

Pediatric blunt renal trauma with wide fragments dislocation: successful organ saving management by internal stenting and percutaneous perirenal drain

Trauma renale chiuso in eta' pediatrica con ampia dislocazione dei frammenti: possibilita' di un trattamento conservativo tramite posizionamento di stent ureterale e drenaggio percutaneo peri-renale, con salvataggio dell'organo

C. Olivieri,¹ M. G. Grella,¹ V. D. Catania,² A. C. Contini,² V. Briganti,³ A. Calisti¹

Key words: *pediatric; kidney; blunt; trauma; stenting; drain*

Abstract

Children have an high risk of renal damage as a result of blunt trauma. Conservative management is always recommended for lower grades (I to III) but is rather controversial whenever high grade injuries (grade IV and V) are concerned. We describe a case of successful conservative management in grade IV renal injury occurred in a 9-years-old girl with blunt trauma.

Riassunto

I bambini hanno un alto rischio di danno renale in caso di trauma chiuso. Il trattamento conservativo è raccomandato nei casi di danno renale di basso grado (da I a III), ma il suo impiego è controverso nei casi di alto grado (IV e V). Riportiamo un caso di trattamento conservativo con preservazione del rene in una bambina di 9 anni con danno renale di IV grado in seguito a trauma chiuso.

Introduction

Trauma is the main cause of morbidity in children younger than 17 years of age. Blunt abdominal trauma affect kidney in 10% of the cases¹ due to peculiarities of pediatric axial skeleton (less developed and ossified ribcage, decreased peri-renal fat, smaller paraspinal and abdominal muscles). These features contribute to the increased susceptibility of pediatric patients to traumatic renal lesions.²

Management options range from expectant management and close observation (including minor procedures like Ureteral stenting) to urgent or delayed exploration, in the attempt to repair parenchymal, pelvicalyceal or vascular injuries or to perform partial or total nephrectomy.³

Renal injuries can be graded on CT scan into five Grades according to the American Association for the Surgery of Trauma Organ Injury Severity Scale⁴ (Table 1). Conservative management is always recommended for lower grades (I to III) but is rather controversial whenever high grade injuries (grade IV and V) are concerned.⁵

Recent reports on non operative management of some grade V parenchymal injuries reopened the discussion.^{6,7} Exploration of high grade renal trauma, may be challenging due to anatomical distortion, urine collection and the presence of hematoma. Nephrectomy is the unavoidable conclusion of most of these surgical adventures. Conservative management offers the chance of sparing the kidney.^{8,9}

An unusual case of non-penetrating renal trauma with complete separation of parenchymal fragments is here reported. Despite an initially incorrect approach to these condition which appeared as a clear indication to open management, conservative approach revealed to be completely successful.

¹ Pediatric Surgery and Urology Unit, San Camillo Forlanini Hospital, Rome, Italy

Indirizzo per la corrispondenza (Corresponding author):

Maria Giovanna Grella

Pediatric Surgery and Urology Unit, San Camillo Forlanini Hospital, Rome, Italy

Circonvallazione Gianicolense 87 - 00152, Rome - Italy

Phone: +39 328 2673793, +39 06 58703278

Fax: +39 06 58704438

Mail: mariagiovanna.grella@libero.it

Table 1

AMERICAN ASSOCIATION FOR THE SURGERY OF KIDNEY INJURY SCALE.

Grade	Injury	Description of injury
I	Contusion	microscopic or gross hematuria, urologic studies normal
	Hematoma	subcapsular nonexpanding without parenchymal laceration
II	Hematoma	Nonexpanding perirenal hematoma confined to renal retroperitoneum
	Laceration	< 1,0cm parenchymal depth of renal cortex without urinary extravasation
III	Laceration	>1,0cm parenchymal depth of renal cortex without collecting system rupture or urinary extravasation
IV	Laceration	parenchymal laceration extending through renal cortex, medulla and collecting system
	Vascular	main renal artery or vein injury with contained hemorrhage
V	Laceration	completely shattered kidney
	Vascular	avulsion of renal hilum that devascularizes kidney

Case report

A 9-years-old girl crashed her bicycle and was struck onto her left flank by handlebars. She complained, on hospital admission, severe abdominal pain and presented gross hematuria. CT scan of the abdomen showed a grade IV renal injury with complete amputation of lower third of left kidney and a large perirenal hematoma displacing fragments (Fig.1). Moderate peritoneal effusion in the lower quadrants on Ultrasounds.

Initial management comprehended double J left ureteral stent endoscopic positioning and laparoscopic exploration with peritoneal drain placement to drain huge reactive fluid collection.

The patient remained hemodynamically stable, with gradually decreasing abdominal and flank pain. Ultrasonographic monitoring showed resolution of intraperitoneal effusion and reduction of organized perirenal hematoma. Peritoneal drain and double J peritoneal stent were removed in sequence within one week and two weeks from trauma.

A second CT scan one week later revealed a large fluid collection extending from the left perirenal fascia to the omolateral psoas muscle; the lower pole of the kidney was completely separated and displaced from the rest of the organ, connected only by a thin arterial renal branch (Fig.2).

Perirenal urinoma was drained percutaneously, followed by new left Ureteral stenting and bladder catheter positioning. This last endoscopic maneuver was required after retrograde pyelogram revealed persistent contrast leakage from the truncated lower calices (Fig.3) which ceased one month after (Fig.4). Ureteral stent was then removed and the patient discharged after ultrasonographic demonstration of no active perirenal effusion and of residual decreasing organized hematoma on CT scan (Fig.5).

Four months after a new CT scan and a renal scintigraphy were performed. Perirenal hematoma was completely reabsorbed and displaced renal fragments re-approached restoring parenchymal continuity (Fig.6).

Discussion

Children are at high risk for solid organ injuries as a result of blunt trauma with particular susceptibility to renal damages.¹⁰ Proper imaging is mandatory for correct management of these lesions.^{11,12} and CT scan cannot be omitted or replaced by Ultrasonography only. It offers the possibility to make timely reconstruction of three-dimensional image of the abdomen and pelvic region and the



Figure 1.

CT scan of the abdomen shows complete amputation of lower third of left kidney and a large perirenal hematoma displacing fragments suggestive for grade IV renal injury with



Figure 2.

CT scan one week after the trauma reveals a large fluid collection extending from the left perirenal fascia to the ipsilateral psoas muscle. The lower pole of the kidney was completely separated and displaced from the rest of the organ, connected only by a thin arterial renal branch

quality of imaging allows for interventional decision making (e.g. ureteral stenting). Among patients who have already undergone CT scan, US is a good option for follow up minimizing radiation exposure.¹¹

Optimal management of pediatric blunt renal injury is still far to be defined.¹³ There are no evidence-based guidelines^{14,15} and, in most of the cases, decisions are based on personal surgical philosophy or anecdotal experience, that means on the lowest level of evidence.¹⁰ With these limitations, grade I and II renal trauma are considered by most of the Authors as minor and do not require surgical exploration.¹⁶ The majority of patients with high grade blunt renal trauma (IV-V) have historically been managed by surgery. In their case series Wessel *et al.*¹⁷ operated on all patients with grade IV or V. However the use of less invasive minor procedures, like nephrostomies and/or ureteral stents in patients with

urinary extravasation, can reduce the recourse to major surgery among patients with high grade renal injuries.^{18,19} Henderson *et al.*⁸ in their series treated non operatively 31/35 cases with grade IV and 5/9 cases with grade V renal injury. The Authors of the latter work state that conservative management reduces the risk of nephrectomy that accompanies open surgical exploration. In a recent meta-analysis, Umbreit *et al.*²⁰ identify 95 children with grade IV blunt renal injury; 81 of them (85%) were managed conservatively or with percutaneous procedures, and 14 (15%) required open surgery. Among the patients operated on by laparotomy, 71% (10/14) underwent nephrectomy (50% total, 50% partial); renal saving was achieved only in 29% (4/14). A review of the most recent case series of grade IV blunt renal trauma, with regard to the number of open surgical procedures performed and nephrectomies required, is provided by Table 2.^{3,5,6,8,9,15,17,18,21,22,23,24,25,26} In some series, up to 100% of patients that undergo open surgery require partial or total nephrectomy.

Our case with a grade IV renal injury and completely displaced fragments after a severe blunt renal trauma confirms the role of conservative management in renal sparing even in extreme conditions. A peculiarity of our case was the complete detachment of the inferior pole from the rest of renal parenchyma, with no damage of the inferior polar artery that allowed vascular supply to the damaged pole. Roger *et al.*⁵ have suggested that this condition is associated with a reduced success rate of conservative management. In their work, among 10 patients with grade IV renal injury, the only 2 patients that required ureteral stenting had a complete detachment of a vascularized renal fragment; however, in 1 case (50%) stenting was not successful and an open surgery was eventually required.

In our patient urinoma was successfully relieved by percutaneous perirenal drain and ureteral stenting; spontaneous re approaching of renal fragments was fully achieved in about four weeks. Anyway, despite satisfactory results, we could find some room for

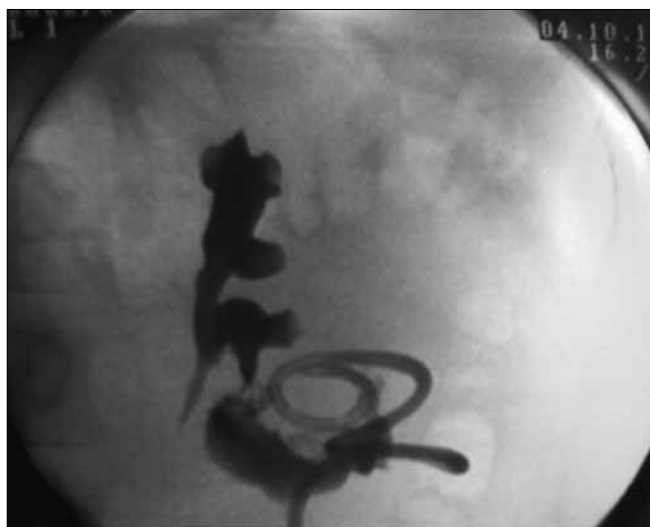


Figure 3.

Retrograde pyelogram reveals persistent contrast leakage from the truncated lower calices.



Figure 4.

Retrograde pyelogram, one month after the trauma, reveals persistent contrast leakage from the truncated lower calices.

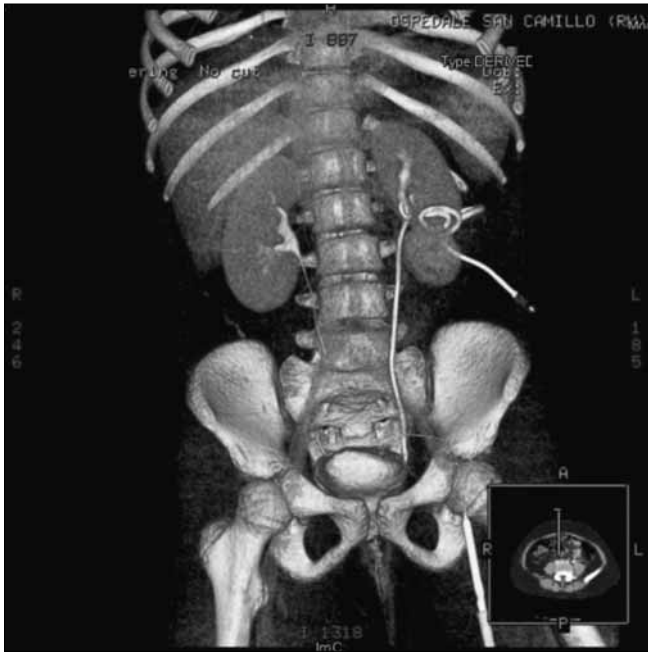


Figure 5.

Reconstructive 3D CT scan shows residual decreasing organized hematoma.

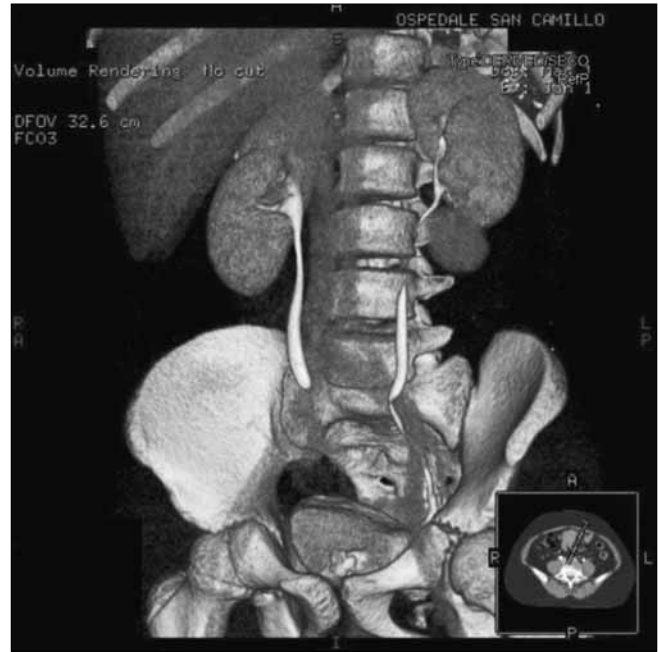


Figure 6.

Reconstructive 3D CT scan shows complete resorption of perirenal hematoma and restored parenchymal continuity.

improvement in our decisional process. Removal of double J stent after two weeks only before calyceal rupture completely healed allowed reforming of urinoma which required percutaneous drain. This was initially placed without simultaneous ureteral stent and bladder catheter positioning which ensured urinary stream collection. All these mistakes delayed resolution of renal lesion and prolonged hospital stay. In any case no major complication was observed. In conclusion, complete renal fracture with dislocated fragments but with preserved blood supply can be successfully managed conservatively provided that the correct sequence of procedures is respected.

References

- McAninch JW, Carroll PR, Klosterman PW, Dixon CM, Greenblatt MN. Renal reconstruction after injury. *J Urol*. 1991 May;145(5):932-7.
- McAlear IM, Kaplan GW, LoSasso BE. Renal and testis injuries in team sports. *J Urol* 2002;168:1805.
- Mohamed AZ, Morsi HA, Ziada AM, Habib EM, Aref AM, Kotb EA, Eissa MA, Daw M Management of major blunt pediatric renal trauma: Single-center experience. *Journal of Pediatric Urology* 2010;6, 301-5
- Armenakas NA, Duckett CP, McAninch JW. Indications for nonoperative management of renal stab wounds. *J Urol* 1999; 161:768-71.

Table 2

REVIEW OF THE LITERATURE FOR NEPHRECTOMY IN SURGICALLY TREATED GRADE IV PEDIATRIC BLUNT RENAL TRAUMA. 3,5,6,8,9,15,17,18,21,22,23,24,25,26

Author (year)	n. of cases	Surgically treated cases (n)	Nephrectomy		% nephrectomy in open surgery
			partial (n)	total (n)	
Fitzgerald (2011)	6	1	0	0	0
Mohamed (2010)	14	4	0	0	0
Shariat (2008)	51	7	NS	2	29%
Henderson (2007)	35	3	0	1	33%
Broghammer (2006)	10	2	1	1	100%
Bozeman (2004)	20	7	NS	4	57%
Buckley (2004)	11	3	NS	0	0
Nance (2004)	11	1	0	1	100%
Rogers (2004)	10	1	0	0	0
Ceylan (2003)	7	3	2	1	100%
Margenthaler (2002)	14	3	0	3	100%
Moudouni (2001)*	20	18	9	3	67%
Russel (2001)	15	2	2	0	100%
Wessel (2000)	5	5	1	0	20%

*only group 1 was considered, because data for group 2 could not be derived. NS: not specified

- ⁵ Rogers CG, Knight V, Macura KJ, Ziegfeld S, Paidas CN, Mathews RI. High Grade renal injuries in children – is conservative management possible? *Urology*. 2004; 64: 574–9.
- ⁶ Broghammer JA, Fisher MB, Santucci RA. Conservative management of renal trauma a review. *Urology* 2007;70:623–9.
- ⁷ Salem HK, Morsi HA, Zakaria A. Management of high grade renal injuries in children after blunt abdominal trauma. Experience with 40 cases. *J Pediatr Urol* 2007;3:223–9.
- ⁸ Henderson CG, Sedberry-Ross S, Pickard R, Bulas DI, Duffy BJ, Tsung D, Eichelberger MR, Belman AB, Rushton HG. Management of High Grade Renal Trauma: 20-Year Experience at a Pediatric Level I Trauma Center. *J Urol* 2007;178:246–50.
- ⁹ Moudouni SM, Hadj Slimen M, Manunta A, Patard JJ, Guiraud PH, Guille F, Bouchot O, Lobel B. Management of major blunt renal lacerations: is a nonoperative approach indicated? *Eur Urol*. 2001 Oct;40(4):409–14.
- ¹⁰ Aguayo P, Fraser JD, Sharp S, Holcomb III GW, Ostlie DJ, St. Peter SD. Nonoperative management of blunt renal injury: a need for further study. *J Pediatr Surg* 2010; 45, 1311–4
- ¹¹ Fraser JD, Aguayo P, Ostlie JD, St. Peter SD. Review of the evidence on the management of blunt renal trauma in pediatric patients. *Pediatr Surg Int* 2009; 25:125–32
- ¹² Smith JK, Kenney PJ. Imaging of renal trauma. *Radiol Clin North Am* 2003; 41:1019–1035.
- ¹³ Malhotra AK, Fabian TC, Croce MA, et al. Blunt hepatic injury: a paradigm shift from operative to nonoperative management in the 1990s. *Ann Surg* 2000;231:804–13.
- ¹⁴ Kuzmarov IW, Morehouse DD, Gibson S. Blunt renal trauma in the pediatric population: a retrospective study. *J Urol* 1981;126:648–9.
- ¹⁵ Nance ML, Lutz N, Carr MC, et al. Blunt renal injuries in children can be managed nonoperatively: outcome in a consecutive series of patients. *J Trauma* 2004;57:474–8.
- ¹⁶ Nguyen MM, Das S. Pediatric renal trauma. *Urology* 2002; 59:762–7.
- ¹⁷ Wessel LM, Scholz S, Jester I, Arnold R, Lorenz C, Hosie S, Wirth H, Waag KL. Management of kidney injuries in children with blunt abdominal trauma. *J Pediatr Surg* 2000; 35 (9): 1326–30
- ¹⁸ Russell RS, Gomelsky A, McMahon DR, et al. Management of grade IV renal injury in children. *J Urol* 2001;166:1049–150.
- ¹⁹ Philpott JM, Nance ML, Carr MC, et al. Ureteral stenting in the management of urinoma after severe blunt renal trauma in children. *J Pediatr Surg* 2003;38:1096–8.
- ²⁰ Umbreit EC, Routh JC, Husmann DA. Nonoperative management of nonvascular grade IV blunt renal trauma in children: meta-analysis and systematic review. *Urology*. 2009 Sep;74(3):579–82.
- ²¹ Fitzgerald CL, Tran P, Burnell J, Broghammer JA, Santucci R. Instituting a conservative management protocol for pediatric blunt renal trauma: evaluation of a prospectively maintained patient registry. *J Urol*. 2011 Mar;185(3):1058–64.
- ²² Shariat SF, Jenkins A, Roehrborn CG, Karam JA, Stage KH, Karakiewicz PI. Features and outcomes of patients with grade IV renal injury. *BJU Int*. 2008 Sep;102(6):728–33; discussion 733.
- ²³ Bozeman C, Carver B, Zabari G, Caldito G, Venable D. Selective operative management of major blunt renal trauma. *J Trauma*. 2004 Aug;57(2):305–9.
- ²⁴ Ceylan H, Gunsar C, Etensel B, Sencan A, Karaca I, Mir E. Blunt renal injuries in Turkish children: a review of 205 cases. *Pediatr Surg Int*. 2003 Dec;19(11):710–4.
- ²⁵ Margenthaler JA, Weber TR, Keller MS. Blunt renal trauma in children: experience with conservative management at a pediatric trauma center. *J Trauma*. 2002 May;52(5):928–32.
- ²⁶ Buckley JC, McAninch JW. Pediatric renal injuries: management guidelines from a 25-year experience. *J Urol*. 2004 Aug;172(2):687–90; discussion 690.