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Frequency of Acute Kidney Injury in Paediatric Patients Admitted With Sepsis in Ayub Teaching Hospital

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ABSTRACT

Background: Acute kidney injury (AKI) is a frequent and potentially life-threatening complication of pediatric sepsis and is associated with adverse outcome, including increased morbidity, extended hospitalization, and increased mortality. The reported frequency of sepsis-associated AKI varies widely, and regional data from Khyber Pakhtunkhwa are limited. This research aimed to assess the frequency of acute kidney injury among pediatric patients with sepsis in a tertiary care hospital. **Objectives:** To assess the prevalence of acute kidney injury in pediatric population admitted as a case of sepsis in Ayub Teaching Hospital **Materials & Methods:** This cross-sectional study was carried out in the Department of Pediatrics, Ayub Teaching Hospital, over six months period after approval of the research synopsis. The study population included pediatric patients from 1 month to 14 years of age admitted with sepsis. A sample size was calculated as 165 using WHO calculator for sample size, based on anticipated AKI proportion of 19%, with 95% confidence level and 6% absolute precision. A Consecutive non-probability sampling was used to enroll patients. Children with congenital renal anomalies or chronic kidney disease were excluded. Demographic data variables (age, gender, residence), urine output, and laboratory parameters including serum creatinine, urea, electrolytes, CRP, TLC, and blood culture were collected. Categorical variables were reported as frequencies and percentages, while continuous variables were summarized as mean ± SD or median (IQR) based on normality assessed by the Shapiro–Wilk test. Stratification was performed, and Fisher's exact test was applied, with $p \leq 0.05$ considered statistically significant. **Results:** The mean age of the patients was 22.3 ± 14.2 months. There were 13 (7.9%) patients with AKI with sepsis. The mean urine output was significantly reduced in patients with AKI as compared to those without AKI (0.36 ± 0.26 vs. 1.79 ± 0.72 ml/kg/hr). AKI was found to be statistically significant association with decreased urine output ($p = 0.001$), while no significant association was observed with gender. **Conclusion:** Acute kidney injury was found in a notable proportion of children admitted with sepsis and was strongly associated with reduced urine output. Early identification of renal involvement through close monitoring of urine output and renal function may help reduce complications and improve outcomes in pediatric sepsis.

INTRODUCTION

The Kidney Disease: Improving Global Outcomes (KDIGO) defines acute kidney injury (AKI) as a condition where there's either an increase in serum creatinine (SCr) levels by at least 0.3 mg/dL or a 50% rise within 48 hours from the baseline value or up to a week following hospital admission leading to reduction in urine output. The severity of AKI is categorized by KDIGO from stage 0, indicating no AKI, to stage 3, which is determined by the greatest change in SCr levels or the lowest urine output during the hospitalization period [1].

The primary factors leading to acute kidney injury include hepatorenal syndrome and sepsis, each accounting for 31.6% of cases. Nephrotoxic drugs are responsible for 21% of instances, while dehydration is the cause in 10.5% of cases. Additionally, bile pigment-associated acute tubular necrosis also contributes to this condition [2].

Acute kidney injury (AKI) is a frequent complication in a pediatric patients admitted to ward and its incidence varies between 26% of the children hospitalized with some degree of AKI[3]. Acute kidney injury (AKI) often leads to extended hospitalizations, longer durations in the critical care unit (CCU), and the necessity for mechanical ventilatory support[7]. The mortality rate for AKI varies

widely, ranging from 44% - 78%. Furthermore, children who recover from AKI are at a high risk of enduring kidney damage(9). Symptoms such as proteinuria, high blood pressure, and a decreased rate of glomerular filtration (GFR) can continue to affect up to 60% of those who survive the condition[3,6].

Sepsis in pediatric population is defined as inflammatory response of the body against infection in the form of abnormal temperature, abnormal leukocyte count with tachycardia and tachypnea in the presences of suspected or proven infection[4].

Research indicates that acute kidney injury (AKI) is becoming more prevalent in hospitalized patients, with occurrences ranging between 35% to 85%. In cases of moderate sepsis, about 19% of patients are affected by AKI. This %age escalates as the severity of sepsis worsens, with nearly half of the patients suffering from septic shock also developing AKI. [5,8]

This research aims to assess the prevalence of AKI in children presenting with sepsis. Sepsis is a relatively common condition within our community, yet there is a very limited research on this topic. Given that the incidence of AKI can vary from one group to another, and considering that no such study has been conducted locally or in KPK. This investigation will furnish current and comprehensive data on the occurrence of AKI in pediatric sepsis cases. The findings will be disseminated among local medical professionals to highlight the seriousness of this issue and to inform the development of future studies and treatment recommendation.

MATERIALS AND METHODS

This cross-sectional study was carried out in the Department of Pediatrics, Ayub Teaching Hospital, Abbottabad, Pakistan, over a period of six months from November 15, 2024 to May 15, 2025 after approval of the research synopsis. Ethical approval was obtained from the Hospital Ethical Committee of Ayub Teaching Hospital and the CPSP Research Committee, and written informed consent was taken from parents or legal guardians prior to enrollment. The study population comprised children from 1 month to 14 years of age of both genders admitted with sepsis as per operational definition. A sample size was calculated as 165 using WHO calculator for sample size, assuming an anticipated proportion of AKI in sepsis of 19%, with 95% confidence level and 6% absolute precision. A Consecutive non-probability sampling was used to enroll patients. Children with renal derangement due to congenital renal malformations or chronic kidney disease were excluded. Following enrollment, demographic data such as age, gender, and residence were recorded, and clinical assessment together with laboratory investigations including CBC, kidney function tests, serum electrolytes, C-reactive protein (CRP), and blood culture were performed. Using aseptic conditions, 4–5 mL of venous blood was collected, of which 1 mL was analyzed in an EDTA bottle for three-part differential using an automated hematology analyzer (NIHON KOHDEN MEK-6500/MEK-6510, Nihon Kohden Corporation, Tokyo, Japan), while the remaining sample was processed in the hospital laboratory. Data were collected by the primary investigator on a standardized data collection proforma, ensuring confidentiality, and were recorded and statistically analyzed using SPSS version 27.0.

Data Analysis

Data were statistically analyzed using the SPSS version 27.0. Categorical variables including gender, place of residence, blood culture results, maternal education, and presence or absence of acute kidney injury were summarized as frequencies and percentages. Continuous variables including age, weight, monthly income, CRP, TLC, serum urea, serum creatinine, serum electrolytes, and urine output were evaluated for normality using the Shapiro–Wilk test. normally distributed variables were expressed as mean ± standard deviation (SD), while non-normally distributed variables were presented as median with interquartile range (IQR). To infer findings from the sample to the target population, acute kidney injury status was stratified across age groups, gender, blood culture results, clinical symptoms, and other relevant variables. Fisher's exact test was used for Post-stratification comparisons, and a p-value ≤ 0.05 was considered statistically significant. All results were presented in the tabular form and graphical diagrams.

RESULTS

Age range of this study was from birth to 14-year-old patients with mean age of 22.3 ± 14.2 months, and mean values of sodium, potassium and chloride was 137.54 ± 13.45 mg/dl, 3.94 ± 0.58mg/dl and 98.43 ± 4.26mg/dl respectively as shown in table no 1.

Table 1

N=165

	Mean	Std. deviation
Age (months)	22.33	14.26
Sodium (mg/dl)	137.54	13.45
Potassium (mg/dl)	3.94	0.58
Chloride (mg/dl)	98.43	4.26

Mean urine output in patients with AKI was 0.36 ± 0.2 ml/kg/hr, while in patients without AKI was 1.79 ± 0.7 ml/kg/hr and mean age in patients with AKI was 27.0 ± 9.5 months, while in patients without AKI was 21.93 ± 14.5 months as shown in table no 2.

Table 2

N=165

		Acute Kidney Injury		
		Mean	**N**	**Std. deviation**
Age (months)	Yes	27.00	13	9.58
	No	21.93	152	14.54
	Total	22.33	165	14.26
Urine Output (ml/kg/hr)	Yes	0.36	13	0.26
	No	1.79	152	0.72
	Total	1.68	165	0.79

Frequency of acute kidney injury was 13 (7.9 %) of total 165 patients. Among the patients 87 (52.7 %) were male and 78 (47.3 %) were female as shown in table no 3.

Table 3

N=165

		Frequency	percentages
Acute	Yes	13	7.9%
Kidney	No	152	92.1%
Injury	Total	165	100.0%
Gender	Male	87	52.7%

	female	78	47.3%
	Total	165	100.0%

On stratification of data there statistically significant relation between acute kidney injury and decreased urine output. There was no significant relation between AKI and gender of the patient as shown in table 4.

Table 4
N=165

Acute Kidney Injury					
		yes	No	Total	p-value
Gender	Male	9	78	87	0.2146
	Female	4	74	78	
	Total	13	152	165	
Urine Output (ml/kg/hr)	≤0.5 ml/kg/hr	9	2	11	0.001
	>0.5ml/kg/hr	4	150	154	
	Total	13	152	165	

DISCUSSION

Sepsis was recognized as a multifactorial syndrome that arises from an aberrant host immune response to an infectious trigger, and remained on of the leading cause of morbidity and mortality in pediatric patients. Sepsis is characterized by a combination of aberrant host inflammatory response to infection, altered microvascular blood flow, and metabolic derangement was found to contribute to renal epithelial cells cycle arrest and apoptosis. Early diagnosis of sepsis associated AKI was therefore considered crucial for early initiation of renal replacement therapy. Creatinine was identified as late marker for diagnosis and to date several biomarkers were evaluated, with neutrophil gelatinase associated lipocalin (NGAL) being one of the most extensively researched.[10]

Relationship between sepsis and AKI was studied extensively in the literature. one study reported incidence of AKI was 9.6%, including 4.5% death, 1.7% renal replacement therapy and 5.8% persistent kidney dysfunction which was comparable to the incidence observed in the present study.[12] In another study almost one in four hospitalizations with severe sepsis was complicated by AKI, which was associated with more than threefold increased risk of mortality, and a reported prevalence of 23.6%, significantly higher than that observed in the current study, which included all sepsis cases[11]. A large multicenter study from china reported much lower AKI incidence rate of 0.32% of AKI with mortality rate of 3.4%, whereas studies from Nigeria, India and Pakistan showed 41.5%, 50.4% and 30% mortality rates respectively.[13]

Hemodynamic instability was also shown to play critical role in the development of AK. Fitzgerald JC et al demonstrated that the odds of AKI increased by 9% when the systolic blood pressure remained below first percentile for more than 35 minutes. Furthermore, prolonged duration of severe systolic hypotension in the first 48 hours of pediatric sepsis management was associated with higher incidence of AKI[14].

Overall, the findings in this study emphasized the need for early renal risk stratification, close monitoring of urine output and serum creatinine, and timely optimization of hemodynamics and fluid management in septic children. Early identification of AKI was associated with opportunities for adjustment of nephrotoxic medication, appropriate antibiotic dose modification and initiation of renal protective strategies which were considered likely to improve clinical outcomes.

CONCLUSION

Sepsis associated AKI continues to be a major complication in pediatric sepsis, leading to increased morbidity and mortality. Decreased urine output showed a significant association with the onset of AKI. Early detection of hemodynamic instability and close monitoring of renal function are essential to decrease AKI incidence. Early renal protective intervention and timely renal replacement therapy may improve outcomes in septic children.

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