International Journal of Scientific Advances
ISSN: 2708-7972
Volume: 6 | Issue: 3 | May – Jun 2025 Available Online: www.ijscia.com
DOI: 10.51542/ijscia.v6i3.18

Incidence of Acute Kidney Injury in Asphyxiated Babies in Abia State University Teaching Hospital, Aba, Nigeria

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ABSTRACT

Background: Perinatal asphyxia is a major contributor to neonatal morbidity and mortality, especially in resource-poor countries where facilities for neonatal care are limited. One of the major complications of perinatal asphyxia is acute kidney injury (AKI). AKI in infants with perinatal asphyxia signifies a significant clinical problem that can have far-reaching impacts. Early recognition, prompt institution of conservative management, and close monitoring of renal function are essential to minimize morbidity, mortality, and long-term consequences in these infants. In Nigeria, there is a paucity of data on AKI in asphyxiated newborns. Few studies have been carried out, but none has been done at Abia State University Teaching Hospital (ABSUTH) South-East Nigeria. ***Methods:*** We conducted a cross-sectional descriptive study including 155 full-term neonates admitted at the special baby care unit of ABSUTH, Aba, with perinatal asphyxia. Asphyxiated neonates were grouped into severe (0-3), moderate (4-5), and mild (6) based on Apgar score at 5 minutes. Serum creatinine was done daily for the first week of life and the result was documented in the patient's clinical progress sheet. Subjects enrolled in the study were categorized within 72 hours of admission into the AKI group and no-AKI group. Acute kidney injury was defined as serum creatinine of 133µmol/L or a percentage increase in serum creatinine of ≥ 50% (1.5-fold from the baseline). ***Results:*** Of the 155 infants enrolled, 43.9% had mild perinatal asphyxia, 29% had moderate, and 27.1% had severe perinatal asphyxia. The incidence of AKI, using serum creatinine ≥ 133µl/L was 48.8%. This was found to be statistically significant with a p-value <0.05. ***Conclusion:*** AKI occurs more commonly among patients with perinatal asphyxia. Moreso with increasing severity of asphyxia. There is a need for more studies to be done using more sensitive diagnostic markers of AKI.

Keywords: Perinatal Asphyxia; AKI; ABSUTH; Serum Creatinine.

INTRODUCTION

Perinatal asphyxia refers to hypoxic or ischemic insult to the fetus or newborn that is of sufficient magnitude and duration to cause biochemical or functional changes. [1]

Perinatal asphyxia and its major complication, hypoxic-ischemic encephalopathy (HIE), are important causes of mortality and morbidity in full-term newborns. [1,2] The incidence of perinatal asphyxia in Nigeria is between 100 and 180 per thousand live births and this accounts for 16% to 55% of neonatal deaths. [3]Despite the use of variable and non-uniform criteria for the diagnosis of birth asphyxia, perinatal audits and epidemiological studies in several countries have consistently shown that birth asphyxia is second only to low birth weight as a cause of early neonatal deaths accounting for approximately 30% of neonatal deaths.[4,5]

[6] In critically ill patients, AKI is a major cause of mortality and long-term morbidity. [7,8,9] The kidneys of neonates are particularly vulnerable to hypoxia and hypoperfusion. This susceptibility to hypoperfusion has been attributed to high renal vascular resistance, high plasma renin activity, low glomerular filtration, decreased intra-cortical perfusion rate, and decreased reabsorption of sodium in the proximal tubules in the first days of neonatal life. [10]

AKI is a recognized complication of severe birth asphyxia, where it results in a poor outcome and may also result in permanent renal damage in up to 40% of survivors. [11,12] There is a high incidence of AKI among asphyxiated term infants ranging between 50-72%[13]. The severity of perinatal asphyxia correlates with increasing incidence of AKI.[14]

Few studies have been done in Nigeria on the incidence of AKI in perinatal asphyxia, however, there is still a dearth of data, and more so, no such studies have been conducted at the Abia State University Teaching Hospital, Aba.

METHODS

This was a cross-sectional descriptive study conducted at the special care baby unit of the Abia State University Teaching Hospital (ABSUTH), Aba, over a period of 21 months. Term neonates admitted within 6 hours of delivery with a diagnosis of perinatal asphyxia who met the inclusion criteria were included in the study. 155 term neonates who met the inclusion criteria were enrolled after written informed consent was obtained from the caregiver after careful explanation of the purpose, benefits, and potential harm of the study. Ethical approval was obtained from the Health Research and Ethics Committee of the Abia State University Teaching Hospital, Aba before this study was commenced.

Using a study proforma/case record form, the parents/caregivers were interviewed by the researcher, and information about the subject's age on admission, gender, contact address, phone numbers, presenting complaints, pregnancy, labour, and delivery history was obtained. Gestational age was obtained by calculation from the date of the last menstrual period and/ or possible neonatal ultrasonography to help in excluding preterm newborns from the study. The history of chronic kidney disease in the mother was also excluded. Apgar scores at 1, 5, and 10 minutes were obtained and recorded. Apgar scores of referred subjects were obtained through either their referral notes or if there were no referral notes, phone calls were made to the referring facility to help the researcher estimate the Apgar score of the subject. Asphyxiated neonates were grouped into severe (0-3), moderate (4-5), and mild (6) based on Apgar score at 5 minutes. [15] The weight, length, occipitofrontal circumference, and temperatures, of each of the subjects were measured and documented. Other aspects of the examination, including neurological examination were done.

Serum creatinine was done daily for the first week of life using the Cobas Integra machine using the compensated Jaff method and the result was documented in the patient's clinical progress sheet. Subjects enrolled in the study were categorized within 72 hours of admission into the AKI group and no-AKI group and Acute kidney injury was defined as serum creatinine of 133µmol/L or a percentage increase in serum creatinine of ≥ 50% (1.5-fold from the baseline). [161,6,18] The no-AKI group was identified by normal serum creatinine values on both day 1 and day 3.

Newborn babies diagnosed with perinatal asphyxia were transferred to the special care newborn unit for observation and treatment. Management was individualized and according to the unit protocol for managing patients with perinatal asphyxia and subsequently discharged for follow-up.

Data analysis

The data was recorded on the study proforma (Appendix C) and analyzed using IBM SPSS (Statistical Package for the Social Sciences) version 25. Data was appropriately summarized into tables and graphs.

Descriptive statistics were used to summarize quantitative variables while qualitative variables were summarized as proportions. Categorical data/variables were summarized using Chi-Square or Fisher's exact test.

To determine the sensitivity and specificity of serum creatinine in identifying AKI, a 2X2 contingency table was created. In addition, non-normally distributed data were expressed using the median. A receiver operating characteristic (ROC) curve was generated by plotting the sensitivity against 1-specificity and the area under the curve was calculated. A two-sample t-test was used for continuous variables and Chi-Square or Fisher's exact test was used for categorical variables. A p-value of ≤0.05 was considered statistically significant.

RESULTS

One hundred and fifty-five subjects with perinatal asphyxia were studied of which 80 (51.5%) were males and 75 (48.4) were females giving a male-to-female ratio of 1.06:1. The mean age of the subjects was 2.85±1.72 hours. The majority of the neonates were delivered through spontaneous vertex delivery while 23.2% were delivered via caesarean section.

TABLE 1: Socio-demographic characteristics of the study population.

	FREQUENCY (N=155)	PERCENTAGE (%)
Age on Admission (Hours)		
2	78	50.3
4	47	30.3
6	30	19.4
Gender		
Male	80	51.6
Female	75	48.4

Table 2 shows the gestational age at which the mother booked for ANC and the mode of delivery. Most mothers booked during the first trimester, followed by 36% during the second trimester, less than 2% booked during the third trimester. Also, the majority of the mothers delivered through spontaneous vertex delivery.

TABLE 2: The Gestational Age at Which The Mother Booked for ANC and The Mode of Delivery.

	FREQUENCY(n=155)	PERCENTAGE(%)
Gestational Age at Which Mother Booked for ANC		
1st Trimester	97	62.6
2nd Trimester	56	36.2
3rd Trimester	2	1.2
Mode of Delivery		
C/S (Caeserean Section)	36	23.2
SVD (Spontaneous Vertex)	119	76.8

Table 3 shows a number of subjects having mild, moderate, and severe perinatal asphyxia. Most of the subjects 68(43.9%) had mild perinatal asphyxia, 45 (29.0%) had moderate, while 42 (27.1%) had severe perinatal asphyxia.

TABLE 3: Distribution of subjects with perinatal asphyxia.

APGAR SCORE AT 5 MINUTES	FREQUENCY	PERCENTAGE (%)
Mild (6)	68	43.9
Moderate (4-5)	45	29.0
Severe (0-3)	42	27.1
Total	**155**	**100.0**

Table 4 shows that the majority of the patients with severe perinatal asphyxia (92.9%) developed acute kidney injury while only 11.8% of those with mild perinatal asphyxia developed AKI.

TABLE 4: Severity of perinatal asphyxia in the AKI/ no-AKI group.

APGAR SCORE AT 5 MINUTES	AKI (%)	NO-AKI (%)	TOTAL
Mild	8 (11.8%)	60 (88.2%)	68
Moderate	28 (62.2%)	17 (37.8%)	45
Severe	39 (92.9%)	3 (7.1%)	42
Total	**75 (48.4%)**	**80 (51.6%)**	**155**

**P = 0.001*

Levels of serum creatinine increased mostly from the second day of the life of subjects. Most subjects (60%) had levels of serum creatinine of 51-150µmol/L.

TABLE 5: Levels of Serum Creatinine.

SERUM CREATININE (µmol/L)	DAY 1(%)	DAY 2 (%)	DAY 3 (%)	DAY 4 (%)	DAY 5(%)	DAY 7(%)
>50	7(4.5)	8(5.2)	9(5.8)	13(8.4)	19(12.3)	19(12.3)
51-150	91(58.7)	93(60.0)	91(58.7)	90(58.1)	89(57.4)	90(58.1)
151-250	47(30.3)	45(29.0)	46(29.7)	40(25.8)	42(27.1)	38(24.5)
>250	10(6.5)	9(5.8)	9(5.8)	12(7.7)	5(3.2)	8(5.2)

Figure 1 shows a receiver operating characteristic (ROC) curve generated by plotting the sensitivity on the Y-axis and the 1-specificity on the X-axis. The cut-off for the diagnosis of AKI using day 3 serum creatinine of 133µmol/l is at a sensitivity of 90.7%.

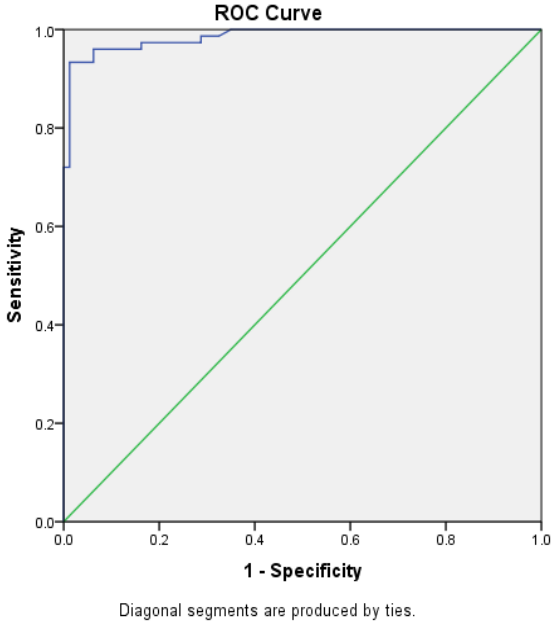

FIGURE 1: ROC curve for serum creatinine.

DISCUSSION

Patients with AKI demonstrated a higher level of serum creatinine with the increase seen from the second day of life. This was similar to findings from studies done by Pejovic et al [19], Selewski et al [20], Gupta et al [21], and Kaur et al [22]. Karlowicz and Adelman however, demonstrated an increase in serum creatinine on the fourth day of admission[13] Increase in serum creatinine is one of the criteria for defining AKI in these cohorts of patients.

We found an increasing incidence of AKI with increasing severity of perinatal asphyxia. Studies by Karlowicz and Adelman reported similar findings. Also, another case-control study done in India corroborated this finding. Furthermore, serum creatinine steadily increased with increasing severity of perinatal asphyxia and AKI in this study, corroborating a study done on AKI in asphyxiated neonates by El Raggal et al [23] This finding could be attributed to ischemia of renal parenchyma which occurs in AKI. Gupta et al, in a study on the incidence of renal failure in asphyxiated neonates, showed that the severity of renal failure correlated with the Apgar score and HIE grading of the neonates [21] Also, Kaur et al and Karlowicz et al, demonstrated a greater number of patients developing AKI in severe than moderate perinatal asphyxia.[22,13]

The analysis of the receiver operating characteristic curves of serum creatinine at a cut-off of ≥ 133µl/L showed a sensitivity for serum creatinine of 90.7% and the incidence of AKI of 48.8% was found. This was comparable to previous studies which reported a prevalence of 30-50%[11,24]. A study on the role of urine NGAL as an early marker of AKI in sick neonates done in south-south Nigeria found an incidence of 23.5% using serum creatinine while Udoh et al found an incidence of AKI of 11.5% using serum creatinine as a diagnostic marker.[25,26] The lower incidence of AKI using serum creatinine as a diagnostic marker could be explained by serum creatinine concentrations not changing until half of the kidney function is lost. [27]

CONCLUSION

AKI is a common complication in asphyxiated newborns. The incidence of AKI increases with increasing severity of birth asphyxia. Every effort geared towards the reduction of birth asphyxia in neonates will ultimately reduce the incidence of AKI.

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