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Etiology and Outcomes of Acute Kidney Injury: A Comprehensive Study in Four Tertiary Centers of Dhaka

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Habibur Rahman
Department of Pediatric Nephrology, Bangabandhu Sheikh Mujib Medical University, Shahbagh, Dhaka-1000, Bangladesh

*** Corresponding Author**
Professor Md. Habibur Rahman, MD, FCPS, Chairman, Department of Paediatric Nephrology, Bangabandhu Sheikh Mujib Medical University, Shahbagh, Dhaka-1000, Bangladesh
Mob No- +8801711381693
Email: mhrahman.bsmmu@gmail.com

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Introduction: This study was conducted to determine the etiology and outcomes of AKI in 4 tertiary centers of Dhaka, Bangladesh irrespective of RRT requirement and the hospital setting in which they were treated.
Materials and Methods: This retrospective study was carried out in 4 tertiary care centers (Bangabandhu Sheikh Mujib Medical University, National Institute of Kidney Disease and Urology, Dhaka Shishu Hospital, and Dhaka Medical College Hospital) and 3 NICUs (Bangabandhu Sheikh Mujib Medical University, Dhaka Shishu Hospital and Dhaka Medical College Hospital of Dhaka) from January 2013 to December 2014. For the purpose of this study, AKI was defined according to the pediatric RIFLE (risk, injury, failure, loss, and end stage) criteria. All children admitted to the Pediatric Nephrology Inpatient Department and NICU of these hospitals were enrolled in the study. Data were collected from the registry of the hospitals. Ethics approval was obtained from the Institutional Review Board.
Results: A total of 2285 patients in the Nephrology Ward and 3764 patients in the NICU were included in the study. About 8.1% (185) of the patients had AKI, and the death rate was 18.5%. Out of 3764 children in the NICU, 530 had AKI and 17.2% of the patients died.
Conclusions: The renal cause of AKI was the most predominant causes in our setting in hospitalized patients and perinatal asphyxia was a predominant cause of AKI in neonates. The overall mortality rate was 13-26%, which is comparable to other South Asian countries.

Keywords: Acute kidney injury; Etiology; Outcome; Child.
Running Title: Etiology and Outcomes of Acute Kidney Injury

Introduction

Acute kidney injury (AKI) (also referred to as acute renal failure) reflects a broad spectrum of clinical presentations ranging from mild to severe injury that may result in permanent and complete loss of renal function. The range of severity and the variety of the causes of AKI have resulted in multiple classification systems complicating diagnosis and subsequent management. Lack of consensus has resulted in a broad range of estimated prevalence in the ICU ranging from 1% to 70% depending on the criteria used [1,2]. The underlying mechanisms of AKI include a decrease in the kidney's ability to excrete nitrogenous waste, manage electrolytes, regulate intravascular volume, and assist with maintenance of the acid-base balance. The clinical effects of AKI depend on the clinical situation but almost invariably increase mortality and morbidity [3,4]. Epidemiologic studies of AKI, particularly early AKI that does not require renal replacement therapy (RRT), are

surprisingly sparse and there are differences in definitions, making incidence, prevalence, and particularly outcomes difficult to compare. AKI is managed by a variety of specialities, renal wards, high-dependency wards, and intensive care units (ICU). A number of studies have included ICU patients [5,6] while others have only included those with severe AKI [7,8] or only those requiring RRT [9,10]. Because AKI occurs more frequently in infants and young children, the incidence of this condition is rising in accordance with demographic trends; therefore, the real incidence may be much higher than current estimates, with major implications for service planning. Because AKI is associated with high mortality and treatment with RRT is costly, early detection of patients is important to avoid RRT. The cause of AKI differs according to the patient's age and socioeconomic condition of the region. The outcome also varies according to the time of presentation, duration of anuria, and of course hospital facilities.

AKI can be divided into pre-renal injury, intrinsic renal disease including vascular insults, and obstructive uropathies. Some causes of AKI, such as cortical necrosis and renal vein thrombosis, occur more commonly in neonates, whereas HUS is more common in younger children, and RPGN generally occurs in older children and adolescents. An important cause of AKI in neonates is exposure to maternal drugs in utero that interfere with nephrogenesis such as angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, and nonsteroidal anti-inflammatory drugs [11-15]. This study was conducted to determine the etiology and outcomes of AKI in 4 tertiary centers of Dhaka, Bangladesh irrespective of RRT requirement and the hospital setting in which they were treated.

Materials and Methods

This retrospective study was carried out in 4 tertiary care centers (Bangabandhu Sheikh Mujib Medical University, National Institute of Kidney Disease and Urology, Dhaka Shishu Hospital, and Dhaka Medical College Hospital) and 3 NICUs (Bangabandhu Sheikh Mujib Medical University, Dhaka Shishu Hospital and Dhaka Medical College Hospital of Dhaka) from January 2013 to December 2014. For the purpose of this study, AKI was defined according to the pediatric RIFLE (risk, injury, failure, loss and end stage) criteria. All children admitted to the Pediatric Nephrology Inpatient Department and NICUs of these hospitals were enrolled in the study. Data were collected from the registry of the hospitals. Ethics approval was obtained from the Institutional Review Board. A total of 2285 patients in the Nephrology Ward and 3764 patients in the NICU were included in the study. Data including demographic details, etiology of AKI, precipitating factors, duration of hospital stay, requirement for and mode of RRT, and date of death were extracted from patient records.

Serum creatinine, Blood urea, serum electrolyte, complete blood count, and random blood sugar, and data regarding KUB ultrasound were extracted from records. A diagnosis of AKI was considered when serum creatinine was 1.5 times higher than normal according to age, sex and height. Patients were excluded when baseline values were not available and death occurred before renal recovery. The patients were also excluded when creatinine rise was less than a factor of 1.5 or when the rise was not sustained for 24 hours. (RIFLE criteria [16]: Fig. 1).

Results

A total of 2285 patients in the Nephrology Ward and 3764 patients in the NICU were included in the study. The results are classified in tables 1-3. About 8.1% (185) of patients had AKI, and death occurred in 18.5%. Out of 3764 children in the NICU, 530 had AKI and 17.2% of the patients died.

Table 1. Demographic characteristics of cases (n=2285)

Hospital	No. of Pt	AKI	M/F	% of AKI
BSMMU	577	36	24/12	6.2%
NIKDU	485	46	32/14	9.4%
DSH	540	53	35/18	9.8%
DMCH	683	50	36/14	7.3%

Table 1 shows most of AKI patients were male with a male to female ratio of 2.1:1.

Category	GFR Criteria	UO Criteria
Risk (R)	Increased creatinine ×1.5 or GFR ↓ by 25%	UO <0.5 ml/kg per h × 6 h
Injury (I)	Increased creatinine ×2 or GFR ↓ by 50%	UO <0.5 ml/kg per h × 12 h
Failure (F)	Increased creatinine ×3 or GFR ↓ by 75% or creatinine ≥350 μmol/L (rise at least 44 μmol/L)	UO <0.3 ml/kg per h × 24 h or anuria × 12 h
Loss (L)	Persistent AKI >4 wk	
ESRD (E)	ESRD >3 mo	

Fig. 1. RIFLE criteria (AKI, Acute Kidney Injury; RIFLE, risk, injury, failure, loss, ESRD; UO, urine output.)

Table 2. Etiology and outcome of AKI in 4 tertiary center of Dhaka city (n=2285)

Hospital	Pre-renal	Renal	Post-renal	IPD	Death
BSMMU	**33.5%**	**51.0%**	**15.5%**	**96.2%**	**16.6%**
NIKDU	**17.3%**	**60.8%**	**21.9%**	**87.0%**	**13.03%**
DSH	**34.0%**	**54.7%**	**11.3%**	**92.1%**	**22.6%**
DMCH	**66.0%**	**32.0%**	**2.0%**	**100%**	**20.0%**

Table 2 shows that the renal cause was the predominant cause of AKI in most centers but pre-renal cause prevailed in one center (DMCH). In all centers, IPD was the mode of treatment for AKI. Table 3 shows PNA was the primary cause of AKI in neonates in most centers, followed by sepsis. RRT was not needed in most the cases.

Discussion

This retrospective study, conducted in 4 tertiary care centers in Dhaka, Bangladesh found that the rate of AKI in hospitalized patients was around 8% although we have used the RIFLE criteria for determining AKI. Two recently proposed classifications, the RIFLE and AKIN [16] criteria, have been validated as diagnostic and prognostic tools in critically ill adult patients with AKI. Studies in critically sick children, using the RIFLE or its pediatric modification, have shown that the incidence of AKI varies from 10% to 58%. Based on the former, Schneider et al. [17] reported that 339 out of 3396 (10%) patients admitted to a PICU in Los Angeles had AKI. The AKIN criteria have been used in three recent studies in children [18-20]. Zappitelli et al reported that the incidence of AKI in hospitalized children treated with aminoglycosides was 20% using the AKIN definition and 33% according to the pRIFLE. Although these criteria were used in other studies, [19,20] neither study reported its incidence. Using similar criteria, we found that the rate of AKI ranged from 3-5% in hospitalized patients. There is limited information on AKI in hospitalized, non-critically ill patients [21].

The etiology of AKI in children varies in developed and developing countries. In the former, AKI follows major surgery, complications associated with malignancies, and the use of nephrotoxic drugs [22]. In developing countries, hemolytic uremic syndrome, severe systemic infections, diarrheal dehydration, and post-infectious glomerulonephritis constitute important causes [23]. However, it is notable that most of the causes are intrinsic renal causes. Similarly, Schneider et al. [17] reported that the rate of AKI at admission and during hospital stay was 5.7% and 10%, respectively.

The occurrence of AKI has significant implications, with considerable short and long term morbidity and mortality. Almost 6-45% of critically ill patients with incident AKI require renal replacement therapy. In the present study, most of the patients required RRT. The risk of mortality varies, reflecting the heterogeneous criteria used for definition, and the spectrum and severity of the underlying illness. The rate of AKI-related mortality varies from 9 to 67% in developed countries, although the rate of mortality was 13-26% in the present study, depending on the center.

Limitations:

The present study has multiple limitations. Precise measurement of urine output was not done and a diagnosis of AKI was made based only on levels of serum creatinine. Although some studies suggest that criteria based on urine output have little effect on the assignment of the final AKI stage and its

Table 3. Etiology and outcomes of AKI in NICU

Hospital	No. of Pt	AKI	M/F	Congenital	Sepsis	PNA	NEC	RRT	Death
BSMMU	921	11	8/3	33.5%	31.0%	33.5%	2%	18.2%	9.1%
DSH	680	18	13/5	5.3%	28.1%	65.1%	1.5%	16.6%	16.6%
DMCH	2163	501	294/207	2.1%	7.9%	89.0%	1%	2.4%	26.0%

association with outcomes, this might have resulted in underreporting of the incidence. The present study was not powered to examine the risk factors of mortality, and larger studies that address these risk factors are necessary. Finally, lack of information on outcomes after discharge did not allow assessment of the impact of mild AKI on short and long-term renal function.

Conclusions

The renal cause of AKI was the most predominant cause in hospitalized patients in our setting and perinatal asphyxia was a predominant cause of AKI in neonates. The overall mortality rate was 13-26%, which is comparable to other South Asian countries.

Conflict of Interest

None declared

Financial Support

None declared

References

1. Mehta RL, Pascual MT, Soroko S, Savage BR, HimmelfarbJ, Ikizler TA, Paganini EP, Chertow GM; Program to Improve Care in Acute Renal Disease: Spectrum of acute renal failure in the intensive care unit: The PICARD experience. *Kidney Int*66:2004;1613–1621.
2. Carbonell N, Blasco M, Sanjuan R, Garcia-Ramon R, BlanquerJ, Carrasco AM: Acute renal failure in critically ill patients: A prospective epidemiological study. *Nefrologia* 2004;24:47–53.
3. Bahloul M, Ben Hamida C, Damak H, Kallel H, Ksibi H, Rekik N, Chelly H, Bouaziz M: Incidence and prognosis of acute renal failure in the intensive care unit: Retrospective study of 216 cases. *Tunis Med* 2003;81:250–257.
4. Cole L, Bellomo R, Silvester W, Reeves JH: A prospective, multicenter study of the epidemiology, management, and outcome of severe acute renal failure in a "closed" ICU system. *Am J RespirCrit Care Med* 2000;162: 191–196.
5. Stevens PE, Tamimi NA, Al-Hasani MK, Mikhail AI, Kearney E, Lapworth R, Prosser DI, Carmichael P: Nonspecialistmanagement of acute renal failure. *QJM* 2001;94: 533–540.
6. Khan IH, Catto GR, Edward N, Macleod AM: Acute renal failure: Factors influencing nephrology referral and outcome. *QJM* 1997;90: 781–785.
7. Firmat J, Zucchini A, Martin R, Aguirre C: A study of 500 cases of acute renal failure (1978 –1991). *Ren Fail* 1994;16: 91–99.
8. Metcalfe W, Simpson M, Khan IH, Prescott GJ, Simpson K, Smith WC, MacLeod AM, Scottish Renal Registry: Acute renal failure requiring renal replacement therapy: Incidence and outcome. *QJM* 2002;95: 579–583.
9. Feest TG, Round A, Hamad S: Incidence of severe acute renal failure in adults: Results of a community based study. *BMJ* 1993;306: 481–483.
10. Liano F, Pascual J: Epidemiology of acute renal failure: A prospective, multicenter, community-based study. Madrid Acute Renal Failure study group. *Kidney Int 1996*;50: 811–818.
11. Waikar SS, Curhan GC, Wald R, McCarthy EP, ChertowGM: Declining mortality in patients with acute renal failure, 1988 to 2002. *J Am SocNephrol* 2006;17: 1143–1150.
12. Lip GYH, Churchill D, Beevers M, Auckett A, Beevers DG Angiotensin converting enzyme inhibitors in early pregnancy. Lancet 1997;350:1446–1447.
13. Martinovic J, Benachi A, Laurent N, Daikha-Dahmane F, BuglerMC Fetal toxic effects and angiotensin-II-receptor antagonists. Lancet 2001;358:241–242.
14. Cooper WO, Hernandez-Diaz S, Arbogast PG, Dudley JA, DyerS, Gideon PS, Hall K, Ray WA Major congenital malformations after first-trimester exposure to ACE inhibitors. N Engl J Med 2006;354:2443–2451.
15. Benini D, Fanos V, Cuzzolin L, Tato L In utero exposure to nonsteroidal anti-inflammatory drugs: neonatal acute renal failure. PediatrNephrol 2004;19:232–234.
16. Acute Kidney Injury Network, Mehta RL, Kellum JA, Shah SV, Molitoris BA, Ronco C, *et al.* Acute Kidney Injury Network: Report of an initiative to improve outcomes in acute kidney injury. Crit Care. 2007;11:R31.
17. Schneider J, Khemani R, Grushkin C, Bart R. Serum creatinine as stratified in the RIFLE score for acute kidney injury is associated with mortality and length of stay for children in the pediatric intensive care unit. Crit Care Med 2010;38:933-9.
18. Ozcakar ZB, Yalcinkaya F, Altas B, Ergün H, Kendirli T, Ates C, *et al.* Application of the new classification criteria of the Acute Kidney Injury Network: a pilot study in a pediatric population. Pediatr Nephrol. 2009;24:1379-84.
19. Zappitelli M, Moffett BS, Hyder A, Goldstein SL. Acute kidney injury in non-critically ill children treated with aminoglycoside antibiotics in a tertiary healthcare centre: A retrospective cohort study. Nephrol Dial Transplant. 2011;26:144-50.
20. The Turkish Society for Pediatric Nephrology Acute Kidney Injury Study Group, Duzova A, Bakkaloglu A,

Kalyoncu M, Poyrazoglu H, Delibas A, *et al*. Etiology and outcome of acute kidney injury in children. PediatrNephrol 2010;25:1453-6.
21. Bowers LS, Wong ET. Kinetic serum creatinine assay II. A critical analysis and review.ClinChem 1980;26:555-61.
22. Cerdá J, BaggaA, Kher V, Chakravarthi RM. The contrasting characteristics of acute kidney injury in developed and developing countries. Nat ClinPractNephrol.2008;4:138-53.
23. Srivastava RN, Bagga A, Moudgil A. Acute renal failure in north Indian children. Indian J Med Res.1990;92:404-8.