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ORIGINAL ARTICLE

Frequency of causes of acute kidney injury at a children tertiary care hospital.

Imran Maqsood[1], Asim Khurshid[2], Hashim Raza[3]

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ABSTRACT… Objective: To determine the frequency of causes of acute kidney injury (AKI) in children at a tertiary care hospital. **Study Design:** Descriptive, Cross-sectional study. **Setting:** Department of Pediatric Medicine, The Children's Hospital & Institute of Child Health, Multan. **Period:** January 2022 to December 2022. **Material & Methods:** A total of 268 children presenting with AKI were analyzed. Once registered, 5 ml venous blood sample was drawn and sent to the laboratory of the hospital for serum creatinine level and blood culture reports. All the relevant information like age, gender, residential status, monthly family income, maternal literacy and their relation to causes of AKI were noted. **Results:** In a total of 268 AKI cases, 164 (61.2%) were boys and 104 (38.8%) girls. The mean age was 4.33±2.57 years. There were 163 (60.8%) children who belonged to rural areas and 105 (39.2%) were from urban areas. Family history of AKI was positive in 61 (22.8%) while mothers of 206 (76.9%) cases were literate. Sepsis was noted in 113 (42.2%) cases, glomerulonephritis in 62 (23.1%) and shock in 65 (24.3%). Sepsis was significantly associated with male gender (p=0.001), younger age (p<0.001), low monthly family income (p=0.002) and family history of AKI (p<0.001). Glomerulonephritis was significantly associated with older age (p<0.001) and maternal illiteracy (p=0.045) while shock was significantly associated with female gender (p=0.013) and family history of AKI (p<0.001). **Conclusion:** Sepsis was the commonest etiological factor for pediatric acute kidney injury followed by shock and glomerulonephritis.

Key words: Acute Kidney Injury, Etiology, Glomerulonephritis, Sepsis, Shock.

INTRODUCTION

Acute kidney injury (AKI) is a clinical manifestation of a reversible build-up of waste products (creatinine and urea) in the blood and an inappropriate regulation of extracellular volume and electrolyte homeostasis.[1] Abrupt decline in renal function results in dysregulation of body electrolytes and volume and retention of nitrogenous waste products. AKI is documented as the commonest progressive cause of morbidity and mortality among children.[2] Pediatric acute kidney injury (AKI) and associated morbidities and mortality have increasing trend all over the world.[3] Standards which have recently been set to define AKI help us to assess epidemiology of pediatric AKI accurately.[4]

In recent times medical health record has been accessible through electronic system, which has enabled the health providers to stratify AKI in real-time and prevent it timely. The clinical scores which have been developed and endorsed recently, have enhanced our expertise to prognosticate AKI and propose reasons for the utilization of the biomarkers among hospitalized children.[5] Newly launched non-invasive biomarkers of AKI have improved the diagnostic ability and AKI prediction and its adversities along with recovery throughout the world.[6]

When compared to children presenting in outpatient department, the proportion of children having acute renal problems is higher among hospitalized children.[7] Reports say that as compared to adults, children exhibit faster recovery from AKI not leaving any residual consequence and complications.[8] AKI in hospitalized patients may often develop certain conditions which

1. FCPS (Pediatric Medicine), Senior Registrar Pediatric Medicine, The Children's Hospital & the Institute of Child Health Multan.
2. FCPS (Pediatric Medicine), Associate Professor Pediatric Medicine, The Children's Hospital & the Institute of Child Health Multan.
3. FCPS (Pediatric Medicine), FCPS (Pediatric Nephrology), Senior Registrar Pediatric Nephrology, The Children's Hospital & the Institute of Child Health Multan.

Correspondence Address:
Dr. Asim Khurshid
Department of Pediatric Medicine
The Children's Hospital & the Institute of Child Health Multan.
asimkhurshiddr@gmail.com

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are life-threatening and considered as the most significant cause of morbidity and mortality among children.[8] In "pediatric intensive care unit (PICU)", renal insult is evident in 5-10% of the patients and in "neonatal intensive care unit (NICU)", the occurrence of AKI among neonates is 8%.[9]

Researchers of the developed countries have conducted numerous studies (retrospective most of them) to evaluate AKI occurrence among seriously ill-children.[7,9] Underdeveloped countries may have different rate of occurrence and risk factors as compared to the developed countries. Therefore, findings of the studies conducted in developed countries may not be valid for the children of underdeveloped countries. In order to prevent and treat AKI, complete awareness about overall rate of occurrence, risk factors and outcome of AKI can be helpful to develop strategies. A study from Saudi Arabia[10] reported sepsis to be present in 45.3% children with AKI while another study[11] reported glomerulonephritis and shock to be the common findings among AKI cases reported in 22.4% and 23.3% cases respectively.

The intention to carry out this study was to ascertain the frequency of different causes of AKI among children of Southern Punjab, Pakistan. This study with a relatively better sample size of AKI cases may provide authentic information on this topic and the results may add reliable database about the population of Southern Punjab, which might help health providers to anticipate different causes of AKI in children.

MATERIAL & METHODS

This descriptive, cross-sectional study was conducted at The Department of Pediatric Medicine, "The Children's Hospital & Institute of Child Health, Multan", Pakistan from January 2022 to December 2022. A sample size of 268 was calculated considering 22.4% frequency of glomerulonephritis[11] at 95% confidence level with 5% margin of error. Non-probability consecutive sampling. Inclusion criteria were children of both genders aged 1-12 years presenting with AKI having minimum duration of AKI as 3 days. Exclusion criteria were known cases of CKD on hemodialysis or those who had COPD, congenital heart diseases, metabolic disorders or malignancies. Children having cerebral palsy, febrile seizures or epilepsy were also excluded. The AKI was labeled as an abrupt (within 48 hours) reduction in kidney function defined by serum creatinine levels > 1.5 mg/dl and decreased urine output (more than 50% reduction). Informed and written consent were acquired from parents/guardians of all children. Approval from Institutional Ethical Committee was also obtained (letter number: 1525, dated: 3-1-2022).

At the time of enrollment, socio-demographic characteristics were noted. Once registered, 5 ml venous blood sample was drawn and sent to the institutional laboratory for serum creatinine level and blood culture reports. These tests were performed by a senior pathologist having minimum of 10 year experience. Diagnosis was made about the different causes of AKI. Sepsis was diagnosed on the basis of positive blood culture (showing bacterial growth on appropriate growth media) on laboratory report. Glomerulonephritis was termed by the presence of red blood cells on urine analysis and (+++) proteinuria on dipstick urine testing which were consistent with ultrasound findings (i.e. increased echogenecity of kidney). Shock was described as the presence of all of these three: i) tachycardia (increased heart rate according to age as assessed clinically by heart beats per minute), ii) cool peripheries (as assessed clinically) and, iii) hypotension (BP less than 50th per centile for age and height). Frequency of causes behind AKI was noted.

Statistical analysis was done using "Statistical Package for Social Sciences (SPSS)", version 26.0. Qualitative variables were shown as frequency and percentages. Quantitative variables were represented as mean and standard deviation (SD). Effect modifiers like age of patients, monthly family income, gender of patient, educational level of mothers and residential status were controlled by making stratified tables. Post stratification chi-square test was applied. P-value < 0.05 was considered as significant.

RESULTS

In a total of 268 children with AKI, 164 (61.2%) were male and 104 (38.8%) female. The mean age was 4.33±2.57 years (ranging 1 to 12 years). The mean age of the male patients was 4.54±2.87 years while that of female was 3.99±1.99 years. Of these 268 study cases with AKI, 163 (60.8%) belonged to rural areas. Monthly family income up to Rs. 35000 was noted in 103 (38.4%) of our study cases. Family history of AKI was positive in 61 (22.8%) children with AKI while 206 (76.9%) mothers of these children were illiterate. Table-I is showing characteristics of children with AKI.

Characteristics		Frequency
Gender	Male	164 (61.2%)
	Female	104 (38.8%)
Age (years)	1-5	61 (77.2%)
	6-12	61 (22.8%)
Residential status	Rural	163 (60.8%)
	Urban	105 (39.2%)
Monthly family income	Low	165 (61.6%)
	Medium	103 (38.4%)
Family history of acute kidney injury		61 (22.8%)
Maternal Literacy	Literate	206 (76.9%)
	Illiterate	62 (23.1%)

Table-I. Characteristics of children with AKI (n = 268)

Sepsis was noted in 113 (42.2%) of our study cases, glomerulonephritis in 62 (23.1%) and shock in 65 (24.3%) as shown in Figure-1.

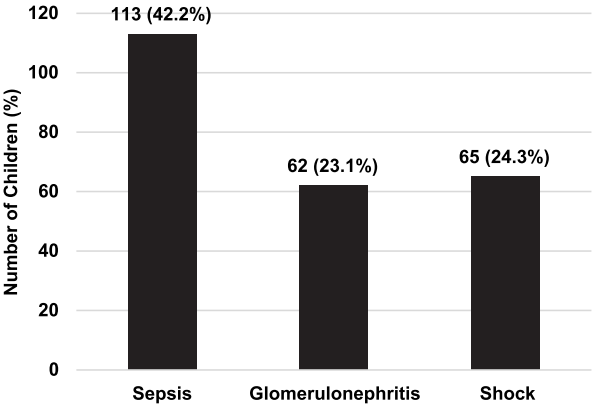

Figure-1. Frequency of causes of acute kidney injury

Sepsis, glomerulonephritis and shock were stratified with regards to gender, age, monthly family income, residential status, maternal literacy and family history and details are shown in Table-II.

DISCUSSION

In the present study, 61.2% children with AKI were male. Tresa et al[11] mentioned the predominance of male gender (60.3%) in their study analyzing children with AKI which is comparable to our findings.

Study Variables		Sepsis		Glomerulonephritis		Shock	
		Yes (n=113)	No (n=155)	Yes (n=62)	No (n=206)	Yes (n=65)	No (=203)
Gender	Male	83 (73.5%)	81 (52.3%)	41 (66.1%)	123 (59.7%)	31 (47.7%)	133 (65.5%)
	Female	30 (26.5%)	74 (47.7%)	21 (33.9%)	83 (40.3%)	34 (52.3%)	70 (34.5%)
	P-value	0.001		0.377		0.013	
Age (years)	1-5	103 (91.2%)	104 (67.1%)	32 (51.6%)	175 (85.0%)	53 (81.5%)	154 (75.9%)
	6-12	10 (8.8%)	51 (32.9%)	30 (48.4%)	31 (15.0%)	12 (18.5%)	49 (34.1%)
	P-value	<0.001		<0.001		0.398	
Residential status	Rural	72 (63.7%)	91 (58.7%)	41 (66.1%)	122 (59.2%)	41 (63.1%)	122 (60.1%)
	Urban	41 (36.3%)	64 (41.3%)	21 (33.9%)	84 (40.8%)	24 (36.9%)	81 (39.9%)
	P-value	0.448		0.375		0.771	
Socio-economic status	Low	82 (72.6%)	83 (53.5%)	42 (67.7%)	123 (59.7%)	21 (32.3%)	144 (70.9%)
	Medium	31 (27.4%)	72 (46.5%)	20 (32.3%)	83 (40.3%)	44 (67.7%)	59 (29.1%)
	P-value	0.002		0.298		<0.001	
Family history of acute kidney injury		41 (36.3%)	20 (12.9%)	31 (50.0%)	30 (14.6%)	11 (16.9%)	50 (24.6%)
	P-value	<0.001		0.119		<0.001	
Maternal literacy status	Literate	83 (73.5%)	123 (79.4%)	41 (66.1%)	165 (80.1%)	54 (83.1%)	152 (74.9%)
	Illiterate	30 (26.5%)	32 (20.6%)	21 (33.9%)	41 (19.9%)	11 (16.9%)	51 (25.1%)
	P-value	0.305		0.045		0.172	

Table-II. Stratification of sepsis with regards to study variables in children with acute kidney injury

A Nigerian study carried out by Esezobor et al[12] presented similar contribution of male gender (68.8%) showing its predominance among children having AKI. Alkandari et al[13] from Canada also found in their study that male gender was predominant (53%) among cases having AKI, which is again in accordance with our findings. The predominance of male gender (66%) was also recorded by Prodhan et al.[14] Moorani et al[15] conducted their study in Karachi and found 56.6% contribution of the male gender among cases of AKI.

In our study cases, the mean age was recorded as 4.33±2.57 years. Mean age described by Tresa et al[11] (7.5±4.4) was in accordance with our findings. In a Nigerian study, Esezobor et al[12] also mentioned similar finding of mean age as 4.8 years. A study from Canada has also shown 5.0±5.5 years as mean age, described by Alkandari et al.[13] From Karachi while the mean age (4.7 years) reported by Moorani et al[15] was also in accordance with our findings.

Sepsis was recorded in 42.2% of the cases whereas 23.1% and 24.3% of the cases presented glomerulonephritis and shock respectively. A study from Saudi Arabia by Al-jboor et al[10] reported 45.3% sepsis in children with AKI which is parallel to our findings. Naik et al[9] mentioned that among children having AKI, shock was noted in 23.3% which also coincides with our findings. The incidence of glomerulonephritis established by Tresa et al[11] in their study was 22.4 % which shows similarity with our findings. Esezobor et al[12] from Nigeria conducted a study and revealed that sepsis (25.7%) was the most common etiological factor of AKI which is comparable with the results of our study. Alkandari et al[13] from Canada has also mentioned similar results in their study.

The present study adds important findings to existing literature. From the findings of this study, sepsis was found to be the most frequent cause behind AKI among children. Children presented with AKI should be suspected to accompany AKI while thorough clinical and laboratory parameters must be analyzed to assist timely diagnosis and treatment of children with AKI.

Being a single study from a tertiary childcare hospital of South Punjab, Pakistan, our findings cannot be generalized. Further research analyzing all anticipated etiologies behind AKI among children should be conducted to further add valuable information.

CONCLUSION

Sepsis was the commonest etiological factor for pediatric acute kidney injury followed by shock and glomerulonephritis in our study. Sepsis was significantly associated with male gender, younger age, low monthly family income and family history of AKI. Glomerulonephritis was significantly associated with older age and maternal illiteracy while shock was significantly associated with female gender and family history of AKI.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Imran Maqsood	Data collection, Data analysis, Literature review.	
2	Asim Khurshid	Study concept, Proof reading.	
3	Hashim Raza	Data collection, Drafting, References.	