Original Article

Acute Kidney Injury: Causes, Laboratory Findings and Impact of Conservative Management on its Outcome

Causes of Acute Kidney Injury

Syed Sajid Hussain Shah[1], Mohammad Ali Raza[1], Shahzad Najeeb[1], Bibi Alia[3], Khyal Muhammad[1] and Ejaz Hussain[2]

ABSTRACT

Objective: To know the major causes, changes in laboratory findings and impact of conservative treatment on outcome in patients with AKI.

Study Design: Retrospective study

Place and Duration of Study: This study was conducted at the High Dependency Unit (HDU) of Paediatric B Ward, Ayub Teaching Hospital, Abbottabad from January, 2018 to December, 2019.

Materials and Methods: Young children of both gender and age between 1 month to 2 year diagnosed with AKI were included while patients with other and chronic co-morbid were excluded. A predesigned proforma was used to extract the data regarding demographics, investigations, diagnosis, and outcome. Data was analyzed using SPSS v.20.0.

Results: In total of 50 patients the means age of the sample was recorded as 6.82 ± 5.95 years, in which 29 (58%) were males and 21 (42%) were females. The serum creatinine of had a mean value of 2.06 ± 1.23 mg/dl, while blood urea recorded a mean of 137.75 ± 62.80 mg/dl. Majority 45 (90%) of patients were admitted with diagnosis of septicemia leading to AKI. In total, 30(60%) patients got discharged, 18(36%) patients expired and 2(4%) patients were referred to other centers.

Conclusion: Septicemia is leading cause of AKI in young children and high mortality was recorded for conservative management.

Key Words: children, acute kidney injury, septicemia, outcome

Citation of article: Shah SSH, Raza MA, Najeeb S, Alia B, Muhammad K, Hussain E. Acute Kidney Injury: Causes, Laboratory Findings and Impact of Conservative Management on its Outcome. Med Forum 2020;31(10):148-151.

INTRODUCTION

Acute kidney injury (AKI) is defined as "the abrupt loss of kidney function, leading to a decrease in glomerular filtration rate (GFR), and impaired control of acid-base, electrolyte and fluid balance."[1] It is associated with high mortality and morbidity and one of the common issues in children who are admitted to intensive care unit and high dependency unit.[2] The children with AKI are prone for chronic kidney injury (CKD) in long term. Studies have shown that significant number of paediatric patients are at risk for CKD in coming few years after episode of AKI.[3]

Though there are different criteria used for predicting AKI in children yet the RIFLE (Risk, Injury, Failure, Loss, End Stage Renal Disease) criteria was the first consensus approach for identification and management of AKI.[4]

Serum Creatinine is also used for assessment of AKI but it is insensitive marker rather it is late marker of acute kidney in jury. The level of serum creatinine rises when already there is loss of 25-50% renal function.[5] There are advance AKI markers like cystatin C, neutrophil gelatinase-associated lipocalin, interleukin 18, kidney injury molecule 1, neutrophilelastase-2 and liver-type fatty acid-binding protein.[6] But these advance markers are not available in most of the tertiary care hospitals in third world countries. The exact incidence of AKI is not known in children, yet different studies have reported different incidence rate. One study form Africa showed the incidence of AKI in children 12.7 / 1000 admissions. Severe AKI was present in 64.7% and mortality rate of 26.5%.[7] Another study from Nigeria showing the incidence of AKI 17.4 cases / 1000 children in one of teaching hospital.[8] The incidence of AKI in Pakistan in not know as no such study has been done. Literature search has shown the incidence of AKI 5% in children who were hospitalized. While children who were admitted to paediatric intensive care unit (PICU) and neonatal intensive care unit were having incidences of 30% each.[9]

[1.] Department of Paediatric / Neonatology[2], Ayub Teaching Hospital, Abbottabad.
[3.] KMU Institute of Medical Sciences.

Correspondence: Syed Sajid Hussain Shah, Assistant Professor, Ayub Medical College, Abbottabad.
Contact No: 0332-9294374
Email: syed_sajid20@yahoo.com

Received: March, 2020
Accepted: June, 2020
Printed: October, 2020

Most of the data in children with AKI and its management are from west. Though there are studies from our part of world yet most studies have limitations. Children who are admitted to high dependency unit (HDU) and PICU are at risk for developing AKI. None of studies done in Pakistan has shown the causes of AKI and outcome of conservative management. The objective of this study is to know the major causes, changes in laboratory findings and impact of conservative treatment on outcome in patients with AKI.

MATERIALS AND METHODS

This study was conducted in HDU of Paediatric B ward, Ayub Teaching Hospital, Abbottabad. This was retrospective study and data was retrieved from the patient records after approval of institutional review board. The data was recorded from January, 2018 till December, 2019 i.e. over two years. It was cross sectional study. Sample size was calculated by open epi sample size calculator taking incidence of AKI 5%, confidence limit 5% and confidence level 95%.[9] Calculated sample size was 73 patients. But as our hospital is not referral center for paediatric nephrology services, so the estimated sample size was 50 patients. Retrieved from data young children of either sex from age of 1 month to 2 years were selected. Admitted patients who remain in HDU with diagnosis of acute kidney injury and preceding cause and who were given dopamine infusion in renal dose i.e. 3-5 microgram/kg/min were included in the study. Children known case of renal anomalies, chronic kidney disease, syndromic features and post-operative surgery were excluded. Due to non-existence of paediatric subspecialties including paediatric nephrology and infrastructure, peritoneal dialysis was not done in any of the patient. Patients with acute kidney injury and underlying pathology, age, sex, weight, urea, creatinine, diagnosis and outcome in hospital were recorded on predesigned proforma. Any patient in whom serum creatinine 1 mg/dl or more were taken as acute kidney injury and outcome recorded in form of discharge, expire, referred and left against medical advice. Data was analyzed by SPSS 20 and Chi square test applied.

RESULTS

There were total of 50 patients included in the study, 29 (58%) were male and 21 (42%) were females. Age of patients ranged from 1 month to 24 months with mean age of 6.82 ± 5.95 years. Out of 50 patients, 45 (90%) patients were 12 months or less in age while only 5 (10%) patients were more than one year of age. Weight of patients ranged from 1.8 kg to 12 kg with mean weight of 5.68 ± 2.69 kg.

The serum creatinine of patients ranged from 1.08 mg/dl to 7.60 mg/dl with mean value of 2.06 ± 1.23 mg/dl. Blood urea ranged from 70 mg/dl to 416 mg/dl with mean of 137.75 ± 62.80 mg/dl. Ultrasound of renal tract could not be done during the hospital stay in 36 (72%) patients due to critical condition. In 14 patients where ultrasound was done, one (2%) patient had normal study, 3 (6%) patients had urinary tract anomaly and 10 (20%) patients had renal parenchymal disease and increase echogenicity. During the stay urine detail report could not be done in 35 (70%) patients. In remaining 15 (30%) patients, 11 (22%) patients had microscopic hematuria.

Majority 45 (90%) of patients were admitted with diagnosis of septicemia leading to AKI. Other diagnosis included 2 (4%) patients with pyogenic meningitis, 2 (4%) patients with acute gastroenteritis and severe dehydration, one (2%) patient with diabetic ketoacidosis. Out of 50 patients, 30 (60%) patients got discharged, 18 (36%) patients expired and 2 (4%) patients were referred to other centers. Males had more expiry as compare to females as shown in table 1. Patients with age one year and less also had more expiries as compare to over one year children as shown in table 2.

Table No.1: Gender vs outcome

Sex	Outcome			Total
	Discharge	Expire	Referred	
Male	17	11	1	29
Female	13	7	1	21
Total	30	18	2	50

Table No.2: Age category vs outcome

Agecategory	Outcome			Total
	Discharge	Expire	Referred	
12.00 months and less	26	17	2	45
12.01 months and above	4	1	0	5
Total	30	18	2	50

DISCUSSION

AKI is one of the common complications in children admitted to paediatric intensive care unit and HDU.[10] Though AKI was considered to be self limiting after recovery from the hospital yet literature has shown that it is associated with chronic sequelae.[11] Studies have shown that paediatric patients with AKI had more visits to doctor and have increase chance of hospitalization after discharge form hospital.[12] Devarajan P[9] in mini review recommended to use the early non invasive biomarkers for diagnosis of AKI in children but in our set up availability of these biomarkers is limited. Muhle-Goll C et al[13] did one pilot study and concluded that Nuclear magnetic resonance spectroscopy in children with AKI has got high diagnostic accuracy. But this in not available in our part of the world and we have to rely on clinical findings for diagnosis. In this study the patients with AKI had increased serum

creatinine. Though serum creatinine is insensitive biomarker yet it indicates serious renal damage. This study has been done to know the major causes, changes in laboratory findings and impact of conservative treatment on outcome in patients with AKI.

Quenot JP et al[14] in one of editorial reported the incidence of AKI in children 45 to 70% with sepsis, while is our study the patients in whom AKI develop, sepsis was in 90% of patients. It is too high in our study population. Bekele BA et al[15] in one of study included children aged 4 months to 15 years where as in our study patients were aged from 1 month to 2 years. In their study females were 54.3% while in our study females were 42%. Sepsis along with diarrhea and pneumonia constitute for 20% of cases with AKI while in our study sepsis and diarrhea accounted for 94% of AKI.

Kari JA et al[16] did study in paediatric intensive care units of three tertiary care hospitals in Kingdom of Saudi Arabia. In their study it was concluded that patients with AKI complicated 1/3rd of intensive care patients and has six time mortality as compare to children with normal renal function. In our study the mortality associated with AKI was 36%. Rasheed S et al[17] did study in Nishtar Hospital Multan and Bahawal Victoria Hospital, Bahawalpur and included children aged 1 to 10 years. In their study 75.7% patients recovered and 3.8% expired, while in our study children less than 2 years were included and 36% patients expired. Expiry in our study population is too much high as compare to Rasheed S et al study. Rustagi RS et al[18] did one study in paediatric intensive care unit of one developing country and included 53 children with AKI. Severe dehydration, central nervous system illness and acute lower tract infections were the underlying causes of AKI. The children with AKI had 4.5 times more mortality rate as compare to children who were not having AKI and admitted in intensive care unit. In our study the under lying disease was sepsis in 90% of patients and two patient had meningitis and two patients with severe dehydration and 36% patients expired. Gupta S et al[19] in their study included children with AKI based on pRIFLE criteria. In their study majority (56%) of patients were females while in our study majority (58%) were males. The major cause leading to AKI in their study was septicemia and multi-organ dysfunction syndrome which accounted for 59.39% while in our study sepsis accounted for 90% causes of AKI. In their study mortality in children with AKI was 46.03% while in our study it was 36%.

Adedoyin OT et al[20] did one study in Nigeria and included children aged 4 to 17 years and in their study sepsis was cause of AKI injury in 28% of patients while in our study the patients were young and sepsis was cause of AKI in 90% of patients. Macedo E et al[21] in their study which was part of "The Global Snapshot, conducted by the ISN '0 by 25' AKI initiative" evaluated paediatric patients with AKI who were hospitalized. Paediatric patients with AKI in upper middle income countries and low and low middle income countries are 11 fold higher adjusted risk of death as compare to patients in high income countries. Baalaaji M et al[22] studied AKI in children with DKA. In their study 71.8% patients recovered with fluid management. In our study there was one child with DKA having AKI who recovered.

In one of the editorial by Ranawaka R et al[23], it was concluded that use of dopamine for management AKI in not beneficial and long term follow up of children should be done to for complete recovery and to detect and monitor for recurrence and progression to CKD. In our study dopamine was used for management but mortality was also 36%. Andreoli SP[24] in one of editorial review concluded that intervention in form of dopamine in renal dose does not affect the AKI course. In fact, prognosis of patient depends on underlying pathology and these patients can develop chronic kidney disease in coming years after initial presentation.

Westrope C et al[25] did one audit to assess the efficacy of continuous renal replacement therapy (CRRT) in children with acute kidney injury in UK and Ireland. There is no facility of renal replacement therapy in out set up. Mortality in infants was around 38.5% while in our study mortality was 36% which is almost equal. Deep A et al[26] in their study also concluded that paediatric AKI patients need supportive care and mostly drugs interventions are not effective. Renal replacement therapy was recommended as main supportive therapy including peritoneal dialysis, CRRT and hemodialysis. Due to logistic issues peritoneal dialysis was not available in our setup, so only conservative management was done in children with AKI but the mortality was too high i.e. 36%. Goldstein SL[27] in one of editorial recommended using the renal replacement therapy modalities in management of paediatric AKI. There are limitations in this study. The data has been corrected retrospectively. Dopamine was given in the patients but underlying pathology was also important as blood culture was not sent in any of the patient due to non-availability in hospital.

CONCLUSION

This study concluded that younger males have higher incidence of AKI and sepsis was found to be the major cause of AKI. The study also recorded a high mortality with conservative management.

Author's Contribution:

Concept & Design of Study:	Syed Sajid Hussain Shah
Drafting:	Mohammad Ali Raza, Shahzad Najeeb
Data Analysis:	Bibi Alia, Khyal Muhammad, Ejaz

	Hussain
Revisiting Critically:	Syed Sajid Hussain Shah, Mohammad Ali Raza
Final Approval of version:	Syed Sajid Hussain Shah

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. McCaffrey J, Dhakal AK, Milford DV, Webb NJA, Lennon R. Recent developments in the detectionand management of acute kidney injury. Arch Dis Child 2017;102:91–6.
2. Alkandari O, Eddington KA, Hyder A, et al. Acute kidney injury is an independent risk factor for pediatric intensive care unit mortality, longer length of stay and prolonged mechanical ventilation in critically ill children: a two-center retrospective cohort study. Crit Care 2011;15:R146
3. Mammen C, Al Abbas A, Skippen P, et al. Long-term risk of CKD in children surviving episodes of acute kidney injury in the intensive care unit: a prospective cohort study. Am J Kidney Dis 2012;59:523–30.
4. Uber AM, Sutherland SM. Acute kidney injury in hospitalized children: consequences and outcomes. Pediatr Nephrol 2020;35:213–20.
5. Askenazi DJ, Ambalavanan N, Goldstein SL. Acute kidney injury in critically ill newborns: what do we know? What do we need to learn? Pediatr Nephrol 2009;24:265–74.
6. Alge JL, Arthur JM. Biomarkers of AKI: a review of mechanistic relevance and potential therapeutic implications. Clin J Am Soc Nephrol 2015;10: 147–55.
7. Shimelis D, Abebe B, Deyessa N. Incidence of Acute Kidney Injury and Determinant Factors in Children Admitted to a Tertiary Hospital. IOSR-JDMS 2018;17(3):48-53.
8. Esezobor CI, Ladapo TA, Osinaike B, Lesi FEA. Paediatric Acute Kidney Injury in a Tertiary Hospital in Nigeria: Prevalence, Causes and Mortality Rate. PLoS ONE 2012;7(12): e51229.
9. Devarajan P. The Current State of the Art in Acute Kidney Injury. Front Pediatr 2020;8:70:1-8.
10. Kaddourah A, Basu RK, Bagshaw SM, Goldstein SL. AWARE Investigators: Epidemiology of acute kidney injury in critically ill children and young adults. N Engl J Med 2017;376:11–20.
11. Sigurjonsdottir VK, Chaturvedi S, Mammen C, Sutherland SM. Pediatric acute kidney injury and the subsequent risk for chronic kidney disease: Is there cause for alarm. Pediatr Nephrol 2018; 10.1007/s00467-017-3870-6.
12. Sutherland SM. Long-Term Consequences of Acute Kidney Injury in Children. Clin J Am Soc Nephrol 2018;13:677–8.
13. Muhle-Goll C, Eisenmann P, Luy B, Kölker S, Tönsho B, Fichtner A. Urinary NMR Profiling in Pediatric Acute Kidney Injury—A Pilot Study. Int J Mol Sci 2020;21:1187.
14. Quenot JP, Dargent A, Large A, Roudaut JB, Andreu P, Barbar S. Treatment of sepsis-induced acute kidney injury in the ICU: the therapeutic targets do not seem to be established yet. Ann Transl Med 2019;7(Suppl 6):S181.
15. Bekele BA, Shimelis D, Iyengar A, Pais P. Clinical profile and outcome of Children who received renalreplacement therapy for acute kidney Injury in Tikur Anbessa specialized hospital; an isn/ src trio experience. Kidney Int Reports 2019;4:S137.
16. Kari JA, Alhasan KA, Shalaby MA, Khathlan N, Safdar OY, Rezgan SAA, et al. Outcome of pediatric acute kidney injury: a multicenter prospective cohort study. Pediatr Nephrol 2018; 33(2):335–40.
17. Rasheed S, Haq Z, Shah MW, SanaUllah. Functional Outcome of Acute Kidney Injury in Children Reporting in a Teaching Hospital. Ophthalmol Update 2018;16(3):722-5.
18. Rustagi RS, Arora K, Das RR, Pooni PA, SinghD.Incidence, risk factors and outcome of acute kidney injury in critically ill children – a developing country perspective. Paediatrics and International Child Health 2017;37(1):35-41.
19. Gupta S, Sengar GS, Meti PK, Lahoti A, Beniwal M, et al. Acute kidney injury in Pediatric Intensive Care Unit: Incidence, risk factors, and outcome. Indian J Crit Care Med 2016;20(9):526–9.
20. Adedoyin OT, Bello OA, Anoba S, Adebayo AT. Determinants of modality of management of acute kidney injuryin children seen at a tertiary hospital in Nigeria. Niger J Paed 2013;40(4):395-9.
21. Macedo E, CerdaÂ J, Hingorani S, HouJ,Bagga A, Burdmann EA, et al. Recognition and management of acute kidney injury in children:The ISN 0by25 Global Snapshot study. PLoS ONE 2018;13(5): e0196586.
22. Baalaaji M, Jayashree M, Nallasamy K, Singhi S, Bansal A. Predictors and Outcome of Acute Kidney Injury in Children with Diabetic Ketoacidosis. Ind Pediatrics 2018;55:311–14.
23. Ranawaka R, Dayasiri K, Gamage M, Milford D. Management of acute kidney injury in children. Sri Lanka J Child Health 2019;48(2):160-4.
24. Andreoli SP. Acute kidney injury in children. Pediatr Nephrol 2009;24:253–63.
25. Westrope C, Kapetanstrataki M, Parslow R, Morris K. Use of continuous renal replacement therapy by Paediatric intensive care units in the UK and the Republic of Ireland. Pediatric Critical Care Med 2018;19(6):0-48.
26. Deep A, Symons JM, Mc Culloch M. Paediatric acute kidney injury: can we match therapy with resources around the world? Intensive Care Med 2019;45:86–8.
27. Goldstein SL. Pediatric Acute Kidney Injury—The Time for Nihilism Is Over. Front Pediatr 2020; 8:16.