e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(3); 697-700

Original Research Article

Study On Clinicoepidemiological Profile and Arterial Blood Gas Analysis Among Acute Kidney Injury Patients in Children Admitted in a Tertiary Care Hospital at Rajasthan.

Manish Mittal[1], Rohit Jain[2], Richa Gupta[3], Shubham Jindal[4]

[1]Assistant Professor, Department of Community Medicine, Geetanjali Medical College and Hospital, Udaipur, Rajasthan

[2]Senior Resident, Department of Pediatrics, Jhalawar Medical College, Rajasthan

[3]Professor and Head, Department of ENT, Pacific Medical College and Hospital, Udaipur, Rajasthan

[4]2nd Year Resident, Department of Community Medicine, Saraswati Institute of Medical Sciences, Hapur, Uttar Pradesh

Received: 25-01-2024 / Revised: 20-02-2024 / Accepted: 05-03-2024

Corresponding Author: Dr Manish Mittal

Conflict of interest: Nil

Abstract:

Introduction: Acute renal failure (ARF) represents a sudden impairment in renal function occurring rapidly over hours to days. It is categorized into prerenal, renal, and post-renal aetiologies, with prerenal ARF being predominant in children. Pediatric ARF remains a significant cause of morbidity and mortality, particularly in hospitalized patients, with reported mortality rates ranging from 29% to 46%. Arterial blood gas (ABG) analysis serves as a vital tool in assessing oxygenation, ventilation, and acid-base status, with interpretations crucial for managing critically ill patients, especially those with chronic kidney disease (CKD) who frequently encounter acid-base disorders.

Objectives: This research primarily aims to analyze the clinicoepidemiological profile of AKI in children and analyze various ABG abnormalities in these patients.

Materials and Methodology: The Present study included Children diagnosed with acute renal failure attending Department of pediatrics, Govt. Medical College, Kota, Rajasthan From March, 2021 to February, 2022. It was a prospective analytical study. A predesigned, pre-tested, semi-structured questionnaire was used for data collection.

Results: The mean age of children with AKI was approximately 5.53 years, with a majority being males (60.9%). Perinatal asphyxia emerged as the most common underlying cause (31.3%), followed by sepsis, dehydration, lower respiratory tract infections (LRTI), glomerulonephritis, and polytrauma. Upon admission, common clinical presentations included fever, oliguria, edema, vomiting, and anemia. Acidosis was prevalent in almost all AKI cases. Hyperkalemia, hyponatremia, and elevated chloride levels were the most common electrolyte abnormalities observed. Mortality rates were highest in Grade III AKI patients, especially in those with oliguria, edema, and requiring mechanical ventilation.

Conclusion: This study contributes valuable insights into pediatric AKI cases highlighting the importance of early recognition of AKI in pediatric population by means of taking appropriate clinical history, identifying various risk factors, utilizing the ABG analysis and early biomarkers(if available).

Recommendations: Study advocates for the routine use of ABG analysis as a bedside tool to assess acid-base status promptly.

Keywords: AKI, ABG, Renal Failure, Acidosis.

Introduction

Acute renal failure (ARF) represents a sudden impairment in renal function, manifesting as an inability to regulate electrolytes, maintain fluid balance, and eliminate waste products. This condition, occurring rapidly over hours to days [1-3], is categorized into prerenal, renal, and post-renal aetiologies, with prerenal ARF being predominant in children [4-6]. Although pediatric ARF often exhibits a favourable prognosis compared to adults, it remains a significant cause of morbidity and mortality, particularly in hospitalized patients, with reported mortality rates ranging from 29% to 46% [10-11]. Early detection and management of ARF and its complications are crucial for improving outcomes. Various prognostic factors including oliguria, comorbidities, and biochemical markers aid in identifying patients requiring aggressive intervention. Arterial blood gas (ABG) analysis serves as a vital tool in assessing oxygenation, ventilation, and acid-base

status, with interpretations crucial for managing critically ill patients, especially those with chronic kidney disease (CKD) who frequently encounters acid-base disorders [7-9]

Biomarkers, including cystatin C, kidney injury molecule 1 (KIM-1), neutrophil gelatinase-associated lipocalin (NGAL), and interleukin-18 offer promising avenues for early diagnosis and prognostication of AKI, allowing for timely intervention and monitoring of kidney function.

Arterial blood gas analysis (ABG) serves as a vital diagnostic tool for critically ill patients with acid-base imbalances, providing insights into their oxygenation and ventilation status. This laboratory test involves the collection of arterial blood, typically from the radial artery at the wrist, using a heparinized syringe. ABG analysis yields crucial information including blood pH, partial pressures of carbon dioxide and oxygen, bicarbonate levels, and additional parameters such as lactate and electrolyte concentrations. Understanding ABG interpretation requires a comprehensive understanding of nomenclature, physiology, and the various types of acid-base disorders. Disruptions in acid-base balance can complicate numerous disease states, sometimes posing life-threatening risks. Monitoring ABGs is integral to the management of high-risk patients during anesthesia and critical care in the intensive care unit (ICU)[10].

Aims & Objectives

Aim: to assess the ABG abnormalities in children of age group 0- 18 year suffering with acute renal failure

Objectives:

- **Primary Objective:**

1. To comprehensively analyze the clinical and epidemiological profile of AKI in pediatric age group.
2. To describe and analyze the ABG abnormalities in children with acute renal failure.

- **Secondary Objective:**

To determine the outcome of AKI patients.

Results and Observations:

Total 64 children were enrolled into the study and apredesigned, pre-tested, semi-structured questionnaire was used for data collection which consisted of demographic details, appropriate clinical history, details of general physical and systemic examination and investigations details. Details of ABG analysis were recorded

Important results and observation are summarized as follows:

1. **Age Distribution**:
   - Most children with AKI were aged less than 1 year (37.5%), followed by the age group of 11-15 years (23.4%).
   - The mean age of children with AKI was 5.53 years.
2. **Gender Distribution**:
   - There were more male patients with AKI-39 (60.9%) compared to females-25 (39.1%).
3. **Underlying Causes**:
   - Perinatal asphyxia was the most common underlying cause of AKI-20 (31.3%), followed by sepsis- 10 (15.6%) and dehydration- 8 (12.5%).
4. **Clinical Characteristics at Admission**:
   - Commonest clinical presentations included fever (40.6%) followed by oliguria (37.5%), and edema (23.4%).
5. **Severity of AKI**:
   - KDIGO grading showed that 32(48.4%) of patients had KDIGO grade I, 20(32.8%) had grade II, and 12(18.8%) had grade III AKI.
6. **Serum Creatinine Levels**:
   - Serum creatinine levels increased with the severity of AKI, with statistically significant differences between the KDIGO grades ($p < 0.001$).
7. **pCO2 and Bicarbonate Levels**:
   - Raised pCO2 levels were associated with higher KDIGO grades ($p = 0.020$), while reduced bicarbonate levels were significantly associated with higher KDIGO grades ($p = 0.025$).
8. **Electrolyte Abnormalities**:
   - Various electrolyte abnormalities were observed, including hyponatremia (65.6%) and hyperkalemia (70.3%), with significant associations with AKI severity.
9. **Albumin Levels**:
   - Hypoalbuminemia was seen in 50% of patients, with significant associations with AKI severity ($p < 0.001$).
10. **Outcome**:
    - The overall mortality rate among AKI patients was 20.3%(13/64), with higher mortality associated with higher KDIGO grades

Class	Death	Survived
KDIGO I(32)	3(9.4)	29(90.6)
KDIGO II(20)	4(20)	16(80)
KDIGO III(12)	6(50)	6(50)
Total	13(20.3)	51(79.7)
Chi-square = 8.900 with 2 degrees of freedom; **p = 0.012 (S)**		

11. Factors Associated with Outcome

Factors	Survived(51)	Death(13)	P value
Age(<5 years)	31(79.5%%)	8(20.5%)	0.788
Oliguria	11(45.8%)	13(54.2%)	<0.001
Edema	7(46.7%)	8(53.3%)	0.001
Hypertension	6((100%)	0(0)	0.444
Anemia	10(90.9%)	1(9.1%)	0.545
Volume overload	2(40.0%)	3(60.0%)	0.086
Mechanical ventilation	2(13.3%)	13(86.7%)	<0.001

Oliguria, edema, and the need for mechanical ventilation were significantly associated with mortality ($p < 0.001$).

Discussion

In the present study, the mean age of pediatric AKI patients was 5.53 years, which aligns with findings from previous research by Shah et al. (2011), Vina Tresa et al. (2016), and Rashi Singal Rustagi et al. (2016), where similar age ranges were reported. The most common underlying causes of AKI in the present study were perinatal asphyxia, sepsis, and dehydration, consistent with observations by Shah et al. (2011) and Rashi Singal Rustagi et al. (2016), although variations exist across different studies.[11] Regarding clinical presentations, fever, oliguria, and edema were prevalent in the present study, which corresponds with the findings of Shah et al. (2011) and Vina Tresa et al. (2016), suggesting consistency in the presentation of AKI in pediatric patients across different studies. In terms of severity grading using KDIGO criteria, the present study found a significant proportion of patients falling into Grade III AKI, similar to observations by Geoffrey M. Fleming et al. (2016), Tracy L. McGregor et al. (2016),[12] and Osama Y. Safder et al. (2019). Elevated serum creatinine and BUN levels were associated with higher KDIGO grades. ABG abnormalities, such as acidosis and raised pCO2 levels, were prevalent in the present study, in line with observations by Rocktaeschel et al. (2003)[13]andHu et al. (2016). Electrolyte imbalances, including alterations in sodium, potassium, chloride, calcium, and phosphate levels, were also noted, consistent with findings by Jiachang Hu et al. (2017). [14]Hypoalbuminemia was common in AKI patients in the present study, as seen in previous research by Rocktaeschel et al. (2003)[15] and RashiSingalRustagi et al. (2016),[16] indicating a consistent pattern across different studies. Regarding outcomes, while the majority of AKI patients in the present study survived, mortality rates were comparable to those reported by Shah et al. (2011), Vina Tresa et al. (2016),[17] and Rashi Singal Rustagi et al. (2016)[18]. Factors associated with increased mortality, such as oliguria, edema, and the need for mechanical ventilation, were consistent with previous findings.[19]

Conclusion: This analytical, prospective study aimed to evaluate clinical and epidemiogical profile along with arterial blood gas (ABG) abnormalities in children with acute renal failure (ARF) admitted to the pediatric department of GMC, Kota. The study found that the mean age of children with ARF was 5.53 years, with a majority being male. Perinatal asphyxia was the most common underlying cause, followed by sepsis, dehydration, and other factors. Clinical presentations at admission included fever, oliguria, edema, vomiting, and anemia. Most patients were classified as KDIGO Grade I, II, or III, with the majority in Grade I. ABG analysis revealed acidosis in almost all patients, predominantly with elevated pCO2 levels. Hyperkalemia, hyponatremia, and elevated chloride levels were common electrolyte abnormalities. Hypocalcemia, hyperphosphatemia, and hypoalbuminemia were also prevalent. ABG and electrolyte abnormalities were more pronounced in higher KDIGO grades, with mortality rates increasing with severity of AKI, particularly in patients with oliguria, edema, and those requiring mechanical ventilation. The study emphasizes the importance of early identification and management of AKI risk factors to improve outcomes in affected children.

Recommendations

1. All patients admitted to the hospital should be closely monitored for electrolyte imbalance and the acid-base homeostasis, as disruption in

this is characterized by rapid decline in renal function.

2. Arterial blood gas is a bedside tool, which can be performed with ease, providing an immediate reflection of acid- base homeostasis of the patient. Hence, Baseline ABG analysis should be routinely done in patients admitted to the hospital to detect early metabolic abnormality and electrolyte imbalance to further predict acute kidney injury, also it must be used as a tool for serial monitoring to decrease morbidity and mortality in patients.

References

1. Proesmans W. Acute renal failure in childhood. EDTNAERCA J [Suppl 2]: 26–29.
2. Esson ML, Schrier RW. Diagnosis and treatment of acute tubular necrosis. Ann Intern Med. 2020; 137: 744–752.
3. Thadhani R, Pascual M, Bonventre JV. Acute renal failure. N Engl J Med. 1996; 334: 1448–1460.
4. Edelmann CM Jr. Pediatric kidney disease, 2nd edn. Little Brown Co, Pittsburgh, 1992; 1923–1940.
5. Woroniecki R, Devarajan P. Acute tubular necrosis. http://emedicine.com, January 2002; 22: 1–10.
6. Kandoth PW, Agarwal GJ, Dharnidharka VR. Acute renal failure in children requiring dialysis therapy. Indian Pediatr. 1994; 31: 305–309.
7. Hui Stickle S, Brewer ED, Goldstein SL. Am J Kidney Dis. Pediatric ARF epidemiology at a tertiary care center from 1999 to 2001. 2005;45: 96–101.
8. Bunchman TE, McBryde KD, Mottes TE, et al. Pediatr Nephrol. Pediatric acute renal failure: outcome by modality and disease; 2001;16: 1067–1071.
9. Castro D, Keenaghan M. Arterial Blood Gas. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: https://www. ncbi.nlm.nih.gov/books/NBK536919/.
10. Pamela D. Winterberg, Christopher Y. Lu. Acute Kidney Injury: The Beginning of the End of the Dark Ages. The American Journal of the Medical Sciences Volume 344, Number 4, October 2012: 318-325.
11. Rocktaeschel J, Morimatsu H, Uchino S, et al. Acid-base status of critically ill patients with acute renal failure: analysis based on Stewart-Figge methodology. Crit Care. 2003;7(4):R60.
12. Shah PR, Falodia J, Kute VB, Kanodia KV, Vanikar AV, Goplani KR, Gera DN, Trivedi HL. Acute renal failure in the pediatric age group - single center prospective study of 180 cases. Saudi J Kidney Dis Transpl. 2011 Sep; 22(5):1072-6.
13. Hu J, Wang Y, Geng X, Chen R, Xu X, Zhang X, Lin J, Teng J, Ding X. Metabolic acidosis as a risk factor for the development of acute kidney injury and hospital mortality. ExpTher Med. 2017 May;13(5):2362-2374.
14. Geoffrey M. Fleming, RashmiSahay, Michael Zappitelli, Eileen King, David J. Askenazi, Brian C. Bridges et al. The Incidence of Acute Kidney Injury and its Effect on Neonatal and Pediatric ECMO Outcomes: A multicenter report from the KIDMO Study Group. Pediatr Crit Care Med. 2016 December; 17(12): 1157–1169.
15. McGregor TL, Jones DP, Wang L, Danciu I, Bridges BC, Fleming GM, Shirey-Rice J, Chen L, Byrne DW, Van Driest SL. Acute Kidney Injury Incidence in Noncritically Ill Hospitalized Children, Adolescents, and Young Adults: A Retrospective Observational Study. Am J Kidney Dis. 2016 Mar;67(3):384-90.
16. Rashi Singal Rustagi, Kamaldeep Arora, Rashmi Ranjan Das, Puneet Aulakh Pooni & Daljit Singh: Incidence, risk factors and outcome of acute kidney injury in critically ill children – a developing country perspective, Paediatrics and International Child Health. 2016.
17. Vina Tresa, Afshan Yaseen, Ali Asghar Lanewala, Seema Hashmi, Sabeeta Khatri, Irshad Ali &Muhammed Mubarak. Etiology, clinical profile and short-term outcome of acute kidney injury in children at a tertiary care pediatric nephrology center in Pakistan. Renal Failure, 2017; 39(1):26-31.
18. Jiachang Hu, Yimei Wang, XuemeiGeng, Rongyi Chen, Xialian Xu, Xiaoyan Zhang et al. Metabolic acidosis as a risk factor for the development of acute kidney injury and hospital mortality. Experimental and Therapeutic medicine, 2017; 13: 2362-2374.
19. Osama Y. Safder, Khalid A. Alhasan, Mohamed A. Shalaby, Norah Khathlan, Suleman A. Al Rezgan, Amr S. Albanna et al. Short-term outcome associated with disease severity and electrolyte abnormalities among critically ill children with acute kidney injury. BMC Nephrology. 2019; 20:89.