Nephrectomy
10.	Murugasen	40/M	RTA	Gr.1 (L)		Conservative
11.	Buvaneswari	18/F	RTA	Gr.2 (R)		Conservative
12.	Santharam	33/M	RTA	Gr.3 (L)		Conservative
13.	Arokidoss	28/M	Fall from Ht	Gr.3 (L)		Conservative
14.	Vaidiyanathan	39/M	TTA	Gr.1 (R)		Conservative
15.	Saravanan	20/M	Fall	Gr.1 (L)		Conservative
16.	Mohan	35/M	RTA	Gr.2 (R)		Conservative
17.	Muniammal	38/F	RTA	Gr.1 (L)		Conservative
18.	Rajasekar	25/M	Fall	Gr.5 (R)	Duodenum	Nephrectomy
19.	Kuppuswamy	40/M	RTA	Gr.1 (L)		Conservative
20.	Sankaran	29/M	RTA	Gr.2 (R)	-	Conservative
21	Johnson	16 / M	Fall	Gr.1 (R)	Rib fracture	Conservative
22.	Ismail	49/M	Fall	Gr.1 (L)		Conservative

23.	Ramajayam	25/M	Stab Injury	Gr.5 (R)	Major Vascular	Nephrectomy
24.	Nanda	20/M	Fall	Gr.4 (R)		Nephrectomy
25.	Murthy	30/M	Stab injury	Gr.3 (R)		Conservative
26.	Sanjeevah	18/M	Fall	B/L Gr.4		Late repair
27.	Muniandi	13/M	RTA	Gr.2 (L)		Conservative
28.	Sumathy	14/F	RTA	Gr.2 (R)		Conservative
29.	Manivannan	13/M	Fall	Gr.2 (R)		Conservative
30.	Jayachander	44/M	RTA	(L) Gr.4	Shattered Spleen	Renal Repair
31.	Gajendran	40/M	RTA	(L) Gr.5	Shattered Spleen	Nephrectomy
32.	Karthick	18/M	RTA	(L) Gr.4	-	Conservative
33.	Tejwani Kumar	13/M	Fall	(R) Gr.4		Conservative
34.	Jegan	29/F	RTA	(R) Gr.5		Nephrectomy
35.	Lakshmi	32/F	RTA	(R) Gr.3		Conservative
36.	Manangatti	25/M	Bull gore	(L) Gr.2		Conservative
37.	Mahesh	20/M	Assault	(L) Gr.2		Conservative
38.	Ramesh	58/M	RTA	(R) Gr.1		Conservative