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Long-Term Follow-up after Kidney Trauma at Prof. Dr. R. D. Kandou General Hospital Manado

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Abstract: Renal trauma, caused by blunt or penetrating injuries, is associated with severe complications such as hypertension, chronic kidney disease (CKD), and pyelonephritis, especially in high-grade renal trauma. The study aimed to evaluate the complications and management of renal trauma patients at Prof. Dr. R. D. Kandou Hospital Manado from January 2022 to October 2024. This was an observational study with a cross-sectional design involving 17 patients that met the inclusion criteria. Data included types of trauma, severity level, management approaches, and post-trauma complications. Trauma severity was classified using the American Association for Surgery of Trauma (AAST) grading system. The results showed that 58.8% of patients had penetrating trauma, while 41.2% experienced blunt trauma. The highest percentages were found in grade II severity (29.4%). Operative management was the most common approach (58.8%). Post-trauma complications included CKD (70.5%), hypertension (29.4%), and pyelonephritis (29.4%). In conclusion, renal trauma, whether blunt or penetrating, often leads to significant complications such as CKD and hypertension. Proper long-term management and monitoring of kidney function and blood pressure are crucial to minimize the complications. This study highlights the need for early and effective intervention in high-grade renal trauma cases.
Keywords: renal trauma; hypertension; acute kidney injury (AKI); chronic kidney disease (CKD); post-trauma complications

INTRODUCTION

Renal trauma is an injury to the kidney caused by blunt force trauma or penetrating injuries such as stab or gunshot wounds.[1] Renal trauma can damage the renal parenchyma or vascularization, leading to bleeding or injury in the collecting system. Renal trauma accounts for 5% of all trauma cases, predominantly occurring in young males (72–93% of cases) with an average age of 31–38 years. The incidence is higher in penetrating trauma, with an average age of 27–28 years. Renal trauma can occur in isolation, but 80–95% of cases are accompanied by other injuries.[2]

Early complications of renal trauma include bleeding, infection, perinephric abscess, sepsis, urinary fistula, hypertension, urine extravasation, urinoma, and rhabdomyolysis, whereas delayed complications include stone formation, chronic pyelonephritis, hypertension, arteriovenous fistula, pseudoaneurysm, and hypertension. Common complications in non-operative management of high-grade renal trauma include hematuria, Acute Kidney Injury (AKI), and urinoma. In contrast, complications in operative management include wound infection, perinephric abscess, and urinary tract infections.[3]

Rhabdomyolysis, which is the breakdown and rupture of muscle fibers, results in the release of muscle cell contents, including the protein myoglobin, into the bloodstream. This condition, caused by ischemia associated with vascular injury or systemic hypoperfusion, increases the risk of AKI.[4] The incidence of post-trauma AKI ranges from 0.1% to 8.4% in various studies, with a mortality rate of 7–83%. Patients are at higher risk of developing chronic kidney disease (CKD) later. Impaired kidney function post-trauma indicates vascular damage, demonstrated by decreased renal function. Impaired renal function, duration, and severity of post-trauma AKI contribute to maladaptive repair, characterized by permanent kidney dysfunction accompanied by significant structural changes. Close follow-up of injured patients and use of imaging, including computed tomography scan, arteriogram, or retro-grade pyelogram when appropriate, increase detection rates and establish the diagnosis in most patients. Treatment varies by etiology and may range from watchful waiting to percutaneous drainage, and in rare cases, nephrectomy.[5]

The aim of this study is to evaluate the complications that occur in patients with renal trauma at RSUP Prof. Dr. R. D. Kandou Manado, as well as the management approaches employed in their treatment, covering the period from January 2022 to October 2024. This research seeks to provide a comprehensive understanding of the types of complications commonly encountered in patients with kidney injuries, as well as the diagnostic and therapeutic methods applied at the hospital. This research aims to assist healthcare professionals in developing more effective management strategies to reduce the risk of complications and enhance patient outcomes in cases of renal trauma.

METHODS

This was an observational cross-sectional study to evaluate blood pressure and serum urea-creatinine level in renal trauma cases at Prof. Dr. R. D. Kandou Hospital. The study analyzed medical records of renal trauma patients from January 2022 to October 2024. Renal trauma patients admitted to the Emergency Surgical Unit (IRDB) at Prof. Dr. R. D. Kandou Hospital were included based on the following criteria: renal trauma without other injuries, aged over 18 years, and inpatient treatment at Prof. Dr. R. D. Kandou Hospital. Exclusion criteria included patients with other trauma, a history of hypertension, pre-existing impaired kidney function, critical illnesses, or missing urea-creatinine data.

Data were obtained from medical records of serum urea and creatinine levels and blood pressure measurements upon the first assessment of post-renal trauma. Renal trauma was classified using the American Association for Surgery of Trauma (AAST) injury scale, divided into grade I-V.[1] Blood pressure was measured using a mercury sphygmomanometer at least twice in a supine position and once in an upright position. Glomerular filtration rate (GFR) was estimated using the Modification of Diet in Renal Disease (MDRD) formula: $GFR = 175 \times (\text{Serum Creatinine}) - 1.154$

× (Age) − 0.203 × (0.742 if female) × (1.212 if African American).[6] Acute kidney injury (AKI) is defined according to the Clinical Practice Guidelines of The Kidney Disease: Improving Global Outcomes (KDIGO) as one of the following: an increase in serum creatinine by ≥0.3 mg/dL within 48 hours; or an increase in serum creatinine to ≥1.5 times the baseline, known or presumed to have occurred within the previous seven days; or urine output <0.5 mL/kg/hour for 6 hours.[7]

RESULTS

Table 1 showed that a total of 17 patients were included in this study. The proportion of male patients was higher, with 13 individuals (76.5%), while female patients accounted for four individuals (23.5%). The most common age range was 18-30 years (70.5%), followed by 31-50 years (23.5%), and >50 years (6%). Types of injury were penetrating trauma (58.80%) and blunt trauma (41.20%). According to the AAST classification of severity,[1] the most common grade was grade II (29.40%), followed by grade III (23.50%), grade I and grade V (each of 17.65%), and grade IV (11.80%). Operative management (58.82%) was more common than conservative management (41.18%). The most frequent post-trauma renal complications were CKD (70.5%), followed by hypertension (29.41%) and pyelonephritis (29.4%).

Table 1. Type of trauma and severity

Category	Patients	Percentage (%)
Type of Injury		
Penetrating trauma	10	58,80%
Blunt trauma	7	41,20%
Severity level		
Grade I	3	17,65%
Grade II	5	29,40%
Grade III	4	23,50%
Grade IV	2	11,80%
Grade V	3	17,65%
Management		
Conservative	7	41, 18 %
Operative	10	58, 82 %
Post-trauma complication		
Hypertension	5	29,41%
Chronic kidney disease (CKD)	9	70,5%
Pyelonephritis	3	29,4%

Table 2 showed that among renal trauma patients with conservative management, seven patients were identified with delayed complications. One patient developed hypertension accompanied by CKD, with a blood pressure of 160/90 mmHg detected in the 5th month post-renal trauma, and a GFR of 39.4 mL/min/1.73m². Another patient developed CKD with a GFR of 78.5 mL/min/1.73m², which was detected in the 17th month post-renal trauma.

Table 3 showed that in patients with renal trauma managed operatively at Prof Dr. R. D. Kandou Hospital from January 2022 to October 2024, 10 patients were identified with delayed complications. Four patients developed hypertension accompanied by CKD, the first patient had a blood pressure of 170/100 mmHg detected in the 10th month post-renal trauma, with a GFR of 29.9 mL/min/1.73m². The second patient had a blood pressure of 160/90 mmHg detected in the 7th month post-renal trauma, with a GFR of 34.2 mL/min/1.73m². The third patient had a blood pressure of 170/90 mmHg detected in the 12th month post-renal trauma, with a GFR of 41.6

mL/min/1.73m². The fourth patient had a blood pressure of 150/80 mmHg detected in the 19th month post-renal trauma, with a GFR of 41.2 mL/min/1.73m². Additionally, one patient developed CKD with a GFR of 58.5 mL/min/1.73m², detected in the 19th month post-renal trauma.

Table 2. Clinical parameters of conservative patients

Patients	Age	Post-trauma renal interval-follow- up (Months)	SBP/DBP (mmHg)		GFR (mL/min)
			Supine	Upright	
1	17	11	130/80	130/80	93.1
2	17	12	110/70	120/80	103.4
3	17	12	130/80	130/80	92.1
4	18	13	110/70	110/80	99.3
5	19	3	120/80	130/90	96.3
6	47	5	150/70	160/90	39.4
7	70	17	130/70	110/80	78.5

Table 3. Clinical parameters of operative patients

Patients	Age	Post-trauma renal interval-follow- up (Months)	SBP/DBP (mmHg)		GFR (mL/min)
			Supine	Upright	
1	24	10	120/80	130/90	43,85
2	28	8	110/70	120/80	106
3	33	10	160/80	170/100	29.9
4	24	11	130/70	130/90	59,8
5	13	16	110/70	120/80	99.3
6	46	7	160/80	160/90	34.2
7	23	12	160/70	170/90	41.6
8	28	21	120/80	130/90	106.8
9	19	19	150/80	150/80	41,2
10	44	19	120/80	130/90	58.5

DISCUSSION

The complications of renal trauma in this study included hypertension (29.41%), CKD (70.5%), and pyelonephritis (29.4%). Additionally, some patients had both CKD and hypertension as complications.

Acute kidney injury (AKI) is defined as a sudden decline in kidney function. This condition is an independent risk factor that increases mortality in patients with severe trauma. In trauma patients, the incidence of AKI is around 5% of all trauma cases.[7] Creatinine estimation is the most relevant parameter for incidence, prognosis, and improvement, and is the most accurate for diagnosing AKI. In renal trauma patients, AKI is a common complication with a relatively high mortality rate. Furthermore, severe injury is a strong risk factor for AKI. Severe trauma, hypovolemic shock, and rhabdomyolysis are all risk factors for AKI.[8]

Studies have shown that patients with severe renal trauma who develop AKI are at a higher risk of developing CKD compared to those who do not experience AKI. This is related to the inflammatory response and renal fibrosis that occurs after acute injury, which can lead to kidney scarring and compensatory hypertrophy in the remaining nephrons,[9] Additionally, the presence of

perinephric hematoma or chronic scarring can disrupt kidney blood flow and activate the renin-angiotensin-aldosterone system (RAAS), leading to hypertension and progressive kidney damage.[10]

While renal trauma is an acute event, if severe or untreated, it can lead to complications that increase the risk of CKD. The trauma can cause scarring (fibrosis) in the kidney tissue and impaired kidney function over time. This is particularly concerning in individuals with pre-existing conditions like hypertension or diabetes, which already strain kidney function. Severe renal injuries can also lead to long-term kidney damage, potentially resulting in CKD. Early detection, monitoring, and appropriate management are crucial to reduce the risk of CKD, as well as to address any immediate issues that could exacerbate long-term renal health problems.[10]

Other risk factors that contribute to the development of CKD in renal trauma patients include the duration of AKI, the severity of the trauma, the presence of hypertension, and the treatment received during the care period, such as frequent blood transfusions or surgical interventions, A recurrent increase in serum creatinine levels in post-trauma renal patients is also an indicator of CKD risk, as a prolonged decline in glomerular filtration rate (GFR) may indicate long-term kidney damage.[11]

Acute kidney injury (AKI) in renal trauma patients often carries a risk of progressing to CKD over time. In this study, CKD occurred in nine patients (70.5%). Severe renal trauma, whether due to blunt or penetrating injury, can cause significant kidney function decline due to damage to kidney tissue and vasculature, which in turn affects kidney perfusion and filtration function. This risk is particularly high in patients who experience AKI following renal trauma, where acute kidney damage does not fully recover, and structural and functional changes occur that can contribute to the development of CKD .[12]

In this study five patients (29.41%) experiencing hypertension. Hypertension is a rare complication in renal trauma patients and is closely related to long-term kidney function decline. Renal trauma, especially if associated with perinephric hematoma or chronic scarring around the kidney, can cause kidney compression, which activates the renin-angiotensin-aldosterone system (RAAS). The RAAS activation increases renin secretion, ultimately leading to hypertension. If not properly managed, this hypertension can worsen kidney damage and accelerate the decline of kidney function in post-trauma patients.[13]

In renal trauma, especially involving vascular injury, impaired kidney blood flow leads to ischemia, which stimulates further renin production and exacerbating hypertension. Hypertension resulting from kidney injury can be persistent, and in some patients, it can progress to malignant hypertension, increasing the risk of further kidney function decline. Additionally, the scarring or fibrosis that occurs as the body responds to kidney injury can also worsen hypertension by affecting the intrarenal arteries and causing stenosis, thereby decreasing kidney perfusion.[14]

Long-term studies show that renal trauma patients with hypertension have a higher risk of experiencing a decline in glomerular filtration rate (GFR), potentially leading to chronic kidney disease (CKD). Therefore, it is crucial to closely monitor blood pressure in post-trauma renal patients and provide appropriate interventions to prevent the progression of kidney disease.[15]

CONCLUSION

Renal trauma, whether caused by blunt or penetrating injury, can lead to serious complications in the kidneys, such as hydronephrosis, CKD, hypertension, and pyelonephritis, particularly in high-grade kidney injuries. This study showed that blunt trauma was the most common, with many patients requiring operative management. Monitoring blood pressure and providing appropriate treatment are necessary to prevent the development of CKD and long-term hypertension. Vascular injury and post-trauma fibrosis increase the risk of further complications, making long-term monitoring and management crucial for renal trauma patients.

Conflict of Interest

The authors affirm no conflict of interest in this study.

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