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# Frequency of Acute Kidney Injury among Neonates with Birth Asphyxia Presenting at Tertiary Care Hospital in Khyber Pakhtunkhwa

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## ABSTRACT

Perinatal asphyxia signifies a decrease in blood or oxygen supply to the fetus before, during, or following birth. This restriction of blood or oxygen during the time around birth can result in serious physiological and neurologic effects. **Objective:** To evaluate the frequency of acute kidney injury among neonates with birth asphyxia presenting at tertiary care hospitals from August 2023 to February 2024. **Methods:** A cross-sectional study was conducted using a consecutive non-probability sampling technique. It was performed on 105-term neonates i.e., born during 37-42 weeks of gestation of either gender who presented with birth asphyxia. Statistical software (IBM SPSS 26) was used to analyze the data. **Results:** The mean gestational age of the neonates was 39.55 ± 1.48 weeks, 49 (46.66%) were male while 56 (53.33%) were female patients. The prevalence of acute kidney injury in our population was 11 out of 105 (10.5%). The incidence of acute kidney injury in mothers with preeclampsia is 5 (45.5%) and 6 (54.5%) for having no preeclampsia. For birth weight 1.9 to 2.5Kg 7(63.6%) we had Acute kidney injury while for those above 2.5 Kg only 4 (36.4%) had Acute kidney injury. 4 (36.4%) out of 11 acute kidney injury neonates had a gestational age of 37 to 39 weeks and 7 (63.6%) had more than 39 weeks' gestational age. **Conclusions:** It was concluded that the frequency of acute kidney injury was 10.5% and no significant difference was found for other variables such as gestational age, and mode of delivery in mothers with preeclampsia history.

## INTRODUCTION

The term "perinatal asphyxia" signifies a lack of oxygen or blood supply to the fetus before, during, or following birth. Restricted flow of blood or oxygen delivery to the newborn or fetus during the time around birth can result in serious physiological and neurologic effects, known as perinatal asphyxia [1]. A decrease in oxygen supply to the critical organs can be either incomplete (hypoxia) or complete (anoxia) when the exchange of gases occurs either in the placenta or the lungs. This triggers hypoxemia and hypercapnia to become more severe over time. The tissues and important organs acquire an oxygen debt if the hypoxemia is severe enough [2]. As a consequence, anaerobic glycolysis and lactic acidosis occur. The neurological implications of perinatal hypoxia are referred to as neonatal hypoxic-ischemic encephalopathy [2]. Fetal Hemoglobin has the highest tendency toward oxygen and hypoxemia every time doesn't mean hypoxia. Hypoxia can occur at any time from the onset of labor till the delivery of the placenta. Like adults, neonates have their compensatory mechanism by transferring all blood to vital organs leaving the end organ hypoxic. Decreases in oxygen can lead to anaerobic respiration and lactic acidosis which further exacerbate the condition and cause permanent damage to organs. In the end, decreased oxygen supply to the brain can also lead to hypoxic-ischemic encephalopathy. The duration of hypoxia has a critical role in the outcome of the patient in terms of its complications [3]. During fetal life, the kidney doesn't work as an excretory organ, soon after birth it starts its functioning and the number of nephrons developed is dependent, on whether the neonate is term or preterm. Acute Kidney injury (AKI) in neonates is considered multifactorial and its prognosis

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depends on the diagnosis and quick management [4]. AKI has many causes and prevalence in a different region with different comorbidities with prevalence ranging from 3 to 63% among neonates. Sepsis is the most common cause in developed regions [5]. In a study, among 332 neonates 120 had AKI with a prevalence of 36.1%, taking Risk, Injury, Failure, Loss of kidney function and End-stage kidney disease (RIFLE) criteria the outcome was Failure 72, followed by injury 26, and finally Risk 17. Sepsis was considered as most common cause [6]. Extremely sensitive to hypoxia, renal insufficiency typically presents itself within 24 hours after a hypoxia ischemic encephalopathy event and can cause permanent cortical necrosis. Avoiding further long-term adverse outcomes in these neonates requires prompt detection and treatment of acute renal damage [7]. A study conducted on birth asphyxia neonates found that 13.3% of neonates were observed to develop acute kidney injury [8].

This study aims to determine the frequency of acute kidney injury among neonates with birth asphyxia presenting at tertiary care hospitals and show if there is any relation between hypoxia and acute kidney injury in neonates. So that it guides toward early diagnosis and intervention and provides a base for further research on this topic.

## METHODS

A Cross-Sectional Study was conducted in the Pediatric Department, Lady Reading Hospital, Peshawar for the study duration was August 2023 to February 2024. A Consecutive non-probability sampling technique was used. All the patients meeting the inclusion criteria i.e. full-term newborns i.e. from 37 to 42 weeks of gestation and neonates with birth asphyxia, were enrolled in the study. The data were collected by a professional team and were kept confidential by giving serial numbers. The neonates having either sepsis, congenital malformation, or Beckwith-Wiedemann syndrome were excluded from the study. Birth asphyxia was defined as the neonate's failure to begin and sustain respiration after birth, which will be evaluated based on the Apgar score. Birth asphyxia will be diagnosed if APGAR scores<7 after 5 minutes of birth. Acute kidney injury was defined as the level of serum creatinine>1.5 mg/dL (133 micromole/L) OR an increase of at least 0.2 - 0.3 mg/dL (17 to 27 micromole/L) per day by conducting a blood test. The Ethical and Research Board of Lady Reading Hospital Peshawar approves this study via CPT # 826/LRH/MTI. The study's goals, benefits, and risks were explained to patients/guardians, and a written informed consent form was obtained. Demographic details like age, gender, and address were documented, and a medical assessment was done followed by a complete physical examination. All the patients diagnosed with birth asphyxia were evaluated for acute kidney injuries such as a level of serum creatinine>1.5 mg/dL (133 micromole/L) OR an increase of at least 0.2 - 0.3 mg/dL (17 to 27 micromole/L) per day by conducting a blood test. The determined sample size is 105 using the WHO sample size calculator with the following parameters. The anticipated proportion of (13.3%) was found to develop acute kidney injury among birth asphyxia neonates with a Confidence level of 95 % and Absolute precision of 5% [8]. Statistical software (IBM SPSS version 26.0) was used to enter and analyze the data. Mean + SD were used to determine the numerical data like gestational age, and birth weight. Frequency and percentages were used to describe the categorical data like gender, pre-eclampsia, acute kidney injury, and mode of delivery. Through comparison, effect modifiers such as birth weight, gender, gestational age, pre-eclampsia, and mode of delivery were managed. A post-comparison chi-square test was conducted, with a p-value of less than 0.05 deemed significant. The results of this study were presented in the form of tables.

## RESULTS

The frequency of acute kidney injury among neonates with birth asphyxia was 11 (10.5%) out of 105 sample size (Figure 1).

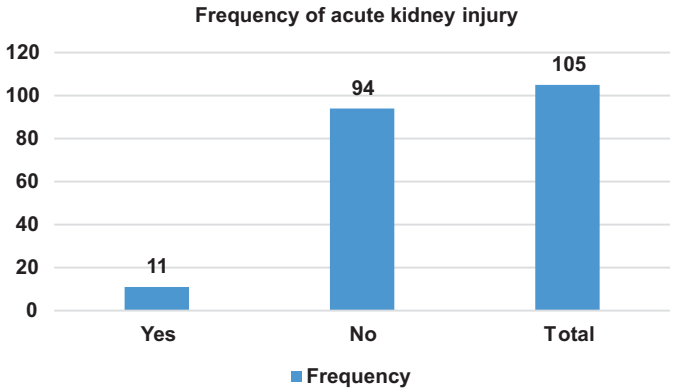


**Figure 1:** Frequency of Acute Kidney Injury among Total Neonates

The average age of gestation for the mothers was 39.55 ± 1.48 weeks. The mean birth weight was 2.4 ± 0.32 kg (Table 1).

**Table 1:** Average Age and Weight of Gestation of Neonates

| Variables | Mean + SD |
|---|---|
| Gestational Age (Weeks) | 39.55 + 1.487 |
| Birth Weight (Kg) | 2.4870 + 0.32966 |

A comparison of acute kidney injury with gestational age was done. Birth weight in kg is divided into two categories: shown and compared. Gender distribution shows that 59 (56.2%) were male, 46 (43.8%) were female patients, 8 (72.7%) males and 3 (27.3%) females developed AKI. In our study 45 (42.9%) mothers of the patients had preeclampsia and 60(57.1%) had no Preeclampsia, 5 (45.5%), neonates with preeclampsia mothers had AKI (Table 2).

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**Table 2:** Comparison of Acute Kidney Injury with Gestational Age among Neonates

| Acute Kidney Injury | Gestational Age (Weeks) | | Total | p-value |
|---|---|---|---|---|
| | 37 to 39 | >39 | | |
| Yes | 4 (36.4%) | 7 (63.6%) | 11 | 0.51 |
| No | 44 (46.8%) | 50 (53.2%) | 94 | |
| Total | 48 (45.7%) | 57 (54.3%) | 105 | |
| | **Birth Weight (Kg)** | | | |
| | **1.9 to 2.5** | **>2.5** | | |
| Yes | 7 (63.6%) | 4 (36.4%) | 11 | 0.26 |
| No | 43 (45.7%) | 51 (54.3%) | 94 | |
| Total | 50 (47.6%) | 55 (52.4%) | 105 | |
| | **Gender** | | | |
| | **Male** | **Female** | | |
| Yes | 8 (72.7%) | 3 (27.3%) | 11 | 0.24 |
| No | 51 (54.3%) | 43 (45.7%) | 94 | |
| Total | 59 (56.2%) | 46 (43.8%) | 105 | |
| | **Preeclampsia** | | | |
| | **Yes** | **No** | | |
| Yes | 5 (45.5%) | 6 (54.5%) | 11 | 0.85 |
| No | 40 (42.6%) | 54 (57.4%) | 94 | |
| Total | 45 (42.9%) | 60 (57.1%) | 105 | |

Regarding the mode of delivery, spontaneous vaginal delivery was 32 (30.5%), cesarean section was 46 (43.8%), forceps delivery was 12 (11.4%), and 15 (14.3%) patients had vacuum-assisted delivery (Table 3).

**Table 3:** Comparison of Acute Kidney Injury with Mode of Delivery among Neonates

| Variable | | Mode Of Delivery | | | | Total |
|---|---|---|---|---|---|---|
| | | Spontaneous Vaginal Delivery | Cesarean Section | Forceps Delivery | Vacuum-Assisted Delivery | |
| Acute Kidney Injury | Yes | 5 (45.5%) | 1 (9.1%) | 3 (27.3%) | 2 (18.2%) | 11 |
| | No | 27 (28.7%) | 45 (47.9%) | 9 (9.6%) | 13 (13.8%) | 94 |
| Total | | 32 (30.5%) | 46 (43.8%) | 12 (11.4%) | 15 (14.3%) | 105 |

## DISCUSSION

Our study shows acute kidney injury (AKI) in 11 out of 105 neonates, with no significance for any risk factor mentioned in the results. The prevalence and risk factors vary as mentioned in different studies. Sepsis is the most common risk factor for acute kidney injury, in a study among 378 critically ill neonates 31.5% with AKI had an independent risk factor of sepsis. Extremely low gestational age is also a risk factor for acute kidney injury in neonates. 37% of neonates born with congenital diaphragmatic hernia were known to have acute kidney injury [9-11]. AKI is associated with birth weight and in neonates with extremely low birth weight AKI occurs more commonly, severe AKI was seen in 168 (19%) out of 900, and stage 3 AKI occurs in 60 (7 %) [12]. The risk factors for AKI in neonates are a critical illness, low birth weight, very low birth weight, gestational age, sepsis, low Apgar score, and congenital heart diseases. Increased levels of bilirubin, necrotizing enter colitis, sepsis, and breathing support requirements all increase risk. The incidence of AKI in low birth weight was studied as 25% in one study. It changes from 11.6 to 55.8% in very low birth weight neonates. Our study has considered the population with normal weight [13-15]. New neonatal AKI preventive and therapy approaches confirm these results. Future studies should incorporate improved fluid overload definitions, prospective long-term follow-up studies to find Chronic kidney disease (CKD) risk variables, and interventional trials of AKI therapies (methyl-xanthine, Renal replacement therapy (RRT) utilizing novel devices). Standardizing monitoring and follow-up of AKI newborns, improved availability and usage of neonatal-specific extracorporeal devices for renal support treatment, and biomarker incorporation into regular clinical practice would all help newborn AKI as well [16]. A study was conducted to measure the outcome of AKI in Preterm and Term babies. It shows that in 1st week of birth, AKI incidence was 1.5% of neonates [17]. In a study on 105 term neonates with birth asphyxia, the majority of the neonates had male gender. The mean birth weight was 2.48 kg. Studies have shown that birth asphyxia is common in male gender while low birth weight is a contributing risk factor [18]. The KDIGO criteria are suggested as a predictor of the outcome of AKI, as we have limited resources in our setup it is advised to perform further study for a better outcome of neonatal AKI [19, 20]. The frequency of AKI in our study was 11 (10.5%), comparable to a study that reported a frequency of AKI of 13.3% [8].

## CONCLUSIONS

It was concluded that the frequency of acute kidney injury among neonates with birth asphyxia in our study was 11 (10.5%). There were no statistically important differences in patients with different modes of delivery, gestational age, Preeclampsia among mothers, and birth weight. So further studies are required in this regard to come to a conclusive result.

### Authors Contribution

Conceptualization: LA
Methodology: LA, HN, SS, SZ, MA
Formal analysis: HN
Writing review and editing: LA

All authors have read and agreed to the published version of the manuscript

### Conflicts of Interest

All the authors declare no conflict of interest.

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