Acute kidney injury in kidney rupture and urinary tract infection in a 6-year-old-boy

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ABSTRACT

Acute kidney injury (AKI) is characterized by multiple abnormalities, including increase in serum creatinin and blood nitrogen urea, electrolyte abnormalities, acidosis, and difficulties in fluid management. The diagnostic of AKI based on pediatric-modified RIFLE (pRIFLE) criteria. We reported a case of 6-year-old-boy with right side abdominal pain since 15 days before admission after fell from the stairs of 2.5 meters height. Physical examination showed distended abdomen on inspection, tenderness on right side of abdominal on palpation, sign of ascites and severe pain. Glomerular filtration rate (GFR) patient was decreased up to 75% and urine culture with sample mid stream obtained with E. coli CFU >10⁵, ESBL isolated. Computed tomography scan without contrast revealed suspicious of grade IV kidney rupture with retroperitoneal hematoma in the pelvis cavity, right renal hypoplasia, and mild left hydronephrosis. Patient had partial nefrectomy with pelvic calic repair, DJ stent was installed at right kidney and received antibiotic. Follow-up on 2 days post surgery revealed normal laboratory values on urinalysis and serum creatinin. Patient was stable in vital signs and hemodinamic with good prognosis.

Keywords: acute kidney injury, kidney rupture, children.

INTRODUCTION

Acute kidney injury (AKI) is characterized by multiple abnormalities, including increase in serum creatinin and blood nitrogen urea, electrolyte abnormalities, acidosis, and difficulties in fluid management.1 Despite this shift in epidemiology, and ordered approach to diagnose AKI divides the potential origins into prerenal, intrinsic and postrenal causes. Post-renal AKI results from obstructive processes, acquired causes of urinary tract obstruction include those that result from local mass effect (unilateral or bilateral obstruction by a tumor, renal trauma), renal calculi, or clots within the bladder.1 Renal injury occurs in approximately 1 to 5% of all traumas and can be classified as blunt or penetrating according to the mechanism. Blunt trauma is responsible for 90% of the genitourinary injuries in childhood, with approximately 90% having coexisting injuries to the thorax, spine, pelvis, femur or intra abdominal organs.2 Traumatic injury to the kidney accounts for greater than 60% of the pediatric genitourinary injuries.2 Acute kidney injury (AKI) is an uncommon but serious complication after trauma. In large trauma populations, the incidence of post-traumatic AKI varies from 0.098
to 8.4% in published series with mortality ranging from 7-83%. We report this case because acute kidney injury in kidney rupture in children is rare case and prognosis is good after partial nephrectomy.

**Case Illustration**
A case of 6-year-old boy was referred to Sanglah Hospital from NTB Hospital in March 2014, with diagnose of right single kidney functional, grade IV right kidney rupture, left kidney hypoplasia, and chronic kidney disease (CKD). The chief complaint was right side abdominal pain since 15 days before admission. He was reported fall from the stairs with 2.5 meters height. His right upper back hit the floor with hematoma, no open wound was found. He experienced vomiting, 3 to 4 times per day, volume ±50 ml pertimes, reddish discoloration upon urination since the incident. He was anemic and history of loss of consciousness was denied.

The patient had been admitted for seven days at Mataram Hospital with chief complaint was hematuria and fever. Laboratory results from complete blood count showed leukocytosis and severe anemia with hemoglobin level 4 g/dL and impairment of kidney function. Abdominal ultrasound showed right kidney rupture. At that time patient was given blood transfusion, analgesic and bedrest. After blood transfusion, hemoglobin increased to 11.9 g/dL, after one week been hospitalized at Mataram Hospital, the patient then referred to NTB Hospital for abdominal CT scan which also showed right kidney rupture. At that time the patient was given antibiotic, analgesic, and bedrest. At the same time the patient was referred to Sanglah hospital for hemodialysis and surgery procedure.

The patient was born full term, spontaneously, and assisted by midwife. His birth weight was 3500 grams and body length 50 centimeters. No visible abnormalities were found. Patient did not complain of urination abnormality. He did not have any prior medications for specific diseases. The immunization history was complete according to the recommended immunization schedule by government. Currently he is at second year of kindergarten. Daily activities prior to illness were normal, in which he participated well in school and in peer activities after school time. There was no family history with similar complaint.

On physical examination the patient looked weak. Blood pressure was 120/75 mmHg (99th percentile). Hypertension was noted upon admission, which might be secondary to pain. The pulse was 108 beats per minute, regular, respiratory rate was 22 cycles per minute, axillary temperature was 36.8°C. His body weight was 16 kg, body height 115 centimeters. His ideal weight was 20.4 kg. Thus, based on Waterlow criteria, his nutritional status was 78.43% (mild malnourished).

The hair was fine and black. The conjunctiva was not anemic, anicteric sclerae, and normal papillary reflexes. The ear, nose and throat were within normal range. There was no palpable lymph nodes nor nuchal rigidity. Chest examination was normal. Abdominal examination revealed distended on inspection, tenderness on right side of abdomen on palpation, sign of ascites, mass or organomegaly cannot be assessed since patient in severe pain. On the lower back, there was haematoma and tenderness, no muscular defense nor bulging, flank dextra sign was positive, bowel sound was normal. The examination of upper and lower extremities showed no deformities. Neurological examination was normal. There was no edema, no cyanosis. Based on anamnesis and physical examination, we diagnosed the patient with right kidney injury.

Laboratory findings showed no anemia after transfusion at Mataram Hospital. Other laboratory test (prothrombin time, partial thromboplastin time, liver function, pancreatic enzymes) were normal. Electrolytes were normal limit. Creatinin serum was 8.8 mg/dL and blood urea nitrogen was 102 mg/dL. GFR decrease 75% (GFR was 7.18). The urinalysis showed leukocytosis (500/3+/mcL, eritrocyte was 250/4+/mcL. Urine culture with mid stream sample obtained E. coli CFU >10^5, with ESBL isolated. Abdominal ultrasonography revealed rupture at the bottom of the pole to the right renal pelvis with free fluid in the pelvic cavity to the right retroperitoneal space, ren hypoplasia, and mild left hydronephrosis, suspicious of bladder rupture, compaction in the right periumbilical, and suspicious of peritoneal hematoma.

Computed tomography scan of the abdomen without contrast revealed suspicious of grade IV kidney rupture with retroperitoneal haematoma in the pelvic cavity, right renal hypoplasia, and mild left hydronephrosis (Figure 1 and 2).
Based on the physical examination, imaging findings, and laboratory results, we diagnosed the patient with acute kidney injury (failure stage) suspicious of grade IV right kidney rupture and left kidney hypoplasia and complex urinary tract infection and mild malnourished state. Patient was planned conservative treatment, with antibiotic, analgesic and bedrest and monitoring kidney function every 3 days. After one week of conservative treatment, the patient had vomiting, fever, worsening abdominal distention, and severe pain (pain score 8). CT scan evaluation showed persistent urinoma expanding to the peritoneum, pararenal abscess, and severe haematoma until pelvic cavum. The patient was hydrated with ringer lactat solution, and given meropenem with adjusted dose every 12 hours, fentanyl 100 mcq for 24 hours continuously dripped. Nutritional management including calorie requirement according to resting energy expenditure (REE) with stress factor via intravena and the patient was planned for surgery to repair right kidney, right nephrectomy (if necessary) with surgical vascular repair back up, and pre surgical hemodialysis. While preparing for hemodialysis, the patient got worse with severe abdominal pain, profuse vomiting, and fever. Physical examination revealed worsening abdominal distention and right abdominal tenderness. Therefore, surgery was done without hemodialysis. Thus, the surgery was planned and done for this patient which revealed shattered right kidney, lower pool kidney devascularisation with unviable tissue (grade 5 kidney rupture, as can be seen on Figure 3), with retroperitoneal abscess around perirenal and pararenal until the pelvic cavity. We performed hematoma drainage, lower full resection, partial nephrectomy with pelvic calic repair and DJ stent was installed at right kidney.

The post-operative course was satisfying without haematuria, creatinin serum was 0.58 mg/dL, and blood urea nitrogen was 12 mg/dL was normal in 2 days post surgery, there was an increasing in GFR toward normal results (GFR 121.6). All the time, patient was hemodynamically stable and serial urinalysis were normal. The patient was discharged from pediatric intensive care unit on the fifth day.

### Table 1  Pediatric-modified RIFLE (pRIFLE) criteria

<table>
<thead>
<tr>
<th></th>
<th>GFR</th>
<th>Urine output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk</td>
<td>Decrease GFR 25%</td>
<td>&lt;0.5 ml/kg/hour for 8 hours</td>
</tr>
<tr>
<td>Injury</td>
<td>Decrease GFR 50%</td>
<td>&lt;0.5 ml/kg/hour for 16 hours</td>
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<tr>
<td>Failure</td>
<td>Decrease GFR 75% or</td>
<td>&lt;0.3 ml/kg/hour for 24 hours or</td>
</tr>
<tr>
<td></td>
<td>GFR &lt;35 ml/min/1.73 m²</td>
<td>anuria for 12 hours</td>
</tr>
<tr>
<td>Loss</td>
<td>Persistent failure</td>
<td>&gt;4 weeks</td>
</tr>
<tr>
<td>End stage</td>
<td>Persistent failure</td>
<td>&gt;3 months</td>
</tr>
</tbody>
</table>

**Figure 2** Abdominal computed tomography scan (without contrast) showed kidney rupture

**Figure 3** Upper and lower pole of kidney

**Figure 4** DJ stent was installed in segmented into two parts, right kidney
After surgery. Condition after discharge from the hospital was still treated with oral fosfomycin for his urinary tract infection. And patient still control to the Mataram hospital, and serial urinalysis were normal, urine culture was no E. coli isolated and the result of CT scan evaluation with contrast 3 months post surgery showed right kidney was good (Figure 5).

DISCUSSION

Acute kidney injury is defined by an abrupt decrease in kidney function that includes, but not limited to, acute kidney failure. Acute kidney injury is a broad clinical syndrome encompassing various etiologies, including pre-renal azotemia, acute tubular necrosis, acute interstitial nephritis, acute glomerular and vasculitic renal diseases, and acute post renal obstructive nephropathy. The Acute Dialysis Quality Initiative group developed the risk, injury, failure, loss and end-stage kidney disease (RIFLE) system for diagnosis and classification of a broad range of acute impairment of kidney function through a broad consensus of experts. RIFLE criteria defined by three degrees of severity, ie R (risk), the risk of renal dysfunction, I (injury), impaired renal function, and F (failure), renal failure, and two variable outputs are L (loss), loss of kidney function, and E (end-stage), terminal renal failure.

In our case, we found decreasing GFR 75% (GFR = 7.18) and urine output was 1.4 ml/kg/hour (for 15 hour). Based on Pediatric-modified RIFLE (pRIFLE) criteria, we diagnose the patient with acute kidney injury failure stage although urine output is normally. Complicated urinary tract infections (UTIs) occur in the setting of urinary tract that has metabolic, functional, or structural abnormalities. In our case, the urinalysis showed leukocytosis (500/3+)/mcL, eritrocyte was 250/4+/mcL. Urine culture obtained with E. coli, ESBL isolated. So, we diagnosed this patient with UTI.

Urinary tract infection was caused by obstruction due to kidney trauma, urine stasis and urinoma. There was early complication due to kidney trauma. Kidney trauma occurs in approximately 1-5% of all trauma cases. There is a 3:1 male to female ratio in kidney trauma patients. In our case, the patient was a 6-year-old-boy, diagnosed by kidney trauma after falls from the stairs approximately 2,5 meters with hematuria.

In order to determine the appropriate management for a kidney injury, the kidney injury first needs to be accurately staged. Classifying kidney injuries helps to standardise different groups of patients, select appropriate therapy, and predict results. The American Association for the Surgery of Trauma (AAST) has developed a kidney-injury scaling system that is now widely used. Abdominal CT scan or direct kidney exploration is used to classify injuries. Kidney injuries are classified was grade 1 to 5 (Table 2). In a retrospective review, the AAST scaling system was determined as the most important variable predicting the need for kidney repair or removal. It also predicts for morbidity after blunt or penetrating injury, and for mortality after blunt injury.
In our case, according to imaging findings, we assessed the patient with grade IV kidney injury. Nevertheless, the surgery exploration revealed grade V complete shattered right kidney and right kidney trauma. Early complications, those that occur within one month of injury are urinoma, delayed bleeding, urinary fistula, abscess, and hypertension.\(^8,9\) Urinomas occur in <1% of kidney trauma cases.\(^8,9\) Small, uninfected, and stable collections do not require intervention. In our case, early complication was urinoma, acute kidney injury failure stage, and complex urinary tract infection.

Management of high grade kidney injury in pediatric population is initial conservative therapy. Nephrectomy should be considered in irreparable grade 4 and 5 kidney injuries.\(^8\) Currently the guidelines for management of high grade pediatric kidney trauma are based on these limited data, and practice varies by practitioner and facility. Hemodynamically stable patient with grade I or II kidney Injury is an ideal candidate for non operative management. Patients with isolated grade III, IV and V kidney injuries are also candidates for non operative treatment. Absolute indications for kidney exploration after trauma include hemodynamic instability due to kidney bleeding, expanding or pulsatile retroperitoneal haematoma and inability to stop persistent or delayed hemorrhage via selective vascular embolization. Nephrectomy should be considered in irreparable grade IV and V kidney injuries.\(^11\)

In our case, the patient had hemodynamic instability and unrelenting gross haematuria, worsening distended abdominal and severe pain, and acute kidney injury (failure stage). The patient planned to late surgical exploration and nephrectomy and planned for pre surgical hemodialysis. While preparing for hemodialysis, the patient got worse with severe abdominal pain, profuse vomiting, and fever. Physical examination revealed worsening abdominal distention and right abdominal tenderness. Therefore, surgery was done without hemodialysis. The post operative course was satisfactorily with no present of haematuria, there was increasing in GFR toward normal result. All the time hemodynamically stable and serial urinalysis measurement was normally.

CONCLUSION
A case of 6-year-old-boy, was referred to Sanglah Hospital from NTB Hospital in March 2014. The chief complain was right side abdominal pain since 15 days before admission. He was reported fall from the stairs with 2.5 meters height. The physical examination the patient looked weak. Blood pressure was 120/75 mmHg (99th percentile). Abdominal examination revealed, distended on inspection, tenderness on right side of abdomen on palpation. On the lower back, there was haematoma and tenderness. Laboratory findings showed GFR decrease 75% (GFR was 7.18). The urinalysis and urine culture showed urinary tract infection and computed tomography scan of the abdomen without contrast revealed suspicious of grade IV kidney rupture with retroperitoneal haematoma in the pelvic cavity, right renal hypoplasia, and mild left hydronephrosis. We diagnosed the patient with AKI failure stage suspicious of grade IV right kidney rupture and left kidney hypoplasia and complex UTI and mild malnourished. Surgical exploration and nephrectomy procedure was succufully performed. CT Scan evaluation (with contrast) 3 months post surgery showed right kidney was good and hemodynamically stable, there was increasing in GFR toward normal result. Acute kidney injury in renal injury is early complication, needed surgical management if the conservative management is failure. Early surgical will give good prognosis patient with kidney rupture.

REFERENCES

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