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Original Article

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CLINICAL AND ETIOLOGICAL PROFILE OF ACUTE KIDNEY INJURY IN PEDIATRIC INTENSIVE CARE UNIT

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Abstract

Backgound: Acute kidney injury (AKI) is one of the leading causes of mortality in sick children in Pediatric Intensive Care Units with different risk factors reported across the globe. While the precise incidence and causes of (AKI) in pediatric patients is unknown overall range of incidence reported is from 1 to 25% in critically ill patients The mortality in AKI in children also has been reported to vary widely from 3.4% to 52%.. Hence the need to study the clinical and etiological profile in the local population is significant. as it helps to predict the occurrence of complications and in planning the appropriate treatment. **Objective:** To determine the incidence ,etiology and short term outcome of AKI as defined by AKIN classification in pediatric patients admitted in pediatric intensive care unit (PICU) aged 1 month to 12 years **Materials and Methods:** This was a prospective observational study conducted in all patients between the age 1 month and 12 years admitted from June 2015 to January 2016 in PICU of Goa medical college. Acute Kidney Injury was defined and staged based on Acute Kidney Injury Network criteria using either serum creatinine or urine output .Serum levels of creatinine were estimated at admission and there after every 24+/- 6 hours for 3 consecutive days in all patients. Short term outcome was classified as complete or partial renal recovery. **Results:** incidence of acute kidney injury in this study was 14.8%. with a male preponderance. Mortality was noted to be 46.7%. Majority of AKI [80.0%] was due to intrinsic renal causes and sepsis being the commonest etiology. Prolonged duration of hospital stay was associated with progression to higher stages of AKI. **Conclusion:** The most common etiology of AKI was sepsis (46.6%) followed by drug induced (16.7%). this association was statistically significant as the p value was 0.006.Patients with a longer duration of hospital stay had poor prognosis with 100% partial recovery in >14 days hospital stay group, p value was 0.005.

Key Words: *Acute kidney injury, serum creatinine*

INTRODUCTION

Acute kidney injury is associated with adverse outcomes, especially in children admitted to the pediatric intensive care unit (PICU). The concept of acute kidney injury has undergone significant re-examination in recent years. acute kidney injury(AKI) is a clinical syndrome in which a sudden deterioration in renal function results in inability of kidney to maintain fluid and electrolyte homeostasis. It is one of the leading causes of mortality in sick children in Pediatric Intensive Care Units. Risk factors for acute kidney injury include age, sepsis, cardiac surgery, infusion of contrast medium, diabetes, rhabdomyolysis, and preexisting renal disease, as well as hypovolemia and shock.

The designation "acute renal failure" seems too broad and there is currently a preference for the term "acute kidney injury"(1). The acute dialysis quality initiative came up with criteria for different stages of renal injury summarized by the acronym RIFLE, which stands for risk ,injury, failure, loss and end-stage kidney. This was subsequently modified by the Acute Kidney Injury Network (AKIN) criteria, with few comparisons between the two systems. The Acute Kidney Injury Network defines 'Acute Kidney Injury' as an abrupt (within 48 hours)reduction in kidney function defined as an absolute increase in serum creatinine of more than or equal to 0.3 mg/dl, an increase in serum creatinine of more than or equal to 1.5-fold from the baseline, or a reduction in urine output (documented oliguria of less than 0.5 ml/kg/hour for more than 6 hours)(2).

While the precise incidence and causes of AKI in pediatric patients is unknown, recent studies suggest that the incidence of AKI in hospitalized children is increasing . The incidence of AKI varies widely across the globe due to geographical, cultural and economic dissimilarities(2). hence it is necessary to study the etiological profile and outcome of AKI in the local population as it helps to predict the occurrence of complications and in planning the appropriate treatment. The overall incidence of acute kidney injury worldwide is difficult to assess .the International Consensus Conference in Intensive Care Medicine mentions an overall range from 1 to 25% in critically ill patients.

The mortality in AKI in children also has been reported to vary widely. Many studies on AKI in children are limited to developed countries. and most of them being retrospective. There is limited data on the clinical and etiological profile of pediatric AKI in indian children with a wide variation in the cause of AKI depending on the region. Hence a study on the clinical and etiological profile of AKI is being undertaken.

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MATERIALS AND METHODS

A prospective observational study. conducted in all patients between the age 1 month and 12 years admitted in Pediatric intensive care unit, Goa medical college from June 2015 to January 2016

Inclusion Criteria

All children admitted in Pediatric intensive care unit in the age group 1 month to 12 years during the study period.

Exclusion Criteria

- Chronic kidney disease at presentation
- Duration of PICU stay < 24 hours
- Refused consent

Tools

Acute Kidney Injury Network criteria, Prestructured proforma, Mercury sphygmomanometer with 2 different cuff sizes, stethoscope, non-stretchable measuring tape, infantometer, electronic weighing scale, cotton swabs,Povidone Iodine, 2 ml disposable syringe, sterile needles, plain bottle, bottle rubber cap.

Definitions

Acute Kidney Injury is defined as an abrupt reduction in kidney function defined as an absolute increase in serum creatinine of more than or equal to 0.3 mg/dl, an increase in serum creatinine of more than or equal to 1.5-fold from the baseline, or a reduction in urine output (documented oliguria of less than 0.5 ml/kg/hour for more than 6 hours)(2). Hypertension was defined as elevated systolic and/or diastolic blood pressure more than or equal to 95th percentile for the age, height and gender on three or more occasions (3). Acute Tubular Necrosis was defined as renal dysfunction in a setting of diarrhea with dehydration, cardiac disease, hemorrhage, sepsis, nephrotoxic drugs, tropical febrile illnesses, envenomations, in the absence of an active urinary sediment. Sepsis was diagnosed using the International Pediatric Sepsis Consensus Conference definition (4).

Data Collection Process

After obtaining permission from the Institutional Review Board all the children aged 1 month to 12 years admitted in Pediatric intensive care unit , satisfying inclusion/exclusion criteria were included after taking Informed consent

Information about the child's age,sex, time of onset of AKI (whether at the time since admission itself or later) and detailed history was taken to ascertain the etiology of AKI, like presence of loose stools or vomiting (dehydration), hematuria (glomerulonephritis), fever (sepsis), decreased urine output, history of envenomation or poisoning, intake of nephrotoxic drugs etc

A detailed physical examination was done including measurement of blood pressure using a mercury sphygmomanometer . In a child height was taken while in case of infants, length was measured using an infantometer. Weight was measured using an electronic weighing machine with the degree of accuracy to the nearest 0.1 kg.. A urine sample was also taken to look for the presence of protein and cells. A midstream urine sample was sent for urine culture and sensitivity testing in case urinary tract infection was suspected to be the cause of AKI. In case the patient was already catheterized at the time of inclusion in the study, urine output was measured using the urobag attached to the same. In case of non-catheterised patients, catheterization was avoided to prevent the risk of urinary infection following catheterisation and hence the urine voided each time was collected in a measuring jar and the sum total was taken every 24 hours to measure the urine output. For infants pamper weighing method was used to measure urine output.

Staging of AKI was done based on Acute Kidney Injury Network criteria. Either serum creatinine or urine output was used to stage AKI, using the criterion which leads to a higher stage of AKI. The serum creatinine value obtained was compared with either a baseline serum creatinine done before the onset of AKI, or age-specific normal value of serum creatinine (5). Serum levels of creatinine were estimated at admission and there after every 24+/- 6 hours for 3 consecutive days in all patients. Subsequently estimation was done at daily interval in patients with AKI until discharge/death. In non AKI patients creatinine estimation was done every 48hours till discharged from picu. Repeat measurement of serum creatinine was done, if found elevated more than the value at diagnosis, AKI was diagnosed or noted as having progressed to the higher stage. The urine output was also considered and if found to be further decreased when compared to the value at diagnosis, progression to higher Acute Kidney Injury Network criteria stage was noted.

Short term outcome was classified as complete renal recovery and partial renal recovery. Complete renal recovery was defined as normal urinalysis, blood pressure and serum creatinine for the age, 0.2 – 0.4 mg/dl for infants; 0.3 – 0.7 mg/dl for 1-2years and 0.5-1 mg/dl for 3-18 years.(5). Partial renal recovery was defined as elevated serum creatinine, presence of abnormal urinalysis, >5 RBC or WBC per high power field or urine protein to creatinine ratio >0.2mg/mg(6). Statistical analysis was done using SPSS version 16.Qualitative data was entered in frequencies and percentages. Categorical data was analyzed using Pearson Chi square test. Significance was fixed at $p < 0.05$.

Acknoledgement

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RESULTS AND DISCUSSION

In this study , out of the total 202 patients screened, 30 patients developed AKI. Thus the incidence was 14.8%. The overall incidence of AKI worldwide is difficult to assess. The International Consensus Conference in Intensive Care Medicine mentions an overall range from 1 to 25% in critically ill patients. Tilly Yard A *et al* also mentions similar incidence (2) while AIIMS, Delhi study reported a higher incidence of 36.1%. South India study by Sreeram K, Parameshwaran N *et al*, the incidence was 25.1%.

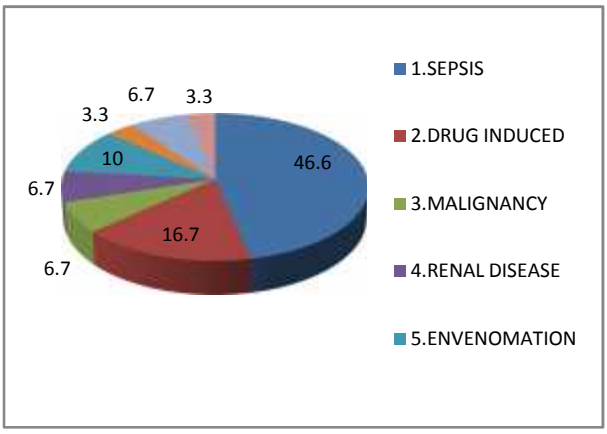

Figure no.1 Distribution of the study sample to acute kidney injury etiology

Most common clinical presenting feature was fever (86.7%), while 33.3% presented with edema.10% with urine discoloration while 27% had normal colored urine. 43.3% cases in this study had decreased urine output. Agarwal I *et al* study on clinical profile of AKI mentions oliguria presenting in 66.6% cases of AKI while fever in 53.3% cases. peripheral edema was present in 50% cases.(7)

Majority of cases included in this study were above 5 years of age(53.3%) while 30% of cases were <1 year of age .16.6% belonged to 1-5 years with a male preponderance of 63.3% with a mean age of 67.63 months while median age was72.0 months. Most of the patients in each age group had renal type of AKI, while 11.1% were post renal cases and rest of the cases in 1-5 year and >5 year group were prerenal ,20.0% and 18.7% respectively.Similar male preponderance was also noted In a study done by Krishnamurthy S *et al*, and Agarwal I *et al* in South India.(7,8)

In majority of cases(36.7%), AKI was diagnosed at admission while 26.7% of cases developed AKI within 3 days of hospital stay. 26.6% cases in 4-7 days of hospital stay and 10% of cases after 7 days of hospital stay. In a study from southern India among children with AKI, the majority [72.3%] had AKI at admission itself (8).

Table no 1 Distribution of study population with respect to AKI etiology and final outcome

AKI ETIOLOGY	COMPLETE RECOVERY	PARTIAL RECOVERY	TOTAL
SEPSIS	5(71.4%)	2(28.5%)	7(100.0%)
DRUG INDUCED	0(0.0%)	1(100.0%)	1(100.0%)
MALIGNANCY	0(0.0%)	1(100.0%)	1(100.0%)
RENAL DISEASE	1(50.0%)	1(50.0%)	2(100.0%)
ENVENOMATION	1(50.0%)	1(50.0%)	2(100.0%)
SHOCK	2(100.0%)	0(0.0%)	2(100.0%)
TOTAL	9(60.0%)	6(40.0%)	15(100.0%)

Most of the patients at follow up were sepsis with aki patients who had 71.4% complete recovery .shock patients had best prognosis,100% complete renal recovery while malignancy and drug induced aki had only partial recovery .renal disease and envenomation cases had 50% complete recovery. this association was statistically significant as p value was 0.023 and chi- square value 9.271.

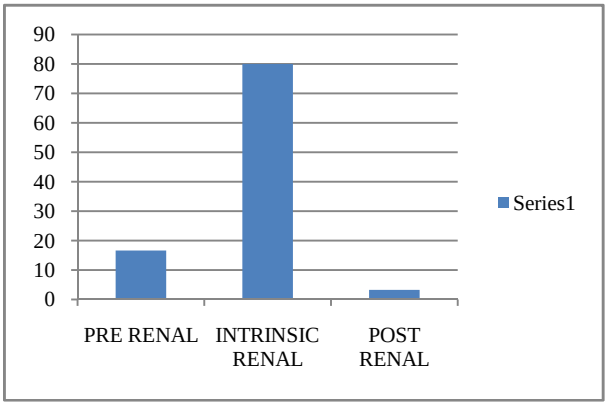

Figure 2 Distribution of the study sample with respect to type of acute kidney injury

Table no 2 Distribution of study population with respect to duration of hospital stay and final outcome

Duration of hospital stay	Complete recovery	Partial recovery	Total
0-3 days	0(0.0%)	0(0.0%)	0(0.0%)
4-7 days	6(100.0%)	0(0.0%)	6(100.0%)
7-14 days	3(42.8%)	4(57.1%)	7(100.0%)
>14 days	0(0.0%)	2(100.0%)	2(100.0%)
TOTAL	9(60.0%)	6(40.0%)	15(100.0%)

Patients with a longer duration of hospital stay had poor prognosis with 100% partial recovery in>14 days hospital stay group,those with hospital stay between 7-14 days showed 57.1% partial recovery.those with lesser hospital stay (4-7 days) had 100% complete recovery.this association was statistically significant as p value was 0.005 and chi square value 7.857.

At diagnosis, 53.3% of cases of AKI belonged to Stage 1 of AKIN Criteria, while 26.7% were Stage 2 and 20.0% were Stage 3. Of the total number of AKI patients 7 progressed to a higher stage during the course of disease. In a prospective multicentre study by Piccinni P,Cruz D N *et al*, where RIFLE criteria was used, progression of AKI to a worse class was seen in a higher number (30.8%) of patients (9). Similar findings noted by Krishnamurthy S,Mondal N *et al* in their study on incidence and etiology of AKI (8). Most of the patients in <1 year group remained as stage 1 AKI while 44.6% progressed to stage 2 AKI. In 1-5 year group most patients attained maximum stage 2 and 3 (40.0%) and in bigger children >5years most patients reached

maximum stage 2(40.0%) while 26.7% reached stage 3. A recent prospective multicentre study on Chinese children with AKI showed 615 children [48.9%] in stage 1, 277 [22.0%] in stage 2, and 365 [29.0%] in stage 3 (10).

Among the patients with AKI mortality was found to be 40.0% ,58.3% and 37.5% respectively in stages 1, 2 and 3. Agarwal I,Kirubakaran C *et al* 7) reported a mortality of 52%. while a prospective multicentre study on Chinese children reported a lower mortality of 3.4% (10) AIIMS study noted a mortality of 46.2% (6) while Manthan M *et al*, reported mortality of 20.1% (11).

Majority of AKI [80.0%] was due to intrinsic renal causes, while it was due to pre-renal causes in 16.6% cases and post-renal causes in 3.3% of cases. most of the cases of AKI presented as pneumonia at admission(23.3%). while malignancy ,renal disease and snake bite presented as 10% each. Connective tissue disorders, dengue fever and gastroenteritis had 6.7% each. 3.3% cases of heart disease and 3.3% cases of enteric fever were also noted. 3.3% cases were immunodeficiency cases. Rest of the cases were included as others(6.7%) in the classification. Most of the cases of AKI were due to sepsis (46.6%). second most important etiology was drug induced AKI (16.7%). Post-renal AKI [which formed 3.3% of total cases] was due to posterior urethral valve [3.3%]. In a prospective multicentre study on Chinese children, the most common causes of AKI were renal causes [57.52%]similar to this study; whereas postrenal causes were a higher number [25.69%] than this study and prerenal [14.96%] causes were less common; In another study in India by Mishra OP on peritoneal dialysis in AKI, hemolytic uremic syndrome [36.8%] was the most common cause of AKI, followed by septicemia [24.6%] and acute tubular necrosis [19.3%](12).

Most important cause ofAKI was sepsis(46.6%). In <1 Year group 77.8% were sepsis induced AKI11.1% due to cardiovascular cases and 11.1% due to obstructive uropathy. In 1-5 year group 40% was due to drug induced and malignancy and 20% due to shock. > 5year group also had a preponderance of sepsis induced AKI (43.7%) while envenomation causing AKI was noted in (18.7%) cases. Renal diseases constituted (12.5%) of cases in this group while 18.7% cases were due to drug induced and 6.2% due to shock. .this association was statistically significant as the p value was 0.006 chi square value was 28.383.

Patients with a longer duration of hospital stay progressed to higher stages of AKI. Those with 0-3 days hospital stay were mostly stage 2 while those with 4-7 days stay were 50% stage 2 and 8.4% stage 3, which progressed to 25% stage 3 in 7-14 days hospital stay.>14 days hospital stay had worst prognosis as majority progressed to stage 3 AKI Hence prolonged duration of hospital stay was associated with progression to higher stages of AKI. This association was statistically significant as the p value was 0.028 and chi –square value 11.458.

Patients with a longer duration of hospital stay had poor prognosis with 100% partial recovery in>14 days hospital stay group, those with hospital stay between 7-14 days showed 57.1% partial recovery.those with lesser hospital stay (4-7 days) had 100% complete recovery. This association was statistically significant as p value was 0.005

45.4% had partial recovery while 54.5% had complete recovery. This was similar to another Indian study by Poonam Mehta *et al* on incidence of AKI in children with 52.1% showing complete recovery(6).

Among the survival population, <1 year group had better prognosis with 75% having complete recovery while 1-5 year group had 50% complete recovery.among children >5 years 55.5% complete recovery.

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