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Etiological observation of Children with Acute Kidney Injury in a Tertiary Care Hospital

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Abstract **Original Research Article**

Introduction: Acute Kidney Injury (AKI), formerly known as Acute Renal Failure, is characterized by a reversible increase in creatinine and nitrogenous waste product concentrations in the blood, as well as the kidney's failure to maintain proper fluid and electrolyte balance. Whether the etiology of AKI varies by area, the incidence of AKI in children appears to be increasing. The etiology of AKI in hospitalized children has shifted from primary renal disease to various causes during the last several decades, particularly in hospitalized children. As a result, further study is needed to determine the most recent trends in AKI in this region. ***Aim of the study:*** The aim of the study was to observe the etiology and its effect on outcome on children. ***Methods:*** This prospective longitudinal study was performed in the Department of Pediatrics, Dhaka Shishu Hospital, Dhaka, during the period of 12 months from January 2015 to December 2015. A total of 50 children were selected from the ones admitted into the hospital following the inclusion and exclusion criteria. A detailed history was taken, thorough physical examination and relevant laboratory investigations were done in all enrolled patients. All underwent necessary supportive care as needed until discharge or death. ***Result:*** In the present study, the mean age of the children was 2.8 ± 1.9 years, with the youngest one being 4 days and the oldest, 12.5 years. Male: female ratio was 1.8:1. Children in the age group of 1-5 years were most commonly affected. Pre-renal cause was the most common cause of acute kidney injury, present in 64% of the cases, and diarrheal complication was the most common disease in pre-renal cases. Mean serum creatinine were extremely high with Mean±SD levels of 4.03±2.81 (mg/dL). ***Conclusion:*** It was observed that, AKI was more common in early childhood (less than 5 years) than more than 5 years. Pre-renal causes etiology was the most common among the participants, and majority of the pre-renal cases were due to the presence of diarrheal complications.

Keywords: Renal, Kidney, Diarrhea, Creatinine, Etiology.

INTRODUCTION

Acute Kidney Injury (AKI) is frequent in developing nations such as Bangladesh. AKI is traditionally characterized as a severe reduction in glomerular filtration rate, resulting in a rise in serum creatinine. It is critical to understand the limits of creatinine as a measure of AKI since a rise in creatinine can occur up to 48 hours after kidney injury has occurred. Despite this restriction, creatinine change remains the gold standard for diagnosing AKI. The epidemiology of AKI has changed over time and now reflects the patient group under investigation. The most prevalent causes of AKI in underdeveloped nations remain to be volume depletion, infection, and primary renal disorders (hemolytic uremic syndrome, glomerulonephritis). Volume depletion and primary renal disease continue to be major causes of AKI in previously healthy children in affluent nations. In hospitalized children in industrialized nations, particularly in tertiary care facilities, the etiology of AKI has shifted from primary renal illness to secondary causes of AKI, which are frequently complex in character and frequently complicate another diagnosis or its treatment (eg: heart disease, sepsis, and nephrotoxic drug exposure). In impoverished nations, pre-renal reasons such as diarrhea, infections, and so on are the most frequent etiology of AKI, whereas in affluent countries, multi-organ failure and post-surgical causes are the most common etiology of AKI [1]. Acute Kidney Injury (AKI), formerly known as Acute Renal Failure, is defined by a reversible rise in blood creatinine and nitrogenous waste product concentrations, as well as the kidney's inability to

control fluid and electrolyte balance correctly [2]. Due to the use of different definitions of ARF in the literature, resulting in substantial differences in reported incidence and outcome, the term ARF was recently replaced with Acute kidney injury (AKI) to offer uniformity of terminology and standardize patient management [3]. Acute kidney damage may be classified into three types: prerenal (induced by reduced renal perfusion, typically due to volume depletion), intrinsic renal (caused by a mechanism within the kidneys), and postrenal (caused by a process outside the kidneys) (caused by inadequate drainage of urine distal to the kidneys). In individuals with pre-existing chronic kidney disease, any of these causes, particularly volume depletion, may produce acute kidney damage in addition to chronic renal function impairment. The frequency of AKI in children appears to be increasing: the etiology of AKI in hospitalized children, in particular, has changed from primary renal disease to multifactorial reasons during the last decades, particularly in hospitalized children. [3] The etiology of AKI varies depending on geography. AKI is more common in older children admitted to intensive care units with multiple co-morbidities and multi-organ failure in developed countries, whereas in developing countries, documented single disease entities such as diarrheal diseases, malaria, hemolytic uremic syndrome, and acute glomerulonephritis are still the leading causes of AKI [4]. AKI is one of the most prevalent life-threatening illnesses in children. It has a major impact on morbidity and mortality in children. The short-term prognosis of AKI therapy is greatly reliant on the underlying cause, the health of the other organs, and the availability of renal replacement therapy [5]. With multi-organ failure, mortality is higher and morbidity is greater [6]. Prerenal causes are responsible for approximately 70% of community-acquired instances of acute kidney damage [7]. The underlying kidney function may be normal in these circumstances, but decreased renal perfusion due to intravascular volume depletion (e.g., from vomiting or diarrhea) or decreased arterial pressure (e.g., from heart failure or sepsis) leads in a lower glomerular filtration rate. Several medicines have been linked to prerenal acute kidney damage. The present study was conducted to observe the ethology of acute kidney injury in children admitted into a tertiary care hospital.

OBJECTIVE

To observe the etiology and its effect on outcome profile of the participants.

METHODS

This prospective longitudinal study was conducted at the Department of Paediatrics, Dhaka Shishu Hospital, Dhaka. Bangladesh. The study duration was one year, starting from January 2015 to December 2015. Initially, the sample size was estimated to be 32 according to the mathematical formula. But in order to increase the validity of the study, the sample size was finalized to be 50. The participants were selected through a convenient sampling method among the children having evidence of kidney injury admitted into the study hospital. Each patient had undergone detailed clinical evaluation and relevant laboratory investigations. Clinical data of each patient was collected in a preformed data collection sheet. A detailed history was taken regarding each patient. Informed written consent was obtained from the legal guardian of the participants, and ethical approval was obtained from the ethical review committee of the hospital. Statistical analysis was performed using the statistical package for social science for windows SPSS version 16 by descript statistics. P value <0.05 considered statistically significant.

Inclusion Criteria

- Children under the age of 15
- Patients fulfilling the definition of acute kidney injury
- Patients who had given consent to participate in the study.

Exclusion Criteria

- Mentally ill.
- Children with acute on chronic kidney disease
- End-stage renal disease

RESULTS

In the present study, the mean age of the children was 2.8 ± 1.9 years, with the youngest one being 4 days and the oldest, 12.5 years. Male: female ratio was 1.8:1. Children in the age group of 1-5 years were most commonly affected. Pre-renal cause was the most common cause of acute kidney injury, present in 64% of the cases, and diarrheal complication was the most common disease in pre-renal cases.

Table 1: Age distribution of the participants (n=50)

Age in years	Frequency (n)	Percentage (%)
<1 month	7	14
1 month - 1 year	14	28
>1 - 5 years	17	34
>5 years	12	24
Total	50	100
Mean age	2.8 ±1.9 years	
Range	4 days – 12.5 years	

Very few children (24%) were older than 5 years of age. 34% of the children belonged to the age group of 1 to 5 years. 28% of the participants were from the age group of 1 month to 1 year, and 14% were less than 1 month of age. The mean age of the participants was 2.8±1.9 years, and the age range of the participants was 4 days to 12.5 years.

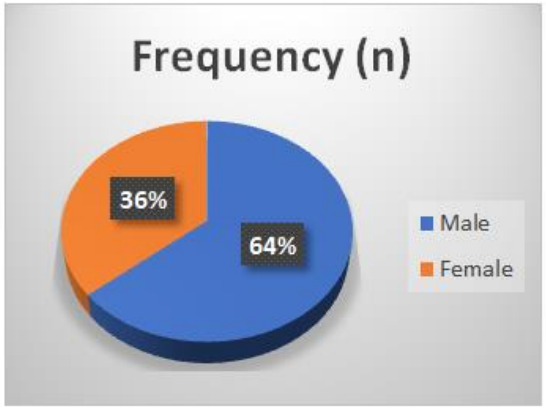

Figure 1: Gender distribution of the participants (n=50)

Among the children, about two-thirds were male (64%), and the remaining one–third (36%) were female. Male: female ratio was 1.8:1.

Table 2: Etiological status of the participants

Causes	Primary Disease	Frequency (n)	Relative Percentage (%)
Pre-renal (64%)	Diarrheal complication	20	62.5
	Septicemia	7	21.9
	Perinatal asphyxia	4	12.5
	Post-surgical	1	3.1
Renal (26%)	Hemolytic Uremic Syndrome (HUS)	5	38.5
	Acute Glomerulonephritis (AGN)	3	23
	Rapidly Progressive Glomerulonephritis (RPGN)	2	15.4
	Wasp bite	2	15.4
	Drug toxicity	1	7.7
Post renal (10%)	Posterior Urethral valve	4	80
	Ureteropelvic Junction obstruction	1	20
Stages of AKI among the participants	Stage 1	20	40
	Stage 2	14	28
	Stage 3	16	32
	Stage 1	20	40

Among the participants, 64% had AKI as a result of pre-renal causes, 26% had AKI due to renal causes and the remaining 10% had post-renal causes. Among the 32 pre-renal cases, majority (62.5%) were due to the presence of diarrheal complications. Renal causes included hemolytic uremic (38.5%), post streptococcal glomerulonephritis (23%), rapidly progressive glomerulonephritis (15.4%), wasp bite (15.4%) and drug toxicity (7.7%). In post renal causes, posterior urethral valve was the most common cause. According to the Acute Kidney Injury Network (AKIN) classification, 40% of patients were in stage 1, 28% of patients were in stage 2 and 32% of patients were in stage 3.

Table 3: Laboratory parameters of the participants during hospital stay (n=50)

Test	Mean	SD
Serum urea (mmol/L)	21	10.2
Serum Creatinine (mg/dL)	4.03	2.81
Serum Sodium (mmol/L)	129.3	6
Serum Potassium (mmol/L)	4.4	0.9
Serum Bicarbonate (mmol/L)	16.4	1.4
Serum Calcium (mmol/L)	1.5	0.3
Serum Phosphate (mmol/L)	1.7	0.4
Blood pH (mm Hg)	7.2	0.9
Urinary Na (mmol/L)	114.7	26.1
eGFR at admission (ml/min/1.73m^2)	190.2±128.6	

Mean serum creatinine at presentation was 4.03±2.81 (SD) mg/dL, which was much higher than normal levels for children. Serum Sodium was low mean of 129.3±6 (SD) mmol/L. Blood pH was mostly acidic 7.2±0.9 (SD) mm Hg. Mean serum urea levels were also slightly elevated. Other serum measurements were among acceptable levels, while mean urinary creatinine level was also much higher than normal.

DISCUSSION

It is a global public health problem with considerable morbidity, mortality, and healthcare costs. Aside from dialysis, no other treatment improves survival, minimizes damage, or accelerates recovery [8]. Acute kidney injury can have many causes, like hypertension, decreased blood flow, organ failure, external damage to the kidneys, blockage of urinary tracts, and many others. Depending on the cause of AKI, it can be classified into pre-renal, renal and post-renal cases. The underlying etiology of AKI strongly influences the outcome. Children with AKI as part of multisystem failure have a considerably greater death rate than children with intrinsic renal illness such HUS, RPGN, and AIN. Recovery from intrinsic renal disease is also heavily influenced by the underlying cause of the AKI. Normal renal function is generally restored in children with nephrotoxic AKI and hypoxic/ischemic AKI. Previously, it was assumed that such individuals had a minimal chance of late sequelae, but numerous recent investigations have shown that chronic kidney disease can develop after AKI [9, 10]. In the current study, the age distribution of the children was found to be 76 percent under the age of five and 24 percent over the age of five. The participants ranged in age from 4 days to 12.5 years. The children's average age was 2.81.9 years. Sixty-four percent of the participants in the study were men, while three-sixths were women. The male-to-female ratio was 1.8:1. The age distribution of AKI patients varies from research to study due to a variety of etiological and geographical variables [11]. A research by Srivastava, which was similar to ours, found that children aged 1-4 years had the greatest prevalence of AKI [12]. Another research, however, found conflicting results, with the majority of participants aged 9 to 12 [13]. Diarrhea was the most common pre-renal cause in this investigation, while GN and HUS were the most common renal causes, therefore only the most prevalent clinical manifestations were included. AKI is becoming more common in industrialized nations as a result of advances in open-heart surgery, bone marrow and solid-organ transplantation for the treatment of oncologic diseases [1, 14]. As a result, AKI is frequently seen in the context of multiorgan failure, hemodynamic instability, and the requirement for vasopressors [15]. However, the patterns of AKI etiology and comorbidities found in this study differ from those observed in industrialized nations. AKI was primarily caused by primary etiology in the current research. The most common cause of AKI in this study was hypovolemia induced by a diarrheal complication. In another research, similar to ours, post-diarrheal AKI owing to hypovolemic shock was the most prevalent pre-renal etiology, while HUS was the most common renal cause [16]. According to the Acute Kidney Injury Network (AKIN) classification, 40% of patients were in stage 1, 28% of patients were in stage 2 and 32% of patients were in stage 3. When observing the mean serum levels, it was observed that, mean Serum Creatinine and urinary creatinine levels were way above the normal levels, while serum urea and eGFR at admission were slightly above the normal range. The remaining mean serum levels were in the acceptable range.

Limitations of The Study

The study was conducted in a single hospital with small sample size. So, the results may not represent the whole community. The study design was not experimental, and prognostic factors were not properly evaluated.

Funding: No funding sources.

Conflict of interest: None declared.

Ethical approval: The study was approved by the Institutional Ethics Committee.

CONCLUSION

It was observed that, AKI was more common in early childhood (less than 5 years) than more than 5 years. Pre-renal causes etiology was the most common among the participants, and majority of the pre-renal cases were due to the presence of diarrheal complications. Mean serum creatinine and urinary creatinine levels were extremely high.

RECOMMENDATION

As the most prevalent cause of AKI in this setting was diarrheal diseases and dehydration, the early detection of prerenal AKI and proper dehydration management would be the most effective measure to reduce the incidence of AKI. Moreover, Exclusive breast feeding, proper handwashing and vaccination would be other important preventive measures to reduce the diarrheal incidence.

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