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Original Article

Association of Various Factors with Acute kidney injury in Children Presenting with Acute Gastroenteritis

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ABSTRACT

Objective: To study the association of various factors with Acute kidney injury in children presenting with Acute Gastroenteritis in pediatrics department.
Study design: Comparative cross-sectional.
Place and Duration of Study: Department of Pediatrics, Combined Military Hospital Bahawalpur, Pakistan from Apr 2021 to Apr 2022.
Methodology: The children under the age of 12 presenting with Acute Gastroenteritis diagnosed by consultant pediatrician were included in the study. They underwent all baseline investigations and assessed in detail by consultant pediatrician for presence of Acute kidney injury (AKI). Factors like age, gender, duration of illness and level of dehydration were assessed with presence of AKI among the children included in the study.
Results: Out of 400 children presenting with Acute Gastroenteritis, 239(59.75%) were male while 161(40.25%) were female. Mean age of the children included in the study was 6.54±3.35 years. 317(79.25%) had no evidence of AKI while 83(20.75%) were diagnosed with AKI. 243(60.75%) had mild, 123(30.75%) while 34(8.5%) children had severe dehydration. Severity of dehydration had statistically significant association with presence of AKI in patients presenting with Acute Gastroenteritis (*p*-value<0.001).
Conclusion: Acute kidney injury was not an uncommon finding in children present with Acute Gastroenteritis. Patients with severe dehydration were more at risk of having AKI as compared to those with no or mild dehydration.

Keywords: Acute Gastroenteritis; AKI; Dehydration

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INTRODUCTION

Kidneys are one of the vital organs of body which if are not working properly may lead to serious short term and long term consequences in patients.[1] Statistics from across the globe reflect that acute kidney failure carries very high mortality and morbidity especially if not addressed in time.[2] Situation becomes more grave and difficult when it comes to health care system of developing countries where health facilities are not satisfactory especially in rural areas and mortality increase manifold.[3] Children are otherwise vulnerable group of population which need thorough assessment and early intervention in most of the health care related problems. Acute Gastroenteritis has been one of the most commonly diagnosed medical illness in pediatric group of patients in all parts of the world.[4] If untreated or severe in symptomatology, it may lead to various complications like dehydration, electrolyte imbalance, renal impairment, metabolic derangements, shock, coma and even death.[5,6] Early assessment and prompt management of Acute Gastroenteritis is usually key to prevent life threatening complications in these patients.

Acute Gastroenteritis in children is usually a self-limiting disease but if not managed properly in time may lead to devastating complications. Cao *et al*. in 2013 published a multicenter study from china and revealed that number of causes may lead to Acute kidney injury (AKI) in children and dehydration was observed as a cause in around 7.5% of their study participants.[7] Gauchan et al. in 2020 studied relationship of deranged renal functions and electrolytes with presence and severity of dehydration. They came up with conclusion that dehydration was seen in considerable number of children with acute watery diarrhea and deranged renal functions and electrolyte imbalances were significantly associated with increased severity of dehydrations.[8] Bradshaw *et al*. did a comprehensive analysis of national data of United States regarding acute renal impairment in children suffering from diarrhea and requiring hospitalization they came up with the findings that

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AKI was not an uncommon complication of patients admitted in hospital with diarrheal illness. Those patients who had risk factors of kidney injury along with diarrheal illness were more prone to develop renal impairment.[9]

Viral origin Acute Gastroenteritis has been one of the most common childhood illnesses along with bacterial gastroenteritis. Usually a self-limiting illness requiring adequate rehydration for few days but in some patients due to various risk factors or poor rehydration it can convert into a potentially life threatening illness involving management at tertiary care hospitals. A local study conducted in Bannu district, Khyber Pakhtunkhwa, Pakistan concluded that Acute Gastroenteritis is a highly prevalent clinical condition in children in our pat of the world especially children under the age of 6 years. Limited local data has been published regarding complications faced by these children during the course of illness. We therefore planned this study with the rationale to study the association of various factors with AKI in children presenting with Acute Gastroenteritis at our pediatrics department.

METHODOLOGY

This comparative cross-sectional study was conducted at the departments of Pediatrics, Combined Military Hospital Bahawalpur from April 2021 to April 2022. WHO sample size calculator was used to calculate the sample size for this study with population prevalence proportion of AKI in children presenting with Acute Gastroenteritis as 35%.[11] Nonprobability consecutive sampling was done to recruit the patients for this study.

Inclusion criteria: Patients of either gender between the age of one and twelve years diagnosed with Acute Gastroenteritis by consultant pediatrician in our hospital during were included in the study.

Exclusion criteria: Children with chronic gastroenteritis, congenital abnormalities, metabolic abnormalities, already diagnosed children with renal impairment or failure or those who were immunocompromised due to any acute or chronic condition, were excluded from the analysis. Children whose parents refused to participate in study or those who could not undergo baseline investigations to assess the renal functions were also not included in the study.

Ethical approval (IREB letter number: EC-12-2022) was granted by the ethical committee before the start of study and primary caregivers gave written informed consent. In most of the cases primary caregiver was one of the parents. Diagnosis of Acute Gastroenteritis was made by consultant pediatrician on the basis of relevant history and physical examination supported by laboratory investigations if required.[12] Patients with confounding variables were excluded at this levels by the research team. All those patients who had confirmed diagnosis of Acute Gastroenteritis underwent all baseline investigations especially those necessary to ascertain the renal function. AKI was diagnosed on the basis of clinical and laboratory findings by consultant pediatrician.[13] Hydration status was assessed by research team as well at the time of diagnosis of Acute Gastroenteritis and classed as No dehydration, some dehydration and severe hydration on the basis of clinical signs and pinch test. Research team designed a special proforma with all these variables for this study.

Descriptive statistics were used in the study to describe the variables of the study. Qualitative variables were mentioned in frequency and percentage. Mean and standard deviation was calculated for age of the patients included in the study. Pearson chi-square analysis and Fischer exact test was used to establish the association between age, gender, duration of illness and level of dehydration with AKI. Statistical Package for the social sciences (SPSS) version 23.00 was the software used to process all the data and perform the analysis. Differences between groups were considered significant if *p*-values were less than or equal to 0.05.

RESULTS

Out of 400 children presenting with Acute Gastroenteritis, 239(59.75%) were male while 161(40.25%) were female. Mean age of the children included in the study was 6.54±3.35 years. 317(79.25%) had no evidence of AKI while 83(20.75%) were diagnosed with having AKI. 243(60.75%) had mild, 123(30.75%) had some while 34 (8.5%) children had severe dehydration. 241(60.25%) children were having gastroenteritis of less than 3 days duration while 159(39.75%) children were having gastroenteritis for more than 3 days (Table-I).

In children <6 years of age (n=240), 45 had AKI while in other group having age ranging from 6 to 12 years (n=160) 38 children had AKI (*p*-value =0.229). Out of 83 children who had AKI 46(55.4%) were males while 37(44.6%) were females (*p*-value= 0.368). It was revealed that severity of dehydration had statistically

significant association with presence of AKI in patients presenting with Acute Gastroenteritis. 22 out of 34 children presenting with severe dehydration had evidence of AKI with a *p*-value<0.001 (Table-II).

Table-I: Characteristics Of Children Included in Study(n=400)

Study parameters	n (%)
Age (years)	
Mean + SD	6.54±3.35
Range (min-max)	1 year - 12 years
Gender	
Male	239(59.75%)
Female	161 (40.25%)
Level of dehydration	
No dehydration	243(60.75%)
Some dehydration	123(30.75%)
Severe dehydration	34(8.5%)
AKI	
No	317(79.25%)
Yes	83(20.75%)
Duration of illness	
<3 days	241(60.25%)
>3 days	159(39.75%)

Table-II: Association of Various Factors With Presence of Aki In Study Participants: Pearson Chi-Square And Fishers Exact Test (N=400)

Factors	No AKI	AKI	*p*-value
Age			
<6 years	195(61.5%)	45(54.2%)	0.229
6-12 years	122(38.5%)	38(45.8%)	
Duration of illness			
<3 days	191(60.2%)	50(60.2%)	0.998
>3 days	126(39.8%)	33(39.8%)	
Gender			
Male	193(60.8%)	46(55.4%)	0.368
Female	124(39.2%)	37(44.6%)	
Levels of dehydration			
No	214(67.5%)	29(34.9%)	<0.001
Some	91(28.7%)	32(38.5%)	
Severe	12(3.8%)	22(26.5%)	

DISCUSSION

Considerable number of children in our study had developed Acute kidney injury (AKI) as a result of gastroenteritis and this complication was found associated with severity of dehydration. Pediatric age group makes a big chunk of our population with limited number of specialist physicians especially in far flung areas. Health related awareness is also limited in most parts of rural areas therefore sometimes otherwise self-limiting illnesses may become potentially lethal in children of these areas. Acute Gastroenteritis though considered as a self-limiting illness in most cases but still remains one of the leading causes of mortality and morbidity in children of low and middle income countries. Complications in most cases may be mild and manageable but in some cases organ failure may occur. AKI is one of the preventable complications of Acute Gastroenteritis.

Bradshaw *et al*. in 2019 determined the incidence, correlates, and consequences of AKI among children hospitalized with diarrheal illness in the United States.[15] They came up with the findings that 0.8% of the patients presenting with diarrheal illness had AKI. They also revealed that patients who developed AKI were more at risk of mortality and long hospital stay. Around 20% of patients presenting with Acute Gastroenteritis showed AKI and diagnosis of renal failure was associated with severity of dehydration. Difference in results with an American study may be due to entirely different social and cultural background of patients and quality of primary care services.

Marzuillo *et al*. in 2021 evaluated presence of AKI and its risk factors in children hospitalized for Acute Gastroenteritis and identified early predictors of AKI.[16] Around 1/4th of their study participants showed the presence of AKI and longer duration of symptoms before hospitalization, dehydration, and lower serum bicarbonate levels were associated with presence of AKI. Our results supported the findings generated by Marzuillo *et al*. as AKI was not an uncommon finding in children present with Acute Gastroenteritis in our hospital. Patients with severe dehydration were more at risk of having AKI as compared to those with no or mild dehydration which is similar to conclusion drawn by our study. In their study the checked association of serum bicarbonate level with AKI but we did not assess and correlate this variable.

Vakrani *et al*. conducted a retrospective study in India in 2021 regarding assessment of clinical features, treatment, and prognosis of AKI in cholera patients.[17] They concluded that AKI was common in these patients but not associated with level of dehydration. There was no increased mortality observed in these patients and all of them recovered uneventfully. We did not follow up patients for long term but AKI was observed in 20% patients and more in those who had severe dehydration. This variation is result might be associated with other study variables.

Shahrin *et al*. in 2020 conducted a study in Bangladesh regarding clinical and laboratory

parameters of patients admitted with diarrheal illness at a tertiary care hospital.[18] They revealed that dehydration, sepsis, and hypernatremia were the factors associated with AKI in their pediatric patients. Our findings supported the results generated by Shahrin *et al*. In our study assessed the correlation between dehydration and AKI but association with sepsis and hypernatremia was not assessed.

LIMITATION OF STUDY

Multiple confounding factors may be responsible for acute kidney failure in patients suffering from Acute Gastroenteritis. Strict control of these factors can establish actual association and temporal relationship between ARF and gastroenteritis. Patients were not screened for renal parameters before the onset of Acute Gastroenteritis, therefore it cannot be concluded that ARF was a consequence of gastroenteritis.

CONCLUSION

AKI was not an uncommon finding in children present with Acute Gastroenteritis in our hospital. Patients with severe dehydration were more at risk of having AKI as compared to those with no or mild dehydration.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

ST & AI Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

SA & SZTI: Data acquisition, data analysis, approval of the final version to be published.

KBKR : Critical review, concept, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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