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Original Research Article

Renal traumas in childhood: a five years experience of tertiary care hospital in Turkey

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ABSTRACT

Background: In this study, the experiences of kidney trauma of a third step hospital in a city at the junction of the road will be discussed with the current literature.
Methods: Pediatric trauma patients admitted to Afyon Kocatepe University Hospital between 1 January 2012 and 31 December 2017 were retrospectively examined. Thirty patients with renal injuries were included in the study. Patients with renal injury were examined in terms of age, gender, type of trauma, degree of renal injury, additional organ damage, treatment method, duration of hospitalization, cost and mortality. Statistical analysis was performed with the SPSS program. The p >0.05 was considered as significant.
Results: A total of 30 patients (m:23, f:7) were included in the study. The mean age of the patients was 12.10±5.70. The mean duration of hospitalization was 10.23±17.067 days. The reasons of kidney injury were determined as; traffic accident outside of the vehicle (n=9), fall (n=8), traffic accident inside the vehicle (n=6), bicycle-motorcycle accident (n=5), and firearm injury (n=2). Hematuria (n=8), grade 1 (n=12), grade 2 (n=2), grade 4 (n=5), and grade 5 (n=3) kidney injuries were detected in the patients. Isolated renal injuries were found in 7 patients. Additional organ injuries were found as lung injury (n=3), head injury (N=5), pelvic injury (n=5), spleen injury (n=8), spine injury (n=7), liver injury (n=7), intestinal injury (n=7), and extremity injury (n=7). The average cost was 4948.37 ± 10198.51 TL. One patient had nephrectomy and JJ catheter was placed to one patient due to the development of urinoma and hematoma. All other patients were treated conservatively. The cost and duration of hospitalization of patients with shock status at the time of admission to the hospital were statistically higher than those without shock status (p=0.001; p=0.025). Morbidity and cost of patients with high grades (grade 4 or 5) were higher than those with low grades (p=0.008 and p=0.027, respectively). There was no mortality except for a patient who underwent splenectomy and had concomitant brain parenchymal damage.
Conclusions: Conservative treatment of kidney injuries for children is effective and safe. Additional injuries, shock status and high-grade cause morbidity, mortality and cost increases.

Keywords: Trauma, Child, Renal, Crush, Cost, Conservative treatment

INTRODUCTION

Trauma is one of the main causes of mortality for children. Head, abdomen, thorax, and extremities are the most injured areas in childhood. 80-90% of childhood traumas constitute blunt traumas. 10-20% of them are kidney injuries. Most of the blunt kidney injuries in children (85%) are low-grade.[1] Compared to adults, children have weaker abdominal muscles and less

protective chest walls. In addition, their kidneys are moving, placed lower in the body, the ratio of kidney and body is large, and perirenal fat tissue is less.[1-3] All these anatomical differences cause more kidney injuries in children with traumas compared to adults. Renal injuries detected via evaluation of patients physical examination, laboratory tests, and imaging methods in emergency department. Contrast enhanced abdominal tomography has become the standard of care in the evaluation of the renal trauma. Ultrasonography also has been used but it's sensitivity for renal injury is ranging 25-70%.[4] The criteria of American Association for Surgery in Trauma (AAST) is well-known radiological grading system of renal injuries. In this grading scale injuries graded 1 to5 (grade 1=contusion / limited subcapsular perirenal hematoma; grade 2= <1 cm depth superficial laceration, no evidence of the collecting system involvement; grade 3= laceration >1 cm without extension into the collecting system or renal pelvis; grade 4= extravasation of urine, widening subcapsular hematoma, injured renal artery or vein to result hemorrhage; grade 5= renal hilum or ureteropelvik avulsion, shattered kidney, complete laceration or thrombus of renal artery or vein).[5]

Kidney injuries are treated more conservatively in children, but surgical intervention is necessary for collecting system damage or vascular injuries that disrupts hemodynamics.[6-8] In this study, the experience of kidney trauma in a third-step hospital located at the junction of North-South and East-West roads in the west of Turkey will be discussed.

METHODS

This study was conducted with the consent of the Ethics Committee of Afyon Kocatepe University (2011-KAEK-2, Date: 05.01.2018, Decision no:2018-1-15). This retrospective-cross-sectional study was carried out in accordance with the ethical guidelines of the 1964 Helsinki Declaration and its successor.

Pediatric trauma patients admitted to Afyon Kocatepe University Hospital between 1 January 2012 and 31 December 2017 were examined from the hospital records system. Within the determined time period, 13540 traumatized children were admitted to the emergency department. ICD 10 diagnostic codes (R31.0-Hematuria, S35.00-renal arter, S37.00-Unspecified injury of kidney, S37.01-Minor contusion of kidney, S37.02-Major contusion of kidney, S37.03-Laceration of kidney, unspecified degree, S37.04-Minor laceration of kidney, S37.05-Moderate laceration of kidney, S37.06-Major laceration of kidney, S37.09 -Other injury of kidney) was scanned and 18 patients were reached. The hospital files of 723 patients who were requested to undergo pediatric surgery consultation in the emergency room were examined one by one and 12 renal trauma patients were found as well. Children who had isolated neurosurgery, traumas related with plastic and reconstructive surgery, patients over 18 years of age and children without renal injuries were excluded from the study. The hospital records of the patients were evaluated. Laboratory and radiological examinations were analysed. The presence of hematuria was obtained from daily patient chart and complete urine count. The degree of renal injury was recorded from CT or USG reports. The Grade of renal injury was determined by the criteria of American Association for Surgery in Trauma (AAST).[5] Patients with renal injury were evaluated in terms of age, gender, type of trauma, degree of renal injury, additional organ damage, treatment method, duration of hospitalization, shock status, cost and mortality.

Statistical analysis

Chi-Square and Fisher's exact Chi-square test were used for categorical data analysis. Mann-Whitney U test was used to evaluate quantitative data. The percentage and frequency distributions were calculated as descriptive statistics for categorical data and the mean and standard deviation values for quantitative data were found. Statistical analysis was performed using SPSS (SPSS version 20.0, SPSS Inc., Chicago, IL, USA). P <0.05 was considered as statistically significant.

RESULTS

Within the determined period, a total of 13540 children with trauma were admitted to the emergency department. Renal trauma was observed in 30 patients (0.22 %). The 23 of these patients were males, and there were 7 females. Males statistically subjected to trauma more than females. The mean age of the patients was 12.10±5.70753 (0-18 years old). The mean duration of hospitalization was 10.23±17.067 days (0-68 days).

The reasons of kidney injury were found as traffic accident outside of the vehicle (n=9, 30%), fall (n=8, 26.7%), traffic accident inside the vehicle (n=6, 2%), bicycle and motorcycle accident (n=5; 16.7%), and firearm injury (n=2, 6.7%). Hematuria (n=8, 26.7%), grade 1 (n=12, 40%), grade 2 (n=2, 6.7%), grade 4 (n=5, 16.7%), and grade 5 (n=3, 10%) kidney injuries were detected in the patients. Isolated renal injuries were found in 7 patients. Additional organ injuries were found remaining of all patient.

The 24 patients underwent medical and 6 patients had surgical intervention. Surgical interventions included bronchoscopy, JJ catheter placement, splenectomy, and nephrectomy. A double J catheter was placed in one patient who had hematoma and urinoma (large uro-hematoma) with grade 4 injury, due to the treatment of side effects, which might be developed secondary to this patient's urinoma, such as infection, kidney damage, etc. One patient with grade 5 injury underwent nephrectomy. Crush syndrome developed in a patient with minimal chance disease history and bilateral grade 4 injury after a traffic accident. In the first 16 hours, diagnosis was made and dialysis was started.

Figure 1: Bilateral grade 4 kidney injury: a motorcycle accident which develops crush syndrome.

The patient has been following up in a healthy way without a kidney damage. All patients, except the 3 mentioned above, were followed up and treated conservatively without any surgical intervention to the kidney.

One patient was operated due to splenic laceration and severe head trauma. The patient passed away on the first postoperative day due to brain injury

The cost averaged was calculated as 4948.37±10198.51 TL (107.96-40738.58).

Patients who underwent surgical treatment were treated in hospital for longer periods than patients who underwent medical treatment (p= 0.018). Kidney injuries were classified as hematuria grade 1-2-3 patients with low grade and grade 4-5 patients with high grade. Patients with high grade had significantly longer morbidity than patients with low grade (p=0.008). The hospital costs patients with high grade were higher than those with low grade (p=0.027).

Table 1: Duration of hospitalization and cost rates according to the degree of kidney damage.

		Patient number	Duration of hospıtalizatıon			Cost (TL)		
		N	N (day)	Mean-SD	P value	Sum	Mean	P value
Low grade	Grade 1	12	37	3.08		24294.76	2024.56	
	Grade 2	2	2	1		1241.93	620.96	
	Hematurıa	8	153	19.12	P=0.008	69155.82	8644.47	P=0.027
High grade	Grade 4	5	55	11		37252.81	7450.56	
	Grade 5	3	60	20		16505.94	5501.98	
	General	30	307	10.84		148451.26	4848.506	

Table 2: The effects of additional injury on duration of hospitalization and cost.

Additional ınjury	Patient number	Duration of hospitalization			Cost		
	n	n (day)	Mean-SD	p value	Sum (TL)	Mean-SD	p value
Yes	23	275	11.9±19.07	p=0.471	144149.94	6267.38±11361.25	p=0.069
No	7	32	4.57±5.06		4301.32	614.47±402.55	

Table 3: The effects of shock status on cost and duration of hospitalization.

Shock	Patient number	Duration of hospitalization			Cost (TL)		
	n	n (day)	Mean-SD	p value	Sum	Mean-SD	p value
Yes	12	237	19.75±24.05	p=0.025	136407.12	11367.26±14098.66	p=0.001
No	18	70	3.89±4.01		12043.98	669.11±311.41	

The duration of hospitalization of patients with additional injuries was found to be statistically the same with the patients who had only renal injuries (p=0.471).

The cost of patients with additional injuries was higher than the patients who had only renal injury. However, this comparison was statistically insignificant (p=0.069).

The duration of hospitalization and cost of patients with shock status at the time of admission to the hospital were statistically higher than those without shock status (p=0.001 and p=0.025, respectively).

In a patient with bilateral grade 4 renal injury, crush syndrome was developed within the first 12 hours and the patient was treated with dialysis. Considering the patient

history, it was noticed that this patient had treated for minimal change disease. In another case with grade 4 injury, due to the development of urinoma, retrograde double J catheter was placed and renal functions of the patient was preserved.

DISCUSSION

In the United States, 5 of every 100 thousand people are exposed to kidney injury each year.[9] Kidney injuries of adults and children are treated as non-operative with very few surgical indications.[10,11]

Overs et al. reported that conservative treatment is an effective method for the preservation of kidney function even in grade 4 or 5 kidney damages.[6] In recent studies, conservative treatment is recommended if the patient is hemodynamically stable. However, hemostasis nephrectomy is inevitable in renal artery injuries that disrupt hemodynamics. In our study, nephrectomy was not performed except in one patient whose hemodynamics deteriorated.

In the study of Langhon et al., 82.1% of adult patients with grade 4-5 injuries were successfully treated with conservative treatments, embolization or endo urogenic interventions without surgical exploration or nephrectomy.[7] In a patient with grade 4 kidney damage, urea and hematoma were emptied with JJ catheter placed from the bladder and complications associated with hematoma/urea were prevented.

Minimally invasive procedures such as angioembolization, stenting, and percutaneous draining for grade 4-5 injuries should be used within indication.[8]

When a hemodynamically stable patient with grade 4 or 5 injury has an active bleeding seen on the initial CT image, endo urology and interventional radiology consider the management of the injury very crucial. For the radio-interventional management of such situations, the experience of the radiologist and technical equipments are the key points.

The severity of kidney injury in renal traumas, additional organ injuries, surgeries that the patient had, hospitalization period, applied treatments and imaging methods can lead to cost increases. There are not enough studies in the literature on cost analysis of patients with renal trauma.[12] In our study, as the degree of renal injury got higher, cost and morbidity increased.

The study of Malcolm et al. on nonoperative treatment of blunt renal trauma for patients with 1-3 grade injuries and grade 4 injuries without urinary extravasation shows that routine follow-up imaging hasn't changed the clinical management and increased the cost.[12]

In our clinic, the patient is evaluated with USG or CT at the time of application to the emergency service and radiological follow-up of the patient is performed with USG except in cases of vascular injury. The patient's clinic is followed very strictly during the follow-up with USG, and CT is preferred when hemodynamic deterioration is present with the ongoing hematuria.

In the literature, additional organ injuries of patients with renal injury usually cause mortality.[11] In our series, a patient who underwent splenectomy due to spleen laceration also had mortality because of brain parenchymal injury.

After the motorcycle accident, a patient with bilateral grade 4 kidney injury, vertebral fracture, lung contusion, and grade 2 in spleen and liver had crush syndrome. Crush syndrome is the systemical manifestation which breakdowns the muscle cells while releasing the contents into circulation. It causes acute kidney injury and metabolic derangement.[13]

Crush syndrome usually appears in patients who are under the dent. It may rarely occur in motorcycle accidents as well as in our case. In crush syndrome, tissue damage and muscle necrosis occurs. Excessive crushing of the muscles can lead to death if there is no rapid and effective treatment.

The cause of death in crush syndrome is severe hypovolemic shock, hypokalemia, hyperkalemia, metabolic acidosis, acute myoglobulinuric kidney failure and compartment syndrome. The main cause of shock is the accumulation of large amounts of extracellular fluid in damaged muscles. Shock development accelerates with nitrogen oxide-induced vessel expansion in damaged muscles, hyperkalemia or hypokalemia and adversely affects the whole circulatory system. Electrolyte disorders should be treated with aggressive intravenous hydration and monitoring of the urine output should be performed. Peritoneal dialysis or hemodialysis have to be performed if the diuretic treatment should be initiated immediately. In our case, although the crushed muscles due to the impact of trauma, we think that the damage of both kidneys and the history of minimal change trigger the progression to crush syndrome.

The type of shock seen in trauma patients is called as hemorrhagic shock. The blood volume and percentage, pulse, blood pressure, respiratory rate, urine output and CNS findings are taken into account in the evaluation of hemorrhagic shock.[14] In present study, there were shock findings in 12 patients. The shock status occurs with interventions such as IV fluid, blood transfusion and a number of surgeons so it increases the duration of hospitalization and cost.

Kidney injuries in children should not be overlooked. Placing a catheter in the kidney as retrograde protects the kidney of selected cases with leakage from the collector system. It should be considered that more severe kidney damages might occur with minor traumas of patients who

previously had kidney diseases or congenital kidney abnormalities.[15]

CONCLUSION

Except for grade 5 damages, kidney injuries of children can be safely monitored with conservative treatment in third-stage hospitals. Additional injuries, shock status and high grade result in increased morbidity, mortality and cost. In addition, patient histories should be taken by keeping in mind that previous kidney diseases may exacerbate the effects of the damaged kidney.

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