

## Original Article

# Acute kidney injury in asphyxiated neonates admitted to a tertiary neonatal unit in Sudan

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## ABSTRACT

Acute kidney injury (AKI) is a recognized complication of birth asphyxia. Early recognition of AKI is important in asphyxiated neonates as it helps in early intervention and appropriate management. The aim of this study was to determine the pattern of AKI in asphyxiated neonates and its relation to the grade of Hypoxic Ischemic Encephalopathy (HIE). This was a prospective hospital based study, conducted in the neonatal intensive care unit (NICU) at Gafaar Ibn Auf Children's Specialized Hospital during the period between January 2013 and December 2013. A total of 85 full term asphyxiated neonates who were admitted in NICU and diagnosed as HIE were enrolled in this study. with 50 (58.8%) less than 7 days of age, 31(36.5%) between (8-15) days and 4(4.7%) between (16-28) days. Males were found to be more affected than females (58.9% and 41.1%) respectively. Spontaneous vaginal delivery was the mode of delivery in 48(56.4%), assisted vaginal delivery in

14(16.5%), emergency caesarian in 19(22.4%) and elective caesarian section in. Percentage of AKI in those babies was 54.1%(46). With 30(65%) from those had non-oliguric type. Ten babies (21.7%) had serum creatinine between (1.5 - 2mg/dl), 29 (63.04%) between (2 - 3mg/dl) and 7(15.22%) between (3-4mg/dl). This means that the majority of patients presented in injury stage. Hyperkalemia was found in (37.6%), hyponatremia in (27.1%) and hypocalcaemia in (25.8%). Most of the babies with AKI had stage (ii) HIE. All babies were treated conservatively and 4(8.6%) died. In conclusion AKI was observed to be a common complication in asphyxiated neonates.

### Key words:

Acute kidney injury; Asphyxia; Neonates; Hypoxic ischemic encephalopathy.

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## INTRODUCTION

Asphyxia remains a common problem in neonatal units and is a significant cause of morbidity and death in term and preterm neonates. The incidence of asphyxia is estimated to be between 1 and 8 per 1000 live births. This wide range can be largely attributed to problems in selecting indicators to identify children with perinatal asphyxia. Perinatal Asphyxia ranks as the second most important cause of neonatal death [1]. Major risk factors of hypoxic ischemic encephalopathy (HIE) according to WHO guidelines are:

1. Acute maternal hypotension
2. Poor maternal lung functions
3. Umbilical cord compression and prolapse
4. Cephalopelvic disproportion and obstructed labor

Events in the immediate perinatal period are most important in neonatal brain injury [2]. Asphyxia can lead to multi organ dysfunction and a redistribution of cardiac output to maintain cerebral, cardiac, and adrenal perfusion while potentially compromising renal, gastrointestinal, and skin perfusion as circulatory response [3]. It is therefore not surprising that acute kidney injury (AKI) is common in asphyxiated neonates. Kidneys are sensitive to oxygen deprivation and renal insufficiency may occur within 24 hours of hypoxic ischemic episode which if prolonged may even lead to irreversible cortical necrosis. In human beings, glomerulogenesis begins at 5 weeks gestational age and develops and peaks at the second trimester. In the fetus, glomerular filtration rate (GFR) has a correlation with both gestational age and body weight. Prenatal GFR, even corrected for body weight is lower in neonates than in adults [4].

The pRIFLE scale, for early detection and classification of the AKI severity is currently widely accepted, (p: pediatric, R: rick, I: injury, F: failure, L: loss, E: end stage) [4].

Rick: 1.5 fold increase in S-creatinine or GFR decrease by 25% or urine output < 0.5 ml/kg per hour

for 6 hours.

Injury- Two fold increase in S-creatinine or GFR decrease by 50% or urine output < 0.5 ml/kg per hour for 12 hours.

Failure- Three fold increase in S-creatinine or GFR decrease by 75% or urine output < 0.3 ml/kg per hour for 12 hours.

Loss- complete loss of Kidneys Function for more than 4 weeks.

ESRD- complete Loss of Kidneys function for more than 3 months [5].

Studies have shown the difference in incidence of AKI between the control group and asphyxiated neonates [6,7]. The aim of this study was to determine the pattern of AKI in Sudanese asphyxiated neonates admitted to NICU in a Tertiary Hospital—and to correlate the AKI with HIE staging.

## MATERIALS AND METHODS

This was a prospective observational hospital based study conducted between January and December 2013 in the neonatal unit at Gaffar Ibn Auf Children's Specialized Hospital, which is the main tertiary hospital located in Khartoum, the capital of Sudan. All asphyxiated full term neonates who were admitted to the neonatal unit during the study period were included, preterm babies were excluded.

Data were collected using a specifically designed questionnaire including maternal and neonatal data, all mothers were interviewed after obtaining their consent. A total of 85 babies were included in the study, all babies were examined by either a consultant pediatrician or a senior registrar. HIE staging from 1 to 3 was determined depending on the presentation, central nervous system examination and presence or absence of convulsions.

Laboratory tests included random blood sugar, CBC, blood urea, creatinine, Na and K. GFR was

also calculated and percentage determined. AKI was classified according to pRIFLE criteria [4]. Oliguric renal failure was diagnosed if urine output was less than 1 ml/kg/hour.

### Data Analysis

Data were analyzed using SPSS program (Statistical Package of Social Sciences), the dependent variable was acute kidney injury and the independent variables were gender and age of the neonate, maternal parity, antenatal care, place and mode of delivery. Chi square test was used to study the association between acute kidney injury and the above independent variables, also the association between acute kidney injury and stage of HIE was studied. Level of significance (P value) was set at 0.05. Ethical approval for this study was granted by Gafaar Ibn Auf Children's Specialized Hospital administration. Consent was taken from all participating mothers.

## RESULTS

A total of 85 asphyxiated neonates were included in this study. Fifty (58.8%) neonates were less than 7 days of age, 31(36.5%) between (8-15) days and 4(4.7%) between (16-28) days. Males were found to be more affected than females (58.6% versus 41.1%).

Forty six (54.1%) of asphyxiated neonates were found to have AKI. Twenty three patients (50%) from the age group (0-7 days), twenty (43.4%) from the age group (8-15 days) and only 3 (6.6%) babies from the age group (16-28 days), with insignificant correlation between the age and AKI occurrence (p-value = 0.133).

Twenty seven (58.7%) mothers of neonates with AKI were multiparous and 19(41.3%) were primiparous (p-value = 0.033) [Table 1].

**Table 1 - Association between acute kidney injury and parity**

	Parity	
	Primigravida	Multipara
Oliguric	10(52.6)	6(22.2)
Non oliguric	9(47.4)	21(77.8)
Total	19	27

Thirty one (67.3%) of asphyxiated neonates with AKI were from mothers with regular antenatal care (ANC), while 15 (32.7%) with no ANC (p-value = 0.239). Home deliveries were reported in 18 (39.2%) babies, while 28(60.8%) were delivered in hospital (p-value = 0.424).

Most of the babies with AKI had stage (ii) HIE (Table 2).

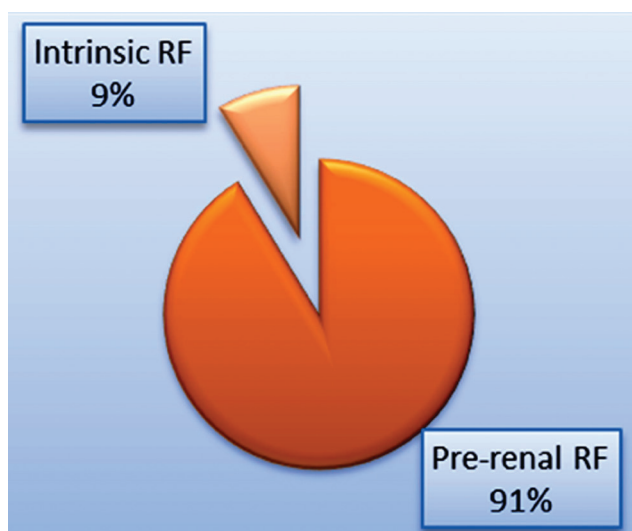
**Table 2 - Hypoxic ischemic encephalopathy staging and acute kidney injury**

Stage	Oligouric		Non oligouric	
	N	%	N	%
Stage I	3	18.8	7	23.3
Stage II	10	62.5	19	63.3
Stage III	3	18.8	4	13.3
<b>Total</b>	<b>16</b>	<b>100.0</b>	<b>30</b>	<b>100.0</b>

Serum creatinine was ranging between 1.5-1.9mg/dl in 10 (21.74%) babies, 2-3mg/dl in 29 (63.04%) and more than 3mg/dl in 7 (15.22%) neonates with significant association with HIE staging (p-value = 0.003).

According to pRIFLE criteria, AKI in asphyxiated neonate classified to 13(28.2%) babies in R (GFR decreased by 25%) class, 25 (54.8%) in I (GFR decreased by 50%) class and in F (GFR decreased by 75%) class, 8 (17.36%) neonate of the study group, with no significant association with HIE staging (p<0.200).

Blood urea was ranging between 50-100mg/dl in 28(78.81%) and 100-200mg/dl in 18(21.18%). Rising Serum K was in 32(37.6%) of all asphyxiated neonates. Serum Ca showed low level in 16(26%) asphyxiated babies and serum Na was normal among most of the neonates in this study. Pre-renal failure was found in 42 (91.3%) and intrinsic renal failure in 4 (8.7%) of the population (Figure 1).



**Figure 1 - Distribution of the study sample according to type of renal failure (RF).**

Conservative treatment was applied in all of the patients. Outcome of the asphyxiated neonates having AKI included 91.3% who showed complete recovery and 4(8.7%) deaths.

## DISCUSSION

Compared to old children, newborn babies are more susceptible to acute kidney injury because they have low glomerular filtration rate, high renal vascular resistance, high plasma renin activity and decreased reabsorption of sodium in the proximal tubules. Moreover, difficulties in serum creatinine interpretation make it more difficult to achieve a

consensus regarding AKI definition [8].

The epidemiology of AKI has changed in the past few decades, with rapid advances in medical technology. Recent studies recognize that even small increments in serum creatinine levels increase morbidity and mortality [9,10]. The current study is the first report from Sudan focusing on the incidence of acute kidney injury in asphyxiated neonates and applying pRFILE classification for diagnosis and outcome.

Our study showed that AKI was a common consequence among asphyxiated neonates in 46 (54.1%) babies, it is most common in stage 2 in 29(63%) babies and this finding is similar to the study done in Austria which showed that 56% of asphyxiated neonates had AKI. It is also similar to the study done in Saudi Arabia where they found that AKI in 18 out of 32 (56.25%) asphyxiated babies with significantly high level of serum urea and creatinine on day 3 of life [11]. Our study showed that 69.4% of the mothers had regular antenatal care and the incidence of home delivery among asphyxiated neonates was 39.2% which is considered high. This is comparable to a study done in Pakistan where 64% of the mothers had regular ANC, however home delivery was found in 56% which is even higher and this is probably due to the beliefs of parents and grandparents [12]. Our study showed that 56.7% of the asphyxiated babies were delivered by spontaneous vaginal delivery, 16.5% by assisted vaginal delivery and C/S in 27,1% , these findings are different from an Indonesian study where they found spontaneous vaginal delivery in 43%, assisted vaginal delivery in 10% and C/S in 47% . This higher C/S rate would influence the fetal outcome [13].

Our study showed that the commonest HIE stage was stage 2 in 54.1%, this is similar to a study done in Kenya which showed Stage 2 in 30 out of 60 babies (50%) [14]. Non-oliguric AKI was found in 65% of asphyxiated neonates in our study which is similar to report from USA which highlights the insensitivity of oliguria to predict AKI in neonates [15] and again

it is similar to a study that was done in India where the non-oliguric renal failure represented 78% of asphyxiated neonates[16] . In contrast a study from New Delhi reported oliguric renal failure in 69% of asphyxiated neonates (17).

In the present study all neonates with AKI as a result of birth asphyxia received supportive treatment with good outcome where 91.3% of babies had full recovery and death occurred in 8.7%. A higher mortality rate was reported in a recent Indian study where 18.75% of neonates with AKI died [6]

## CONCLUSION

Acute kidney injury (AKI) is common among asphyxiated neonates .It should be suspected in all sick newborns as early recognition and prompt management prevent severe kidney injury.

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