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Case Report

Imaging modalities and management of pediatric high-grade renal trauma in an Indonesian tertiary hospital: a report of two cases and literature review ☆,☆☆

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ABSTRACT

As one of the most commonly injured organs in the genitourinary system during trauma, a thorough understanding of pediatric renal trauma's diagnosis and management is essential for physicians. The improvement of imaging modalities in recent years has shifted most treatments to a conservative approach. Non-operative management could reduce the risk of nephrectomy while increasing renal salvage rate. However, high-grade pediatric renal injury management remains controversial. We aimed to report two children with high-grade renal trauma, diagnosed using computed tomography and retrograde pyelography studies, undergoing different approaches. The first patient underwent a nephrectomy, whereas the second patient underwent non-operative management.

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Introduction

Genitourinary tract injuries are less common compared to other abdominal organ injuries, among which renal trauma makes up one to five percent of all cases worldwide [1]. The majority of cases occur due to blunt abdominal trauma during motor vehicle accidents, thus most injuries are concomi-

tant with other injuries, whereas isolated renal injuries are less common [2]. The case may be challenging for physicians in deciding the diagnostic modality and treatment of choice for each case [3]. Most published reports and studies mainly focus on adult renal trauma. Pediatric patients are not the miniaturized version of adult patients, thus they often require a different approach for trauma. Children are more prone to renal injuries due to higher mobility, less perirenal fat, and

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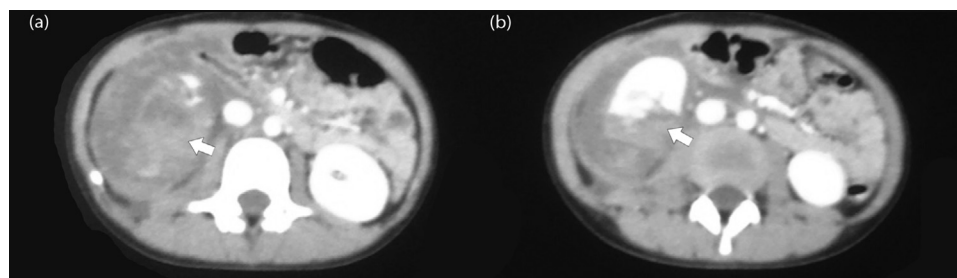


Fig. 1 – (A, B) Axial view of the contrast-enhanced abdominal CT indicating a grade 5 right renal trauma with active perirenal hemorrhage.

location of the kidney, which extends beyond the rib cage [4]. In the past, renal trauma is generally managed via nephrectomy, however, most patients are currently managed non-operatively due to the wider availability of computed tomography (CT) examinations in multiple centers and a better understanding of renal injury treatment [5]. In recent years, pediatric trauma management has also shifted to non-operative care due to improvements in strategies mirroring that of the adult population based on clinical, laboratory, and radiographic results, allowing for an accurate assessment [6]. Conservative management focuses on preserving renal parenchyma and minimizing morbidity [7]. Low-grade renal injuries are regularly managed conservatively with excellent outcomes and unlikely long-term complications. However, the standard recommendation for high-grade renal injuries in pediatric patients remains controversial over the years [8]. Renal trauma in a particular country may differ from other areas as sociodemographic factors may affect the etiologies of trauma. Understanding the characteristics of renal trauma is beneficial in developing specific strategies or guidelines unique to certain countries. In Indonesia reports regarding pediatric renal trauma are severely limited. We aimed to report two pediatric patients with renal trauma cases undergoing different approaches in a tertiary hospital in East Java, Indonesia, and perform a literature review of pediatric renal trauma diagnostic and treatment strategies.

Case presentation

Case 1

A 7-year-old girl was involved in a motorcycle accident as a passenger, in which she fell into a gutter. She complained of right flank pain and bloody urine. She had no previous history of trauma or any abnormalities involving the kidneys. Her hemodynamic status was stable. Laboratory results showed that her hemoglobin (Hb) levels are slightly below the normal limits (9.7 g/dL), and she had microscopic hematuria. The Focused assessment with sonography for trauma (FAST) imaging protocol showed right renal intracapsular hematoma. The initial contrast-enhanced abdominal computer tomography (CT) showed an isolated grade 5 renal injury with active perirenal hemorrhage and large hematoma, as shown in

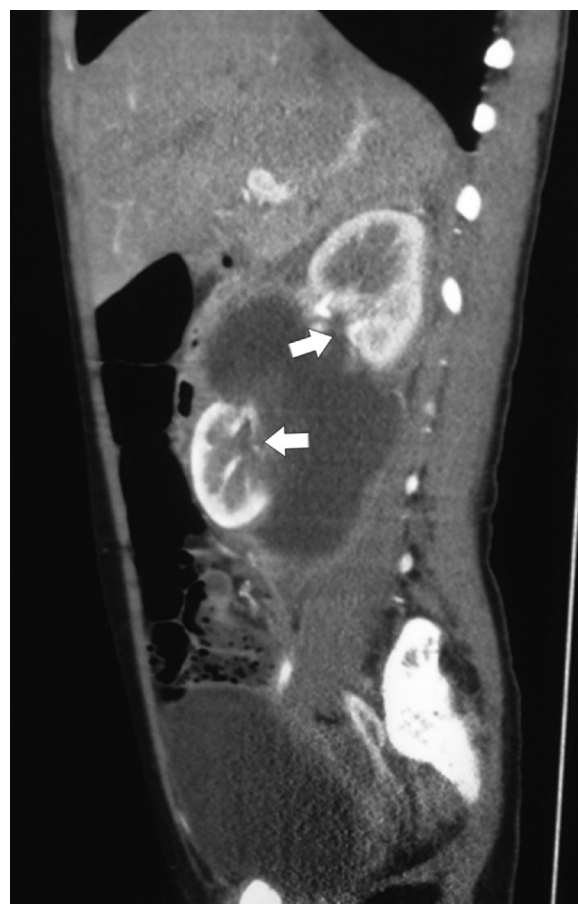


Fig. 2 – Sagittal view of the contrast-enhanced abdominal CT indicating a mid-posterior rupture and urinoma.

Fig. 1. The patient was initially managed conservatively. On the 11th day of treatment, she complained of fever and right flank pain. Her heart rate and temperature were 104 bpm and 39.7°C respectively. Broad-spectrum antibiotics were administered, and a repeated CT was performed. The abdominal CT in **Fig. 2** showed a grade 5 renal trauma, indicated by a mid-posterior rupture, active perirenal hemorrhage, and a urinoma. An open right renal exploration was performed. The surgery revealed a cystic mass consisting of urine and pus. A right subcapsular nephrectomy was performed. The resected



Fig. 3 – Resected renal tissue post-subcapsular nephrectomy.

renal tissue is shown in Fig. 3. The patient was discharged 7 days after the operation without further complaints, stable hemodynamic, and normal laboratory results.

Case 2

A 5-year-old boy fell while riding on his bicycle. He complained of right flank pain and hematuria after the accident. Before the accident, he had no history of trauma or comorbidities. Upon admission, his hemodynamic status was stable, and he was feverish (T: 38.3°C). Physical examination revealed a palpable cystic mass in the right flank region. Laboratory results were within normal limits, except for white blood cell count (16.88/uL). The patient was diagnosed with an isolated grade 5 renal trauma based on the results of the CT, showing a shattered kidney, urinoma in the right perirenal region 9.7 × 6.7 × 7.4 cm in size, as shown in Fig. 4. The retrograde pyelography (RPG) examination in showed extravasation of the contrast. After the RPG, a double-J (DJ) stent was placed and percutaneous drainage of the urinoma was performed. A clear yellowish 150-cc urine was obtained, followed by placement of a 10 Fr nasogastric tube for postoperative drainage. Following the operation, the patient's condition had improved,



Fig. 4 – Sagittal view of the contrast-enhanced abdominal CT indicating a grade 5 renal trauma and urinoma.

and he was discharged on the 22nd day without further complaints or complications.

Discussion and review of the literature

In this report, two different approaches to grade 5 blunt renal trauma are presented. As renal trauma causes more childhood deaths compared to other cases, a detailed and thorough understanding of the patient's clinical findings is necessary to offer a proper management [9]. In the past, the diagnostic and management guideline of pediatric renal trauma was adapted from the international guidelines for adult patients [6]. The lack of standard diagnostic and treatment management for pediatric patients has led to different strategies used in centers. The principle of management is based on the clinical examination, hemodynamic status, grade of injury, associated organ injuries, and the presence of hematuria [10]. Both patients came with a mechanism of injury, which raised suspicion toward the trauma. In blunt injuries, rapid deceleration due to motor vehicle accidents, falling from a height, or a direct blow to the flank is essential information for

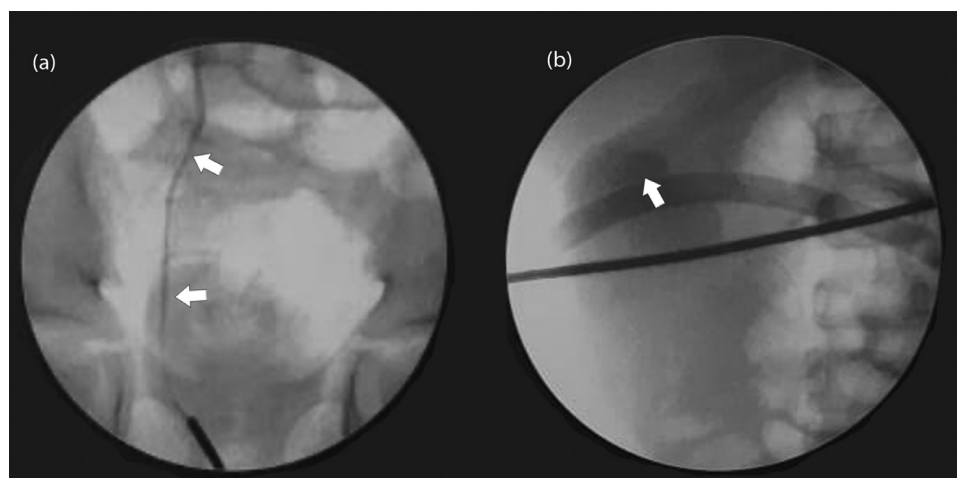


Fig. 5 – (A, B) Right RPG showing contrast filling the kidney and extravasation. RPG, retrograde pyelography.

potential renal trauma [8]. The signs obtained during the secondary survey, potentially involving the kidneys, were hematuria, flank hematoma, ribs fracture, abdominal mass, and abdominal tenderness. Renal traumas in children are rarely isolated and usually associated with the trauma of other extra and intraabdominal organs. Building a proper diagnosis is the most important initial step as it often determines the eventual approach. Intravenous pyelography was the standard method of diagnosis a few decades ago. Currently, intravenous pyelography has been replaced by ultrasonography and CT. Diagnosing pediatric renal trauma using the FAST protocol has a high specificity, but low sensitivity. Even if it is regularly used initially during every radiological evaluation of intraabdominal trauma cases, it should not be used as a sole method of screening. Moreover, the accuracy of FAST varies greatly between operators [11]. The current gold standard for renal trauma is a multiphase abdominal contrast-enhanced CT [4]. In this report, we performed a contrast-enhanced abdominal CT with an additional delayed excretory phase to evaluate the kidney's collecting system injury indicated by urine and blood extravasation. This phase is currently recommended to be performed in addition to the regular standard phase by the current guideline in adult renal trauma [12]. However, a multicentre prospective study conducted in 2017 questioned the necessity of the delayed phase during CT. They were unable to show a difference in outcomes between the patients who underwent the delayed imaging and those who did not [13]. Nevertheless, a contrast-enhanced CT should always be performed as the findings of a CT examination are positively associated with the clinical and urinalysis results in children with renal trauma [14]. Once the diagnosis is established, intense monitoring should be performed to evaluate urine output and the presence of hematuria. A complete laboratory evaluation, consisting of blood count, hemostasis function, kidney function, and urinalysis should also be performed. Additional laboratory parameters can also be examined if warranted by the presence of certain complications [15]. In both patients, the laboratory results indicate signs of infection. Initially, the patients were planned to be treated conservatively. Surgery may be avoided in approximately 97% of all pediatric renal trauma

cases and 50% in Grade 5 renal trauma cases [16,17]. In recent years, multiple pieces of evidence suggest that conservative management in pediatric high-grade renal injuries is reliable for hemodynamically stable patients, with excellent preservation of renal function [4]. Conservative management consists of bed rest, monitoring, and symptomatic treatment. Minimal invasive procedures such as ureteral stenting or angioembolization may be recommended if indicated [15]. In some cases, an additional RPG examination followed by percutaneous drainage and ureteral stent placement may be performed when there is symptomatic urinoma due to extravasation, as shown by the second case [18]. A percutaneous approach of drainage may be recommended based on its small intraoperative and postoperative morbidity compared to a more invasive approach [4]. Patients undergoing a conservative approach may be allowed to mobilize out of bed when their general condition allows them to and hematuria has cleared. However, physical activities should be avoided for at least 6 weeks [19]. Most studies recommend that hemodynamically unstable patients should undergo a surgical exploration after an initial resuscitation. The indications for surgery include arterial injury, extensive nonviable tissue, and massive urinary extravasation [20]. Renal salvage via nephrectomy requires maximal exposure of the kidney, bleeding control, and debridement of nonviable tissues. In the first patient, surgery was eventually planned based on his worsening clinical signs and laboratory results. A partial nephrectomy should be performed in non-viable renal tissue. It is usually performed if the kidney is not salvageable. It is currently only found to be necessary in around 3% of all grade IV renal injuries and 11% of grade V injuries. Other alternatives of treatment have not been discussed or studied fully. There are no valid international guidelines regarding the embolization treatment [21]. There is growing evidence that repeated imaging in asymptomatic patients with high-grade renal injuries is unnecessary [22]. A repeat imaging was only performed on the first patient in these cases due to her worsening condition several days after admission. This report offers important data regarding the management of pediatric renal trauma in Indonesia as East Java is the second largest province in Indonesia, representative of

the major demographics representing the country. However, future large-scale multicentre studies are required to fully examine Indonesia's diagnostic and treatment application.

Conclusion

The principle of pediatric renal trauma management is based on the patient's injury severity and hemodynamic status. Clinical findings, laboratory results, and imaging modalities are necessary to develop a proper strategy. Even though the FAST protocol can be used initially, a multiphase contrast-enhanced CT is required to assess the patient, although repeated imaging may not be necessary in all cases. A conservative approach should always be recommended to preserve renal function if possible.

Author contributions

MAR, YPK, and FR contributed equally to this article. All authors have read the manuscript and agreed to the contents.

Guarantor

Fikri Rizaldi

Patient consent and ethical approval

Informed consent for patient information to be published in this article was obtained. Appropriate informed consent was obtained for the publication of this case report and accompanying images. This report has been approved by the ethical committee of Dr. Soetomo General-Academic Hospital.

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