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ORIGINAL ARTICLE

Frequency of acute kidney injury in birth asphyxia at a Tertiary Care Hospital, Karachi.

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ABSTRACT… Objective: To determine the frequency of acute kidney injury (AKI) in neonates presenting with birth asphyxia. **Study Design:** Cross-sectional study. **Setting:** Department of Pediatrics, National Institute of Child Health, Karachi. **Period:** December 2022 to May 2023. **Material & Methods:** A total of 159 neonates of both gender, aged between 7-28 days and having birth asphyxia were analyzed. Demographic features were recorded. The blood sample was collected in a sterile manner using 5 ml syringe and sent to the institutional laboratory for serum creatinine and electrolyte analysis. The frequency of AKI was noted. **Results:** In a total of 159 neonates, 95 (59.1%) were boys, The mean baseline serum urea and creatinine were 33.5±32.1 and 0.83±0.62 mg/dl respectively. AKI was noted in 65 (40.9%) neonates. Girls (p=0.035), relatively lower occipital frontal circumference (p=0.004), normal vaginal delivery (p<0.001), history of seizures (p<0.001), abnormal USG KUB (p<0.001), poor conscious level (p<0.001), higher birth asphyxia grading (p<0.001) and poor urine output (p<0.001) were linked with AKI. Mean baseline serum urea levels and serum creatinine levels were significantly raised among neonates who had AKI. **Conclusion:** The frequency of acute kidney injury among neonates having perinatal asphyxia was high. AKI was noted to have significant association with female gender, relatively lower occipital frontal circumference, normal vaginal delivery, history of seizures, abnormal ultrasonography findings, poor conscious level, higher birth asphyxia grading, and poor urine output at the time of admission.

Key words: Acute Kidney Injury, Birth Asphyxia, Creatinine, Urea, Urine Output.

INTRODUCTION

Birth asphyxia is a frequently encountered issue in neonatal intensive care units (NICUs) and stands as a significant contributor to both mortality and morbidity. The overall occurrence rate of birth asphyxia is reported to vary between 1-10 cases per 1000 live-births.[1,2] The most prevalent complication arising from birth asphyxia is acute kidney injury (AKI), which holds substantial detrimental impacts on overall prognosis.[3] This condition involves severe kidney damage, impairing the kidneys' vital role in fluid and electrolyte balance regulation.[1] Notably, the perfusion of essential organs like the heart, brain, and adrenals takes precedence over the kidneys, gut, and skin. Consequently, perinatal asphyxia commonly leads to kidney injuries. The hallmark of hypoxic-ischemic encephalopathy (HIE), a consequence of perinatal asphyxia, is the involvement of multiple organs.[2] Roughly 82% of infants affected by perinatal asphyxia experience the involvement of one or more organs.[3,4] The genesis of AKI in newborns is generally attributed to a range of multifactorial causes. Birth asphyxia and sepsis are frequently identified as the commonest underlying conditions associated with AKI.[5,6]

The manifestations of AKI can span a wide spectrum, from minor elevations in serum creatinine levels to anuric renal failure.[6,7] The accumulation of nitrogenous waste due to AKI can result in a range of complications.[8] The reported incidence of AKI in cases of birth asphyxia varies significantly, ranging from 30% to 70%.[9] This variability stems from the utilization of

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diverse parameters to define AKI across different studies. Neonates who survive the initial episode of AKI in infancy can have later chronic kidney complications.[10]

Data from published studies shows variability. There is need to establish local perspective as there is paucity of local literature and international data shows variability. The objective of this study was to determine the frequency of AKI in neonates presenting with birth asphyxia at NICU of National Institute of Child Health (NICH), Karachi. Data from this study would improve the knowledge of physicians involved in the care of neonates presenting with birth asphyxia and also help in developing and improving the current management protocols for these neonates.

MATERIAL & METHODS

This cross-sectional study was carried out in NICU of NICH, Karachi, Pakistan from December 2022 to May 2023 after the approval from "Institutional Ethical Review Board" (IERB-27/2022, dated: 21-11-2022). The sample size was calculated to be 159 taking confidence level as 95%, margin of error 5%, reported prevalence of AKI in birth asphyxia as 11.7%[4], the sample size came out to be 159. Non-probability consecutive technique was used. Approval from "Institution Ethical Committee" was obtained. Written as well as informed consents were taken. Inclusion criteria were neonates of both gender, aged between 7-28 days and having birth asphyxia. Neonates having congenital renal anomalies, intracranial hemorrhage or history of febrile seizures were excluded. Neonates with major congenital malformations or those having suspected sepsis (raised CRP on 1st day of life) were excluded. Neonates were diagnosed to have asphyxia if there was presence of at least 2 of the following factors and admitted to NICU within 6 hours of birth: i) first cry delayed for 5 minutes, ii) Apgar score at 5 minutes of age ≤ 5 and remained at ≤ 7 at 10 minutes of age, iii) post asphyxial seizures within first 48 hours after birth.

Demographic features were recorded. The blood sample was collected in a sterile manner using 5 ml syringe and sent to the institutional laboratory for serum creatinine and electrolyte analysis. Hourly urine output of all the neonates were monitored for more than 6 hours and output was measured in a measuring flask. Ultrasonography of kidney, ureters and bladder were done. AKI was labeled if neonate was admitted in NICU and the presence of any one of the following: i) rise in serum creatinine of > 0.3mg/dl in 48 hours from the baseline, ii) rise in serum creatinine > 50% in the past 7 days from the baseline, iii) drop in urine output to 0.5 ml/kg/hour for 6 hour. Grade-1 AKI was defined as serum creatinine value of 0.3mg/dl or increase in 1.5-1.9 times from the baseline with urine output <0.5ml/kg/hour for 6-12 hrs. Grade-2 AKI defined as serum creatinine value of 2.0-2.9 times of baseline with urine output of < 0.5ml/kg/hour for > 12 hour. Grade-3 AKI if serum creatinine value of > 3 times from baseline or serum creatinine > 4.0mg/dl with urine output < 0.3ml/kg/hour for 24 hours or anuria for > 24 hour.

Data was analyzed through "Statistical Package for Social Sciences (SPSS)", 26.0. Mean and standard deviations were calculated for quantitative data. Frequencies and percentages were calculated for the qualitative variables. Chi square test or fisher's exact test were applied and p-value ≤ 0.05 was considered significant.

RESULTS

In a total of 159 neonates, 95 (59.1%) were boys and 65 (40.9%) girls representing a boy to girls ratio of 1.5:1. The mean birth weight and occipital frontal circumference were 2.6±2.1 kg and 34.2±0.8 cm respectively. Antenatal history revealed that 104 (65.4%) cases were un-booked. History of delayed cry was reported in all neonates while history of seizures was reported in 101 (63.5%). The mean Apgar scores at 5 and 10 minutes were 3.8±0.8 and 5.8±1.1 respectively. At the time of presentation, 83 (52.2%) neonates were lethargic. Resuscitation was needed in 41 (25.8%) neonates whereas 24 (15.1%) required ventilator support. Abnormal ultrasonography (kidney, ureters and bladder) was observed among 11 (6.9%) neonates. The mean baseline serum urea and creatinine were 33.5±32.1 and 0.83±0.62 mg/dl respectively. Table-I is showing details about the baseline characteristics of

neonates with birth asphyxia.

Characteristics		Frequency (%)
Gender	Boys	95 (59.1%)
	Girls	65 (40.9%)
Birth weight (kg)	1.5-2.4	19 (11.9%)
	≥2.5	140 (88.1%)
Occipital frontal circumference (cm)	33	41 (25.8%)
	34	65 (40.9%)
	35	53 (33.3%)
Gestational age (weeks)	<37	31 (19.5%)
	≥37	128 (80.5%)
Mode of delivery	Vaginal delivery	20 (12.6%)
	Cesarean section	139 (87.4%)
Antenatal history	Un-booked	104 (65.4%)
	Booked	55 (34.6%)
Conscious level	Irritable	58 (36.5%)
	Lethargic	83 (52.2%)
	Comatose	18 (11.3%)
Birth asphyxia grade	1	58 (36.5%)
	2	83 (52.2%)
	3	18 (11.3%)
Urine output	Nil	8 (5.0%)
	Oliguria	56 (35.2%)
	Adequate	95 (59.7%)

Table-I. Baseline characteristics of children (N=159)

AKI was noted in 65 (40.9%) neonates while girls (p=0.035), relatively lower occipital frontal circumference (p=0.004), normal vaginal delivery (p<0.001), history of seizures (p<0.001), abnormal USG KUB (p<0.001), poor conscious level (p<0.001), higher birth asphyxia grading (p<0.001) and poor urine output (p<0.001) were linked with AKI (Table-II).

Mean baseline serum urea levels and serum creatinine levels were significantly raised among neonates who had AKI (p<0.001) as shown in Figure-1 and 2.

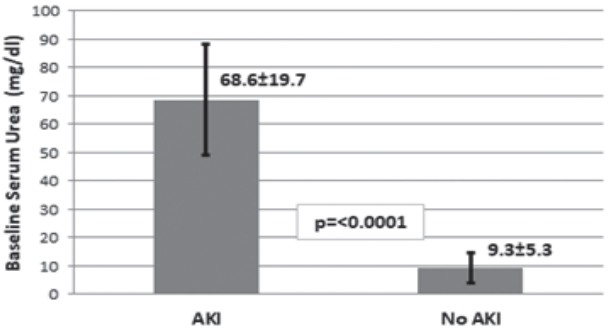

Figure-1. Association of baseline serum urea levels with acute kidney injury (n=159)

Characteristics		Acute Kidney Injury		P-Value
		Yes (n=65)	No (n=94)	
Gender	Boys	32 (49.2%)	62 (66.0%)	0.035
	Girls	33 (50.8%)	32 (34.0%)	
Birth weight (kg)	1.5-2.4	6 (9.2%)	13 (13.8%)	0.379
	≥2.5	59 (90.8%)	81 (86.2%)	
Occipital frontal circumference (cm)	33	20 (30.8%)	21 922.3%)	0.004
	34	33 (50.8%)	32 (34.0%)	
	35	12 (18.5%)	41 (43.6%)	
Gestational age (weeks)	<37	11 (16.9%)	20 (21.3%)	0.496
	≥37	54 (83.1%)	74 (78.7%)	
Mode of delivery	Vaginal delivery	20 (30.8%)	-	<0.001
	Cesarean section	45 (69.2%)	94 (100%)	
Antenatal history	Un-booked	44 (67.7%)	60 (63.8%)	0.615
	Booked	21 (32.3%)	34 (36.2%)	
History of seizures		60 (92.3%)	41 (43.6%)	<0.001
Resuscitation needed at the time or birth		18 (27.7%)	23 (24.5%)	0.648
Ventilator support required		11 (16.9%)	13 (13.8%)	0.592
Abnormal USG KUB		11 (16.9%)	-	<0.001
Conscious level	Irritable	5 (7.7%)	53 (56.4%)	<0.001
	Lethargic	47 (72.3%)	36 (38.3%)	
	Comatose	13 (20.0%)	5 (5.3%)	
Birth asphyxia grade	1	5 (7.7%)	53 (56.4%)	<0.001
	2	47 (72.3%)	36 (38.3%)	
	3	13 (20.0%)	5 (5.3%)	
Baseline Urine output	Nil	8 (12.3%)	-	<0.001
	Oliguria	55 (84.6%)	1 (1.1%)	
	Adequate	2 (3.1%)	93 (98.9%)	

Table-II. Stratification of baseline characteristics (N=159)

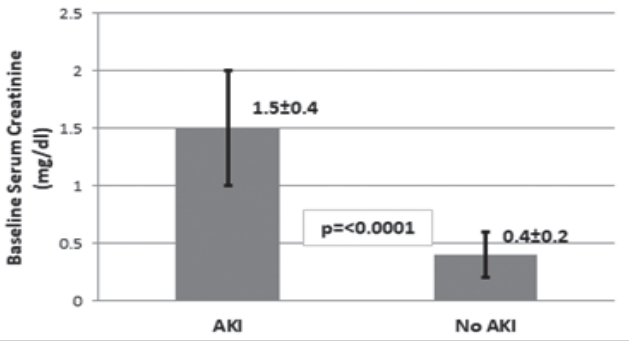

Figure-2. Association of baseline serum creatinine levels with acute kidney injury (n=159)

DISCUSSION

In the present study, the frequency of AKI in children with perinatal asphyxia was quite high (40.9%). Recently conducted retrospective analysis by Mork et al from Taiwan[11] reported the prevalence of AKI in asphyxiated neonates as 35%. Martin-Ancel et al[12] reported that 42% asphyxiated neonates were having AKI which is very similar to the findings of this study. Gupta et al revealed the proportion of AKI in perinatal asphyxia to be 68% which is much higher than what we found.[13] Gluckman et al[14] showed the frequency of AKI in perinatal asphyxia to be 70%. Nouri et al[15] reported the frequency of AKI in neonates who had birth asphyxia to be 33.2%. Alaro et al[16] from Kenya shared that the frequency of AKI in birth asphyxia was 11.7%. Variation in the burden of AKI in perinatal asphyxia could be due to differences in diagnostic criteria for perinatal asphyxia and AKI in different parts of the world. Our findings and many others have shown that the burden of the AKI is high not only in the developing but in the developed world as well.[12-16] In this study, the severity of perinatal asphyxia was significantly associated with AKI as with increase in the severity of birth asphyxia significantly correlated with the frequency of AKI. The findings are in accordance to the published literature.[12,13] It seems that kidney is the most involved and damaged organ among asphyxiated neonates. This study also reflected that baseline serum urea and creatinine levels were significantly higher among neonates who had AKI. Our findings are consistent with what Gupta et al found.[13]

The understanding of newborn AKI has greatly advanced in the past few decades. It is now clear that, despite the fact that serum creatinine levels normalise following AKI incident, they are linked to a greater likelihood of death, a longer stay in the hospital, and chronic kidney injury.[17] The possibility of AKI in neonates with perinatal asphyxia arises from the shift of cardiac output that takes place during hypoxia to maintain cerebral, cardiac, and adrenal perfusion, which lowers the renal oxygen supply. Additionally, the renal parenchymal cells possess a low anaerobic respiration potential and are extremely vulnerable to ischemia damage.[18]

The present study had some limitations as well. As this study was conducted at a single center involving relatively small sample size, studies involving larger sets of birth asphyxiated neonates should be conducted to further estimate the burden of AKI in the cases. We were unable to monitor and record outcomes in the present set of neonates.

CONCLUSION

The frequency of acute kidney injury among neonates having perinatal asphyxia was high. AKI was noted to have significant association with female gender, relatively lower occipital frontal circumference, normal vaginal delivery, history of seizures, abnormal ultrasonography findings, poor conscious level, higher birth asphyxia grading, and poor urine output at the time of admission. Baseline serum urea and creatinine should be performed in all neonates with birth asphyxia for early identification of neonates with AKI to halt its progression and to reduce long term risk of chronic kidney disease.

REFERENCES

1. Timovska SN, Cekovska S, Tosheska-Trajkovska K. **Acute kidney injury in newborns.** Pril (Makedon Akad Nauk Umet Odd Med Nauki). 2015; 36(3):83-9.

2. Medani SA, Kheir AEM, Mohamed MB. **Acute kidney injury in asphyxiated neonates admitted to a tertiary neonatal unit in Sudan.** Sudan J Paediatr. 2014; 14(2):29-34.

3. Shrestha NJ, Subedi KU, Shakya S, Adhikari S. **Prevalence of acute kidney injury in patients with perinatal asphyxia in tertiary hospital.** J Nepal Paediatr Soc. 2019; 39(2):109-15.

4. Alaro D, Bashir A, Musoke R, Wanaiana L. **Prevalence and outcomes of acute kidney injury in term neonates with perinatal asphyxia.** Afr Health Sci. 2014 Sep; 14(3):682-8.

5. Selewski DT, Charlton JR, Jetton JG, Guillet R, Mhanna MJ, Askenazi DJ, et al. **Neonatal acute kidney injury.** Pediatrics. 2015; 136:463-73.

6. Khan M, Khan KMA, Chachar S, Memon AA. **Association and outcome of acute renal failure in neonates in a tertiary care hospital.** Pak Pediatr J. 2014; 38(2):96-101.

7. Bezerra CT, Vaz Cunha LC, Libório AB. **Defining reduced urine output in neonatal ICU: Importance for mortality and acute kidney injury classification.** Nephrol Dial Transplant. 2013; 28:901-09.

8. Aslam M, Arya S, Chellani H, Kaur C. **Incidence and predictors of acute kidney injury in birth asphyxia in a Tertiary Care Hospital.** Journal of clinical neonatology. 2017 Oct 1; 6(4):240.

9. Nour I, Elmaghraby R, Shehata R, El-Refaey A, Aldomiaty H, Mosbah A, Shouman B, Nasef N. **Selective head cooling and acute kidney injury in neonates with hypoxic ischemic encephalopathy.** J Neonatal Perinatal Med. 2020; 13(1):21-30.

10. Kirkley MJ, Boohaker L, Griffin R, Soranno DE, Gien J, Askenazi D, Gist KM; **Neonatal Kidney Collaborative (NKC). Acute kidney injury in neonatal encephalopathy: An evaluation of the AWAKEN database.** Pediatr Nephrol. 2019 Jan; 34(1):169-176.

11. Mok TYD, Tseng MH, Lee JC, Chou Y, Lien R, Lai M, et al. **A retrospective study on the incidence of acute kidney injury and its early prediction using troponin-I in cooled asphyxiated neonates.** Sci Rep. 2020; 10(1):15682. doi:10.1038/s41598-020-72717-w

12. Martin-Ancel A, Garcia AA, Gaya F, Cabanas F, Buergeros M. **Multiple organ involvement in perinatal asphyxia.** J Pediatr. 1995; 127:786-9.

13. Gupta BD, Sharma P, Bagla J, Parakh M, Soni JP. **Renal failure in asphyxiated neonates.** Indian Pediatr. 2005; 42(9):928-934.

14. Gluckman PD, Wyatt JS, Azzopardi D, Ballard R, Edwards AD, Ferriero DM, et al. **Selective head cooling with mild systemic hypothermia after neonatal encephalopathy: Multicentre randomised trial.** Lancet. 2005; 365(9460):663-670. doi:10.1016/S0140-6736(05)17946-X

15. Nouri S, Mahdhaoui N, Beizig S, Zakhama R, Salem N, Dhafer SB, et al. **Acute renal failure in full term neonates with perinatal asphyxia: Prospective study of 87 cases.** Arch Pediatr. 2008; 15(3):229-235. doi:10.1016/j.arcped.2008.01.011

16. Alaro D, Bashir A, Musoke R, Wanaiana L. **Prevalence and outcomes of acute kidney injury in term neonates with perinatal asphyxia.** Afr Health Sci. 2014; 14(3):682-688.

17. Mammen C, Al Abbas A, Skippen P, Nadel H, Levine D, Collet JP, 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(4):523-530. doi:10.1053/j.ajkd.2011.10.048

18. Perlman JM, Tack ED, Martin T, Shackelford G, Amon E. **Acute systemic organ injury in term infants after asphyxia.** Am J Dis Child. 1989; 143(5):617-620. doi:10.1001/archpedi.1989.02150170119037

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2	Misbah Anjum	Concept and designing, Responsible for data.	
3	Bilquis Naeem	Proof reading, Critical revisions.	
4	Muhammad Hanif	Data collection, Proof reading.	
5	Oam Parkash	Data collection, Literature review.	
6	Vijay Kumar	Data analysis, Discussion.	