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Original Research Article

Etiological spectrum and short term outcome of acute kidney injury in children: a prospective study

K. Mahesh, Vishwanath B.*, Kalpana S.

Department of Pediatrics, Vijayanagar Institute of Medical Sciences, Cantonment, Ballari, Karnataka, India

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***Correspondence:**
Dr. Vishwanath. B.,
E-mail: drvishubee@gmail.com.

ABSTRACT

Background: Acute Kidney Injury is a common condition in critically ill children, and it is independently associated with increased mortality. Etiology of AKI in admitted patients is multi factorial. The present study was conducted to determine possible etiologies and to know short term outcome.
Methods: A prospective case series study was conducted in our PICU from Nov 2014 to October 2015. The cases fulfilling criteria as AKI, as per definition were included in study. The urine output was monitored, base line blood urea and serum creatinine was estimated at admission and on alternate days till recovery. Investigations were done to know exact etiology of prerenal, renal or post renal AKI. Cases were managed accordingly and short term outcome was noted.
Results: Out of 150 cases studied, 87(58%) were boys and 63(42%) were girls. Ninety three cases (62%) had oliguria and remaining patients had non-oliguric AKI. Majority of cases in the study belonged to prerenal AKI, followed by renal and post renal AKI. Amongst 150 cases,136 children managed conservatively,11 cases required hemodialysis and 3 cases peritoneal dialysis. In our study, 16 cases succumbed with mortality of 10.66%.
Conclusion: AKI is common associated condition in children admitted to PICU. AKI is commonly seen with acute gastroenteritis with severe dehydration, sepsis, glomerulonephritis and dengue shock syndrome. Most of these conditions are easily preventable. Early and effective management of hypovolemic shock and sepsis is also crucial in prevention of AKI.

Keywords: Acute kidney injury, Children, Etiology, Mortality

INTRODUCTION

Acute Kidney Injury (AKI), previously termed as acute renal failure, is a clinical syndrome in which a sudden deterioration in renal function results in the inability of the kidneys to maintain fluid and electrolyte homeostasis. By definition AKI is an abrupt (within 48 h) reduction in kidney function defined as an absolute increase in serum creatinine of more than or equal to 0.3 mg/dl or an increase in serum creatinine of more than or equal to 1.5-fold from baseline, or a reduction in urine output <0.5 ml/kg/ h for more than 6 hours.[1] AKI occurs in 2-3 % of children admitted to pediatric tertiary care units and in as many as 8% of infants in neonatal intensive care units.[2]

It has been estimated that AKI affects 13.3 million cases per year leading to mortality of 1.7 million deaths per year. Increasing prevalence of AKI is associated with early and long term morbidity and mortality.[3] According to recent meta-analysis conducted, the pooled incidence rate of AKI was 33.7% (95% CI, 26.9 to 41.3) and AKI-associated mortality rates was 13.8% in children (95% CI,

8.8 to 21.0).[4] Four out of 5 cases of AKI occur in developing world.[5] 0 by 25 is an ambitious initiative of International Society of Nephrology which aims to eliminate preventable deaths from AKI world wide by 2025.[3]

Usually, AKI is broadly categorized as pre-renal (secondary to reduced renal blood flow), intrinsic renal disease (from an insult to the renal parenchyma usually due to ischemic, vascular, tubular or glomerular disorders) and post-renal (due to urinary tract obstruction).[6]

During the childhood, the AKI is usually due to sepsis, nephrotoxic drugs and in critically ill patients, renal ischemia.[7]

The spectrum and burden of AKI in developing countries may be different from that of developed countries.[8] The patients from developing countries are younger, infection associated AKI is more common and a significant number of patients may have AKI at admission to hospital. [9,10]

Review of medical literature shows wide variation in etiological spectrum of AKI in developed and developing countries. In developing countries community acquired AKI is very common whereas hospital acquired AKI in frequently observed in developed countries.

AKI is associated with severe morbidity and mortality in children. Incidence, detection, etiological profile and outcome of AKI are important for commencement of preventive and therapeutic strategies. Limited data availability of Indian pediatric AKI and retrospective studies makes it compelling to study etiological profile and outcome of AKI in pediatric patients and current study tries to address this need.

METHODS

This was a prospective and case series study conducted at Vijayanagar Institute of Medical Sciences, a government tertiary teaching hospital at Ballari, Karnataka, India. The study was approved by the Institutional Ethics Committee. All patients with AKI at admission to Pediatric Intensive Care Unit (PICU) or developing later during hospital stay within the age group of 1 month to 15 years admitted in between November 2014 to October 2015 were included in the study. Patients with past history of kidney disease or kidney malformations and post-operative cases were excluded from the study. Informed consent was taken from parents of all participants. Total of 150 cases of AKI which met the inclusion criteria were studied. Diagnosis of AKI was made based on serum creatinine or decreased urine output.

Children with AKI were assumed to be having prerenal AKI if ratio of urea to creatinine is more than 20 and if there is prompt response to fluid boluses. Detailed clinical history taking and examination was done, relevant investigations were done for all children admitted to PICU with AKI using pro forma.

Investigations like complete blood count, urine analysis on two occasions, blood urea, serum creatinine and ultrasound abdomen were done in all cases. Peripheral smear, C3, C4 levels, serum electrolytes, LFT, bleeding profile, 24 hour urinary protein, and renal biopsy were done in selected cases. Blood urea and serum creatinine levels were estimated every alternate day till recovery.

Disease specific treatment was given to etiology that has led to AKI. AKI was managed as per standard protocol and short term outcome was noted. Complete renal recovery was defined as normal serum creatinine for age (0.2-0.4 mg/dl for infants, 0.3-0.7 mg/dl for 1-12 years, 0.5-1 mg/dl for >12 years) and normal blood pressure at discharge. Partial renal recovery was defined as elevated serum creatinine for age or persistent hypertension at discharge.

RESULTS

Out of 150 cases studied, 87(58%) were boys and 63(42%) were girls. Most of the cases were in age group of 6-10 years followed by 1 month to 1 year. Youngest case in study was 45 days old and oldest was 14 years old. Ninety three cases (62%) had oliguria and remaining patients had non oliguric AKI.

Majority of cases in the study belonged to prerenal AKI (78 patients, 52 %), followed by renal AKI in 60 cases (40%) and post renal in 12 patients (8%).Figure 1.

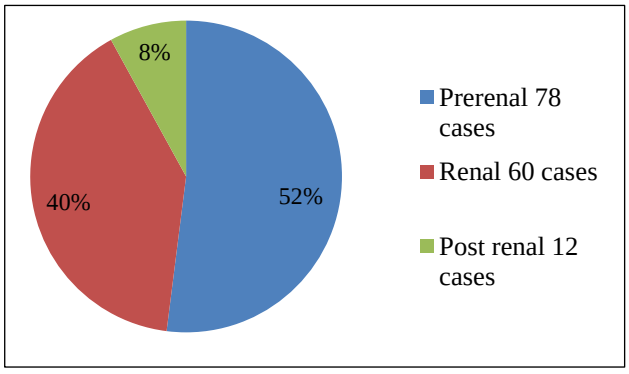

Figure 1: Types of AKI

In prerenal AKI, acute gastroenteritis with severe dehydration was most common etiology (36 cases, 24%). Other causes included sepsis (16 cases, 10.66%), dengue shock syndrome (12 cases, 8%), diabetic keto-acidosis(6 cases ,4%), nephrotic syndrome with volume depletion (4 cases, 2.66%), hepatorenal syndrome(2 cases,1.33%) and CCF (2 cases,1.33%) (Table 1).

In our study, 60 cases had renal AKI. Acute glomerulonephritis was the cause in 35 cases, septicemia in 10 cases, snake bite in 9 cases followed by 2 cases of malaria, hemolytic uremic syndrome and nephrotic syndrome each. Table 2.

Table 1: Etiologic profile of prerenal AKI.

Diagnosis	Number	Percentage
Acute GE with severe dehydration	36	24
Sepsis	16	10.66
Dengue shock syndrome	12	8
DKA	6	4
Nephrotic syndrome with volume depletion	4	2.66
Hepato renal syndrome	2	1.33
CCF	2	1.33
Total	78	52%

Table 2: Etiologic profile of renal AKI.

Diagnosis	Number	Percentage
Acute glomerulonephritis	35	23.33
Septicemia	10	6.66
Snake bite	9	6
Malaria	2	1.33
Hemolytic uremic syndrome	2	1.33
Nephrotic syndrome	2	1.33
Total	60	40%

Out of 150 cases of AKI, 12 children had post-renal cause. Seven cases had bilateral ureteric calculi with hydronephroureterosis and 5 cases had posterior urethral valve with vesico ureteric reflux. Table 3.

Table 3: Etiology of post renal AKI.

Diagnosis	Number	Percentage
Ureteric calculus	7	4.66
PUV with VUR	5	3.33
Total	12	8%

There were total of 26 (17.33%) cases of AKI with sepsis presenting as pre renal AKI in 16 cases and renal AKI in 10 cases.

Among 150 cases, 136 children managed conservatively, 11 cases required hemodialysis and 3 cases managed with peritoneal dialysis.

In our study, 129 cases had complete renal recovery. Four cases of posterior urethral valve and one case of glomerulonephritis had partial renal recovery whereas 16 cases succumbed with mortality of 10.66%. In conservative management group, 11 cases succumbed primarily due to disease that has led to AKI. Among 26 cases of sepsis, 9 patients succumbed accounting for 37.5 % mortality. In dengue shock syndrome, 3 cases died with mortality of 33.33%. In the dialysis group, one case of posterior urethral valve with vesico ureteric reflux died of hospital acquired sepsis and both two cases of hemolytic uremic syndrome which underwent peritoneal dialysis died secondary to uremic encephalopathy (Table 4).

Table 4: Mortality profile of AKI children.

Diagnosis	Number of patients	Number of deaths	Percentage
Septicemia	26	9	37.5%
Dengue shock syndrome	12	4	33.33%
HUS	2	2	100%
PUV with VUR	5	1	20%

DISCUSSION

The present study showed male preponderance with 29 cases(58%) boys and 21 cases (42%) girls. This goes in accordance with study at Baylor college of Medicine, Texas(54 % males and 46% females), JIPMER(54%and 46%) and Brazil 53.6%.[11-13]

In present study, mean age was 12.5 years which is more when compared to other studies (42 months and 56 months), because we noticed most common cause of AKI in our children was acute glomerulonephritis, which usually affects older children.[11,12]

Most of the cases (78 cases) belonged to prerenal cause followed by renal cause (60 cases). Similar observation was made by earlier study at Bangalore in India.[14]

Infections were most common cause of AKI in our study. Among infections, post infectious glomerulonephritis accounted for 35 cases, whereas sepsis was the cause in 26 cases, and dengue shock syndrome in 12 cases. Similar finding was seen in earlier study.[6,15] A study from southern India revealed that infections, post Infectious glomerulonephritis, snake bite and HUS were common causes of AKI.[16] In a study at Egypt, sepsis (36%)and hypovolemia were most frequent reported etiologies. In our study, 14 patients (9.33%) required renal replacement therapy. Similar finding of 11%,5.9% and 8.9% was observed in various studies.[17,18]

In our study, the mortality rate was 10.66%, which is less compared to 46.3% mortality in earlier study at southern India and it is comparable to mortality of 5.2% at nephro-urology center of Pakistan and 12.5% in one more study.[13,19] Highest mortality was seen in among 26 cases of sepsis, where 9 patients succumbed accounting for 37.5% mortality. Similar mortality rate of 34.9% in AKI

secondary to sepsis was observed in earlier study.[20] In dengue shock syndrome, 3 cases died with mortality of 33.33%, as most of them got admitted at terminal stages.

This study has some limitations. Firstly, sample size was small with 150 cases, our study did not cover neonates and post-surgical cases hence major chunk of AKI cases were missed. Nevertheless, being a prospective study, our study describes very relevant information on pediatric AKI spectrum encountered at a government tertiary care referral center in a developing country.

CONCLUSION

AKI is common and important clinical issue in children admitted to PICU. AKI is commonly associated with acute gastroenteritis with severe dehydration, sepsis, glomerulonephritis and dengue shock syndrome. Most of these conditions are easily preventable. These can be prevented by improvements in sanitation, environmental and hand hygiene. Early and effective management of hypovolemic shock and sepsis is also crucial for prevention of AKI. This study stresses the importance of availability of medical renal replacement therapy facilities at resource poor areas..

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