*https://doi.org/10.48047/AFJBS.6.14.2024.7996-8010*

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

# The Analysis Study of Management, Diagnosis and Outcome of Renal Trauma in Pediatrics : A Comprehensive Systematic Review

**[1]Albab Youndra Darmawan, [1]Bety Gustina Sari, [1]Aulia Wiratama Putra, [1]Naufal rifqian, [1]Rokhim Suryadi**

[1]Faculty of Medicine, Trisakti University, Special Region of Jakarta, Indonesia

**Corresponding Author :** Albab Youndra Darmawan., MD. Faculty of Medicine, Trisakti University, Special Region of Jakarta, Indonesia. Address : Kyai Tapa No.1, Tomang, Grogol Petamburan, West Jakarta, Special Region of Jakarta, Indonesia. Email: ayoundra217@gmail.com

Volume 6, Issue 14, Aug 2024

Received: 15 June 2024

Accepted: 25 July 2024

Published: 15 Aug 2024

*doi: 10.48047/AFJBS.6.14.2024.7996-8010*

**ABSTRACT**

**Background:** Pediatric renal trauma is a common issue, with blunt abdominal trauma being more common in children. Treatment focuses on preserving renal function and minimizing invasiveness. Non-surgical methods, based on clinical, laboratory, and radiographic results, have shown promising results in treating minor kidney injuries. However, the optimal approach for severe kidney damage in children remains a topic of ongoing debate. **Methods:** Following PRISMA 2020 guidelines, this systematic review concentrated on full-text English literature published between 2014 and 2024. Editorials and review articles that appeared in the same journal as the submission were not accepted without a DOI. A number of websites, including ScienceDirect, PubMed, and SagePub, were utilized to gather the literature. **Result:** The study looked at more than 1600 publications using reputable sources including Science Direct, SagePub, and PubMed. After it was decided that eight publications needed greater investigation, a more extensive review of the entire literature was carried out. **Conclusion:** Pediatric renal injury is a common trauma for children, resulting in severe injuries, longer hospital stays, and higher fatality rates. Treatment for these injuries has shifted to non-operative management (NOM), with over 90% success rates. We recommend regular CT scans and minimally invasive surgeries for children with kidney damage. Post-traumatic hypertension is a concern after kidney trauma, and follow-up visits should be conducted for at least one year.

**Keyword:** pediatric, renal trauma, management, kidney

## INTRODUCTION

Genitourinary tract injuries account for 10% of all traumas, with the kidney being the most damaged site, accounting for more than half of all urinary tract injuries.[1] Children are more susceptible to renal injuries caused by blunt trauma because of their anatomical structure, which includes a somewhat greater kidney size, less perirenal fat, and a more flexible rib cage.[2,3] Blunt abdominal trauma causes kidney injury in around 25–20% of juvenile patients.[4] Motor vehicle

accidents primarily cause blunt abdominal trauma, which often leads to additional injuries. Isolated renal injuries are less frequent in comparison.[5] Typically, surgical treatments are not necessary for these patients with renal injuries. The main goal of the treatment approach is to preserve renal function while minimizing invasiveness as much as possible.[6] Nevertheless, the choice of the most suitable treatment strategy depends on the patient's hemodynamic condition and the severity of the renal injury.[7]

Blunt trauma caused 90% of the injuries, with almost 80% of these injuries classified as grade 1 to 3. Approximately 20% of patients with grade 4 injuries received treatment through an open operation, while 50% of those with grade 5 injuries got open surgery.[8] Traditionally, a nephrectomy was the typical treatment for renal trauma. However, thanks to the increased accessibility of computed tomography (CT) scans in various medical facilities and a more comprehensive understanding of kidney injury treatment, most patients nowadays receive management without surgery.[9] Pediatric trauma treatment has undergone a recent transformation. Instead of doing surgery, doctors are now using non-operative methods. Advances in adult-like tactics motivated this change. These strategies rely on clinical, laboratory, and radiographic results to make an accurate assessment of the patient's condition.[2] The primary objective of conservative therapy is to protect the renal parenchyma and reduce the occurrence of complications.[10] Typically, non-surgical treatment for minor kidney injuries yields excellent results with minimal risk of long-term complications. Nevertheless, the consensus on the optimal approach for treating severe kidney damage in children has been a subject of ongoing debate.[11]

There is an urgent need to find appropriate management strategies for renal trauma in pediatric patients. The purpose of this systematic literature review was to examine how renal trauma is managed and what results are observed in pediatric patients, using research conducted over the past decade.

## METHODS

### Protocol

The study's author rigorously followed the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 criteria to ensure compliance with all requirements. The presentation of research findings was executed with a thoughtful and meticulous method, ensuring both persuasiveness and accuracy.

### Criteria for Eligibility

This paper provides a thorough analysis of the studies carried out in the last ten years regarding the connection between the management, diagnosis, and outcome of kidney injuries in children. This program aims to enhance patient care practices by undertaking thorough data analysis. The main objective of this thesis is to underscore the significance of specific themes that are widespread throughout a wide range of literary works.

Rigorous inclusion and exclusion criteria were employed to ensure the accuracy of the data used in this research. Any content that has been formally published in the English language between the years 2014 and 2024 is deemed appropriate for inclusion. Submissions without a DOI, published reviews, editorials, and duplicate entries within the same magazine are not considered.

### Search Strategy

We used "renal trauma OR children" as keywords. The search for studies to be included in the systematic review was carried out using the PubMed, SagePub, and Sciencedirect databases.

**Table 1. Search Strategy**

| ***Database*** | **Search Strategy** | ***Hits*** |
|---|---|---|
| Pubmed | *("renal trauma" AND "children")* | 207 |
| Science Direct | *("renal trauma" AND "children")* | 1383 |
| Sagepub | *("renal trauma" AND "children")* | 80 |

### Data retrieval

Prior to commencing this exhaustive inquiry, the authors thoroughly evaluated the pertinence of each publication by scrutinizing its abstract and title. The authors assigned greater significance to only research that fulfilled the article's aims and inclusion criteria. We established a clear and consistent pattern after conducting multiple inquiries. English was the only language that allowed complete text submissions. We utilized a meticulous screening method to obtain content that was directly relevant to the study's subject matter and fulfilled all established inclusion criteria. We largely dismissed and paid little attention to research findings that failed to meet these criteria. The examination encompassed a diverse array of data, comprising factors, titles, authors, publication dates, places, and study methodologies.

**Quality Assessment and Data Synthesis**

The authors carefully examine the abstract and title of each article to identify those that necessitate additional research. As a result, they had to thoroughly scrutinize every document initially submitted for review. The assessment results influenced the selection of review papers. This criterion expedited the prompt selection of papers for additional scrutiny, thereby allowing for a more thorough consideration of prior research and the assessment context.

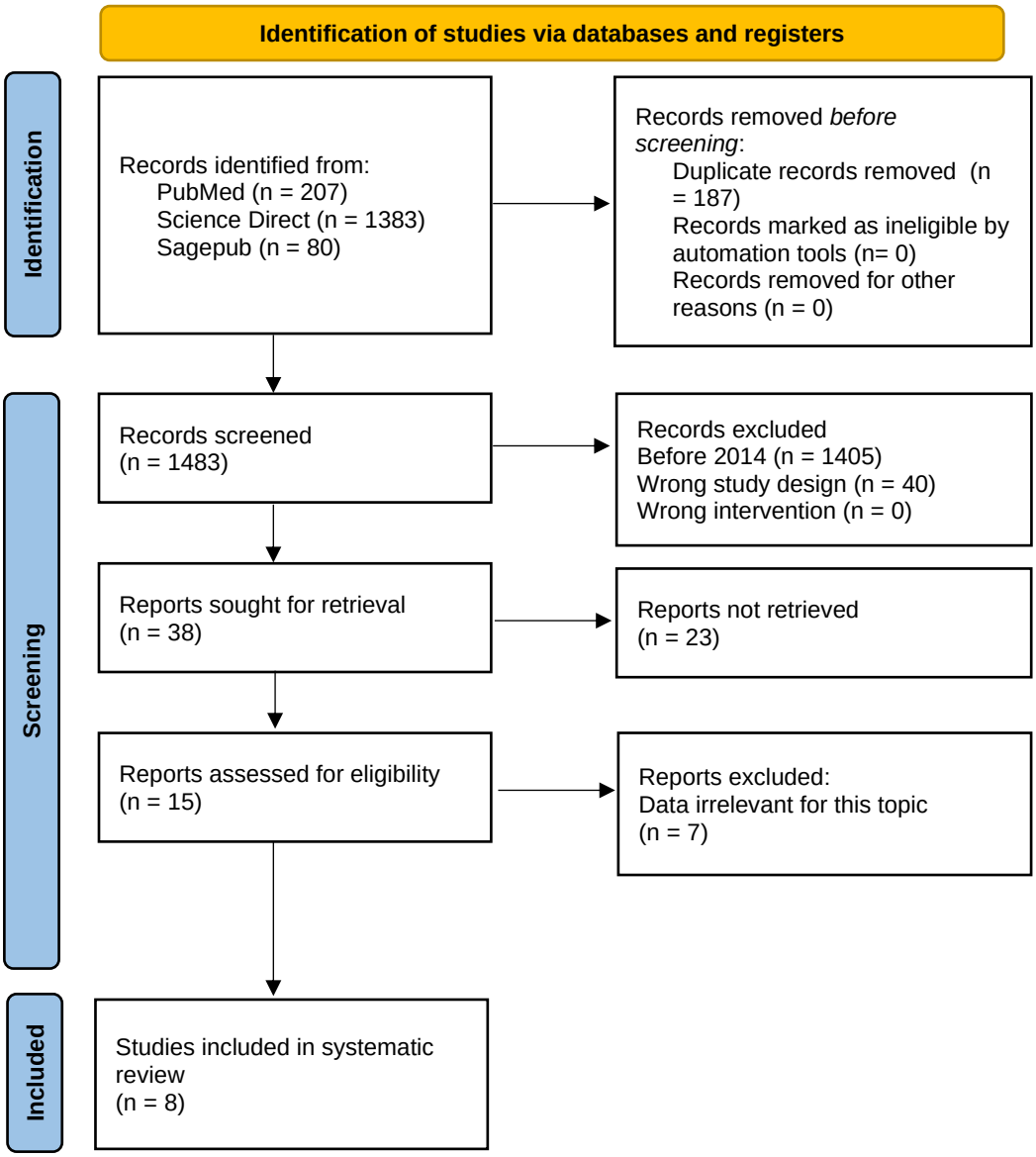


**Figure 1. Article search flow chart**

**Table 2. Critical appraisal of Study**

| Parameters | (Kartal et al., 2020) | (Redmond et al., 2020) | (Shekar et al., 2020) | (Ammor et al., 2022) | (Raizandha et al., 2022) | (Duarsa et al., 2023) | (Ringen et al., 2023) | (Wirjopranoto et al., 2024) |
|---|---|---|---|---|---|---|---|---|
| **1. Bias related to temporal precedence** Is it clear in the study what is the "cause" and what is the "effect" (ie, there is no confusion about which | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| variable comes first)? | | | | | | | | |
| **2. Bias related to selection and allocation** | | | | | | | | |
| Was there a control group? | No | No | No | No | No | No | No | No |
| **3. Bias related to confounding factors** | | | | | | | | |
| Were participants included in any comparisons similar? | No | No | No | No | No | No | No | No |
| **4. Bias related to administration of intervention/exposure** | | | | | | | | |
| Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest? | No. | No. | No. | No. | No. | No. | No. | No. |
| **5. Bias related to assessment, detection, and measurement of the outcome** | | | | | | | | |
| Were there multiple measurements of the outcome, both pre and post the intervention/exposure? | No | No | No | No | No | No | No | No |
| Were the outcomes of participants included in any comparisons measured in the same way? | No | No | No | No | No | No | No | No |
| Were outcomes measured in a reliable way? | No | No | No | No | No | No | No | No |
| **6. Bias related to participant retention** | | | | | | | | |
| Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analyzed? | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **7. Statistical conclusion validity** | | | | | | | | |
| Was appropriate statistical analysis used? | No | Yes | Yes | No | No | No | Yes | No |

## RESULT

We commenced the inquiry by methodically collecting a substantial array of documents from esteemed sources such as Science Direct, PubMed, and SagePub. Following a comprehensive three-stage screening procedure, we have chosen eight papers relevant to our continuing systematic investigation. Afterward, we chose specific subjects for additional analysis and thoroughly assessed each report. To streamline our investigation, we have presented a summary of the assessed material in Table 3.

**Table 3. The literature included in this study**

| Author | Origin | Method | Sample | Result |
|---|---|---|---|---|
| **Kartal et al.[7] (2020)** | Turkey | Case Report | 1 patient | A seven-year-old male patient suffered a grade IV renal injury due to blunt abdominal trauma. After a renal angiogram revealed a right-sided renal inferior segmental artery pseudoaneurysm and arterio-venous fistula, a transcatheter embolization was performed, resulting in no complications and no permanent renal injury. The success rate of transcatheter embolization is 89.47%, ensuring safe and effective treatment. |
| **Redmond et al.[12] (2020)** | USA | Cohort | 53 patients | A study of 53 children with a mean age of 13 years found blunt trauma as the primary cause of injuries. The AAST grade distribution was 37.8% Grade III, 49% Grade IV, and 13.2% Grade V. All Grade III injuries were managed conservatively, while 11 Grade IV/V patients required urological intervention. Overall, the renal salvage rate was 92.4%. |
| **Shekar et al.[13] (2020)** | India | Cohort | 10 patients | The management of 10 children with grade IV renal injury, primarily due to motor vehicle collisions |

| | | | | |
|---|---|---|---|---|
| | | | | and falls, involved non-operative management and minimally invasive interventions. The salvage rate was 87.5%, with better outcomes in those managed earlier. The median hospital stay was 11.5 days. |
| **Ammor et al.[14] (2022)** | Morocco | Case Series | 20 patients | A study of 20 children, 70% males, found that falls and motor-vehicle accidents were the main causes of renal injuries. Abdominal pain was the most common symptom, and 55% had macroscopic hematuria. Low-grade injuries represented 40% of cases, with 60% being AAST grade IV. Spleen and traumatic brain injuries were the most common concomitant injuries. |
| **Raizandha et al.[15] (2022)** | Indonesia | Case Report | 2 patients | Pediatric renal trauma is a common injury in the genitourinary system, necessitating a comprehensive understanding of diagnosis and management. Advancements in imaging modalities have shifted treatment to a conservative approach, with non-operative management potentially reducing nephrectomy risk and increasing renal salvage rate. Two children with high-grade renal trauma underwent nephrectomy and non-operative management. |
| **Duarsa et al.[16] (2023)** | Indonesia | Case Series | 3 patients | Three children with high-grade renal trauma were diagnosed using computed tomography scans and |

| | | | | |
|---|---|---|---|---|
| | | | | treated using NOM. The first patient fully recovered, while the second developed urinoma and underwent percutaneous drainage and double J stent. The third patient experienced continuous hematuria, which was treated via super-selective embolization. |
| **Ringen et al.[17] (2023)** | Sweden | Cohort | 4230 participants | Renal injury was a significant issue in a 17-year study of 4230 pediatric patients at Oslo University Hospital Trauma Registry. Out of these, 115 (2.7%) had renal injury, with nephrectomy, angiographic embolization, and ureteral stent placement being common procedures. |
| **Wirjopranoto et al.[18] (2024)** | Indonesia | Case Series | 4 patients | This case study presents four cases of renal trauma, involving a 13-year-old boy, a 14-year-old boy, and a 4-year-old boy. The first patient experienced hematuria and abdominal pain after falling from a tree, the second suffered left lower back pain and hematuria after elbowing in the left wrist, and the final patient experienced recurrent hematuria. |

## DISCUSSION

The trauma population frequently observes pediatric renal trauma, and patients with renal injury typically experience more severe injuries, longer hospital

stays, and higher fatality rates compared to those without renal injury.[17] From 2010 to 2019, there was a significant increase in the average yearly number of pediatric renal injuries, more than doubling, which suggests a rise in the severity of these injuries. Undoubtedly, the implementation of triage and transfer criteria in 2010 contributed to the observed maturation of the trauma system.[3,17] Isolated blunt renal trauma is rare and typically assumes small injuries, leading to delayed assessment.[3] We believe that a higher concentration of energy transfer in a specific area, like sports-related injuries, causes these injuries, rather than a spread-out transfer of energy in scenarios involving multiple systems. Renal injury that occurs in isolation is more prevalent in high-grade injuries as opposed to low-grade accidents.[17]

In the trauma context, the therapy for pediatric renal injuries has changed to non-operative management (NOM)[3,19], with an increase in low- and high-grade injuries.[4,11] However, a lack of response to resuscitation, characterized by ongoing circulation instability, clearly indicates the need for operational management (OM).[20] Studies have shown that in severe kidney injuries, more than 90% of patients who undergo non-operative management (NOM) have a success rate of 80% or above. Only one case resulted in the need for a nephrectomy, indicating a low failure rate.[12,21,22] Nephrectomy is a frequently performed surgical operation for patients with higher Injury Severity Scores (ISS) who have concomitant injuries that necessitate surgical intervention.[2] The national data bank studies from the USA and Japan.[2,23] have reported a nephrectomy rate of 3.5% (4/115). A nephrectomy was conducted on a patient diagnosed with a Wilms tumor following blunt trauma, two months after the incident. There was no immediate need for surgery.[12]

Approximately 11–12% of children with kidney injuries exhibit urine leaks. Children with grade 3 damage and higher should undergo routine delayed CT scans upon arrival to immediately identify these leaks.[3,4] Physicians frequently perform kidney treatments on this particular group of patients, often achieving success through minimally invasive procedures like cystoscopy with ureteral stent implantation or percutaneous nephrostomy.[3] An angiographic embolization is a minimally invasive technique that is suggested for pediatric patients with renal injuries who are stable in terms of their blood flow. We use this method to address ongoing or delayed bleeding.[19,21] The Ringen et al. study revealed that one patient,

out of six with severe injuries, experienced treatment failure and underwent a nephrectomy on the second day after the injury.[17]

Pediatric patients with kidney damage undergo computed tomography (CT) scans based on clinical suspicion and observations, including impaired physiological function, stomach pain, bruising, and visible blood in the urine.[12] Our institution conducts CT scans in the emergency department (ED) for situations where there is a high probability of major abdominal injury, particularly in children with severe traumas.[17] Merely observing microscopic hematuria does not warrant a CT scan. However, if we identify notable renal damage, we conduct a subsequent sequence to evaluate the presence of urine leakage. There is limited evidence to support the use of routine intensive care unit (ICU) treatment or rigorous bed rest in children with renal damage, despite the use of gross hematuria as a guide for bed rest and release timing.[21,24] Children who show no indications or symptoms of concern should not undergo routine repeat CT imaging to avoid unnecessary radiation exposure.[21,25,26] Post-traumatic hypertension is a concerning consequence that can occur after kidney trauma, with an estimated occurrence rate of 4.2%. Follow-up visits should regularly check for high blood pressure for a minimum of one year.[17,29]

## CONCLUSION

Pediatric renal injury is a common trauma occurrence in children, with patients experiencing more severe injuries, longer hospital stays, and higher fatality rates compared to those without renal injury. From 2010 to 2019, there was a significant increase in the average yearly number of pediatric renal injuries, more than doubling in a center in Sweden. Renal injury is frequently observed in the trauma population, and patients with renal injury typically experience more severe injuries, longer hospital stays, and higher fatality rates compared to those without renal injury. The treatment for pediatric renal injuries has changed to non-operative management (NOM), with an increase in low- and high-grade injuries. Studies show that over 90% of patients undergoing NOM have a success rate of 80% or above for severe kidney injuries. Kids with kidney damage should get regular delayed CT scans to find urine leaks and minimally invasive surgeries like

cystoscopy with ureteral stent implantation or percutaneous nephrostomy. Post-traumatic hypertension is a concerning consequence that can occur after kidney trauma, with an estimated occurrence rate of 4.2%. Follow-up visits should regularly check for high blood pressure for a minimum of one year.

**REFERENCES**

1. Alsaywid BS, Alkhashan MY, Alrimawi MH, Abu-Alsaud NM, Al-Rimawi HM. Blunt renal trauma in pediatric population. Urol Ann. 2019 Jul-Sep;11(3):241-246. doi: 10.4103/UA.UA_149_18. PMID: 31413499; PMCID: PMC6676837.
2. Mahran A, Fernstrum A, Swindle M, Mishra K, Bukavina L, Raina R, Narayanamurthy V, Ross J, Woo L. Impact of trauma center designation in pediatric renal trauma: National Trauma Data Bank analysis. J Pediatr Urol. 2020 Oct;16(5):658.e1-658.e9. doi: 10.1016/j.jpurol.2020.07.019. Epub 2020 Jul 24. PMID: 32773248.
3. Ghani MOA, Snyder E, Xu MC, McKay KG, Foster J, Tong C, Clayton DB, Greeno A, Azam B, Zhao S, Hernanz-Schulman M, Lovvorn HN 3rd. Urine leaks in children sustaining blunt renal trauma. J Trauma Acute Care Surg. 2022 Sep 1;93(3):376-384. doi: 10.1097/TA.0000000000003532. Epub 2022 Jan 5. PMID: 34991128.
4. Farr BJ, Armstrong LB, Barnett SC, Mooney DP. Variation in management of pediatric post-traumatic urine leaks. Eur J Trauma Emerg Surg. 2022 Feb;48(1):173-178. doi: 10.1007/s00068-020-01430-0. Epub 2020 Jul 4. PMID: 32623483.
5. McPhee M, Arumainayagam N, Clark M, Burfitt N, DasGupta R. Renal injury management in an urban trauma centre and implications for urological training. Ann R Coll Surg Engl. 2015 Apr;97(3):194-7. doi: 10.1308/003588414X14055925061117. PMID: 26263803; PMCID: PMC4474011.
6. Eassa W, El-Ghar MA, Jednak R, El-Sherbiny M. Nonoperative management of grade 5 renal injury in children: does it have a place? Eur Urol. 2010

Jan;57(1):154-61. doi: 10.1016/j.eururo.2009.02.001. Epub 2009 Feb 10. PMID: 19223117.

7. Kartal İ, Durmaz HA, Güler Çimen S, Çimen S, Ersoy H. Transcatheter embolization in pediatric blunt renal trauma: Case report and review of the literature. Ulus Travma Acil Cerrahi Derg. 2020 May;26(3):475-481. English. doi: 10.14744/tjtes.2019.93043. PMID: 32436984.
8. Erlich T, Kitrey ND. Renal trauma: the current best practice. Ther Adv Urol. 2018 Jul 10;10(10):295-303. doi: 10.1177/1756287218785828. PMID: 30186367; PMCID: PMC6120183.
9. Colaco M, Navarrete RA, MacDonald SM, Stitzel JD, Terlecki RP. Nationwide Procedural Trends for Renal Trauma Management. Ann Surg. 2019 Feb;269(2):367-369. doi: 10.1097/SLA.0000000000002475. PMID: 28857810.
10. Murphy GP, Gaither TW, Awad MA, Osterberg EC, Baradaran N, Copp HL, Breyer BN. Management of Pediatric Grade IV Renal Trauma. Curr Urol Rep. 2017 Mar;18(3):23. doi: 10.1007/s11934-017-0665-z. PMID: 28233229.
11. Dangle PP, Fuller TW, Gaines B, Cannon GM, Schneck FX, Stephany HA, Ost MC. Evolving Mechanisms of Injury and Management of Pediatric Blunt Renal Trauma--20 Years of Experience. Urology. 2016 Apr;90:159-63. doi: 10.1016/j.urology.2016.01.017. Epub 2016 Jan 26. PMID: 26825488.
12. Redmond EJ, Kiddoo DA, Metcalfe PD. Contemporary management of pediatric high grade renal trauma: 10 year experience at a level 1 trauma centre. J Pediatr Urol. 2020 Oct;16(5):656.e1-656.e5. doi: 10.1016/j.jpurol.2020.06.033. Epub 2020 Jul 6. PMID: 32800481.
13. Shekar PA, Ansari MS, Yadav P, Srivastava A. "Functional outcome in pediatric grade IV renal injuries following blunt abdominal trauma salvaged with minimally invasive interventions". J Pediatr Urol. 2020 Oct;16(5):657.e1-657.e9. doi: 10.1016/j.jpurol.2020.07.017. Epub 2020 Jul 23. PMID: 32758417.

14. Ammor A, Haissoufi KE, Karrouchi M, Nasri S, Skiker I, Benhaddou H. Blunt renal trauma in children: the experience of Mohammed VI University Hospital of Oujda in Morocco between 2015 and 2021. Pan Afr Med J. 2022 Apr 29;41:347. doi: 10.11604/pamj.2022.41.347.31945. PMID: 35909429; PMCID: PMC9279456.
15. Raizandha MA, Kloping YP, Rizaldi F. Imaging modalities and management of pediatric high-grade renal trauma in an Indonesian tertiary hospital: a report of two cases and literature review. Radiol Case Rep. 2022 Mar 9;17(5):1563-1567. doi: 10.1016/j.radcr.2022.02.030. PMID: 35282324; PMCID: PMC8914251.
16. Duarsa GWDP, Satyagraha P, Daryanto B. Non-operative management for high-grade isolated renal trauma in pediatric patients: a case series. Pan Afr Med J. 2023 Feb 6;44:71. doi: 10.11604/pamj.2023.44.71.36833. PMID: 37159632; PMCID: PMC10162895.
17. Ringen AH, Fatland A, Skaga NO, Gaarder C, Naess PA. Pediatric renal trauma: 17 years of experience at a major Scandinavian trauma center. Trauma Surg Acute Care Open. 2023 Nov 14;8(1):e001207. doi: 10.1136/tsaco-2023-001207. PMID: 38020860; PMCID: PMC10649896.
18. Wirjopranoto S, Azmi YA, Soetanto KM. Management of high-grade pediatric renal trauma in tertiary referral hospital in Indonesia: A case series and literature review. Int J Surg Case Rep. 2024 May;118:109671. doi: 10.1016/j.ijscr.2024.109671. Epub 2024 Apr 21. PMID: 38653173; PMCID: PMC11063531.
19. Hagedorn JC, Fox N, Ellison JS, Russell R, Witt CE, Zeller K, Ferrada P, Draus JM Jr. Pediatric blunt renal trauma practice management guidelines: Collaboration between the Eastern Association for the Surgery of Trauma and the Pediatric Trauma Society. J Trauma Acute Care Surg. 2019 May;86(5):916-925. doi: 10.1097/TA.0000000000002209. PMID: 30741880.
20. Notrica DM, Linnaus ME. Nonoperative Management of Blunt Solid Organ Injury in Pediatric Surgery. Surg Clin North Am. 2017 Feb;97(1):1-20. doi: 10.1016/j.suc.2016.08.001. PMID: 27894421.

21. LeeVan E, Zmora O, Cazzulino F, Burke RV, Zagory J, Upperman JS. Management of pediatric blunt renal trauma: A systematic review. J Trauma Acute Care Surg. 2016 Mar;80(3):519-28. doi: 10.1097/TA.0000000000000950. PMID: 26713980.

22. Okur MH, Arslan S, Aydogdu B, Arslan MS, Goya C, Zeytun H, Basuguy E, Uygun I, Çigdem MK, Önen A, Otcu S. Management of high-grade renal injury in children. Eur J Trauma Emerg Surg. 2017 Feb;43(1):99-104. doi: 10.1007/s00068-016-0636-y. Epub 2016 Feb 1. PMID: 26833463.

23. Nakao S, Katayama Y, Hirayama A, Hirose T, Ishida K, Umemura Y, Tachino J, Kiguchi T, Matsuyama T, Kiyohara K, Kitamura T, Nakagawa Y, Shimazu T. Characteristics and outcomes of pediatric blunt renal trauma: a nationwide cohort study in Japan. Eur J Trauma Emerg Surg. 2022 Jun;48(3):2047-2057. doi: 10.1007/s00068-021-01795-w. Epub 2021 Sep 25. PMID: 34562135.

24. Graziano KD, Juang D, Notrica D, Grandsoult VL, Acosta J, Sharp SW, Murphy JP, St Peter SD. Prospective observational study with an abbreviated protocol in the management of blunt renal injury in children. J Pediatr Surg. 2014 Jan;49(1):198-200; discussion 200-1. doi: 10.1016/j.jpedsurg.2013.09.053. Epub 2013 Oct 5. PMID: 24439609.

25. Gates RL, Price M, Cameron DB, Somme S, Ricca R, Oyetunji TA, Guner YS, Gosain A, Baird R, Lal DR, Jancelewicz T, Shelton J, Diefenbach KA, Grabowski J, Kawaguchi A, Dasgupta R, Downard C, Goldin A, Petty JK, Stylianos S, Williams R. Non-operative management of solid organ injuries in children: An American Pediatric Surgical Association Outcomes and Evidence Based Practice Committee systematic review. J Pediatr Surg. 2019 Aug;54(8):1519-1526. doi: 10.1016/j.jpedsurg.2019.01.012. Epub 2019 Jan 31. PMID: 30773395.

26. Schmidt J, Loftus CJ, Skokan A, Hagedorn JC. Routine repeat imaging may be avoidable for asymptomatic pediatric patients with renal trauma. J Pediatr Urol. 2022 Feb;18(1):76.e1-76.e8. doi: 10.1016/j.jpurol.2021.11.005. Epub 2021 Nov 16. PMID: 34872844.