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# ACUTE KIDNEY INJURY IN POSTPARTUM PATIENTS: RISK FACTORS AND OUTCOME

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## Abstract

**Background:** Acute kidney injury (AKI) in postpartum patients poses significant morbidity and mortality risks. The postpartum period is a vulnerable time for women due to physiological changes and potential complications such as preeclampsia, postpartum hemorrhage, sepsis, and acute fatty liver of pregnancy. Despite advancements in obstetric care, the incidence of AKI remains concerning, especially in developing regions with limited access to comprehensive maternal healthcare. **Material & Methods:** This retrospective observational study was conducted at Patna Medical College and Hospital, a tertiary care center in Bihar, India. We included postpartum women diagnosed with AKI between January 2023 and November 2023. AKI was diagnosed based on the KDIGO criteria. Data were collected retrospectively from medical records, including demographic details, obstetric history, clinical parameters, laboratory parameters, and outcomes. Statistical analysis was performed using SPSS version 25.0. Descriptive statistics, chi-square tests, t-tests, Mann-Whitney U tests, and multivariate logistic regression analysis were utilized to identify significant risk factors and outcomes. **Results:** The study included 106 postpartum AKI patients. The majority were aged 20-29 years (56.6%), from low socioeconomic backgrounds (60.4%), and nuclear families (66.0%). Obstetric complications included preeclampsia (28.3%), postpartum hemorrhage (20.8%), sepsis (17.0%), and acute fatty liver of pregnancy (6.6%). Elevated serum creatinine ($2.1 \pm 0.8$ mg/dL) and blood urea nitrogen levels ($45 \pm 15$ mg/dL) indicated significant renal dysfunction. Outcomes showed that 80.2% recovered renal function, 19.8% required dialysis, and the mortality rate was 10.4%. significant risk factors for AKI included age $\geq 30$ years (aOR: 2.3, p=0.03), low socioeconomic status (aOR: 2.8, p=0.01), and preeclampsia (aOR: 3.2, p=0.002). **Conclusion:** This study highlights the critical need for early recognition and management of AKI in postpartum women, particularly in resource-limited settings. Identifying significant risk factors, such as older age, low socioeconomic status, hypertension, and preeclampsia, underscores the importance of targeted interventions and comprehensive prenatal and postnatal care. Improving access to maternal healthcare services, enhanced monitoring of renal function, and effective management of obstetric complications can significantly reduce the burden of AKI and improve maternal health outcomes.

## INTRODUCTION

Acute kidney injury (AKI) in postpartum patients has been a critical and increasingly recognized condition that poses significant morbidity and mortality risks. The postpartum period, defined as the six-week interval following childbirth, is a vulnerable time for women due to substantial physiological changes and potential complications.

AKI in this context has often been a consequence of obstetric complications such as preeclampsia, postpartum haemorrhage, sepsis, and acute fatty liver during pregnancy. Despite advancements in obstetric care, the incidence of AKI in the postpartum period has remained a concerning issue, particularly in developing regions where access to comprehensive maternal healthcare may be limited.[1-3]

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Patna Medical College and Hospital, located in the capital city of Bihar, India, has served as a tertiary care center and a critical hub for maternal and child health services. The institution catered to a diverse population with varying socioeconomic backgrounds, providing a unique setting to study the incidence, risk factors, and outcomes associated with postpartum AKI. Understanding the etiological profile and identifying preventable risk factors was imperative for developing targeted interventions and improving maternal health outcomes.

This study aimed to systematically investigate the clinical profile, risk factors, and outcomes of AKI among postpartum patients admitted to Patna Medical College and Hospital. By analyzing a cohort of postpartum women who developed AKI, we sought to delineate the contributing factors and assess the short-term and long-term renal outcomes. Additionally, this study provided valuable insights into the effectiveness of current management strategies and highlighted areas where improvements in care practices could be implemented.

Understanding AKI's risk factors and outcomes in the postpartum period has been crucial for healthcare providers, policymakers, and public health practitioners. It informed the development of preventive measures, enhanced early detection and intervention strategies, and ultimately contributed to reducing the burden of AKI on affected women and the healthcare system. This research served as a foundational step toward enhancing maternal health care protocols and ensuring safer postpartum periods for women in Patna and similar settings globally.

## MATERIALS AND METHODS

### Study Design and Setting
This retrospective observational study was conducted at Patna Medical College and Hospital, Patna, a tertiary care center serving a diverse population from various socioeconomic backgrounds. The study aimed to investigate the clinical profile, risk factors, and outcomes of acute kidney injury (AKI) among postpartum patients.

### Study Population
The study included postpartum women who were admitted to Patna Medical College and Hospital and diagnosed with AKI between January 2023 and November 2023. The postpartum period was defined as the six-week interval following childbirth. AKI was diagnosed based on the kidney disease: Improving Global Outcomes (KDIGO) criteria, which include an increase in serum creatinine by ≥0.3 mg/dL within 48 hours, an increase in serum creatinine to ≥1.5 times baseline within seven days, or a urine output of <0.5 mL/kg/h for six hours.

### Inclusion and Exclusion Criteria

**Inclusion Criteria**
- Women in the postpartum period (up to six weeks after delivery).
- Diagnosed with AKI based on KDIGO criteria.
- Admitted to Patna Medical College and Hospital during the study period.

**Exclusion Criteria**
- Pre-existing chronic kidney disease.
- Women with a history of renal transplantation.
- Patients who had undergone renal biopsy.

### Data Collection
Data were collected retrospectively from the medical records of the hospital. The following information was extracted:
- Demographic details: age, socioeconomic status, and type of family.
- Obstetric history: parity, mode of delivery, and any obstetric complications.
- Clinical parameters: blood pressure, body mass index (BMI), and presence of co-morbid conditions (e.g., hypertension, diabetes).
- Laboratory parameters: serum creatinine, blood urea nitrogen (BUN), hemoglobin, and complete blood count.
- Outcomes: recovery of renal function, need for dialysis, length of hospital stay, and mortality.

### Statistical Analysis
Data were analyzed using SPSS version 25.0. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Continuous variables were expressed as mean ± standard deviation (SD) or median (interquartile range), and categorical variables were expressed as frequencies and percentages. Comparative analysis was performed to identify significant risk factors associated with AKI in postpartum patients. The chi-square test was used for categorical variables, and the student's t-test or Mann-Whitney U test was used for continuous variables, as appropriate. Multivariate logistic regression analysis was conducted to identify independent risk factors for AKI. A p-value of <0.05 was considered statistically significant.

### Ethical Considerations
The study was conducted by the Declaration of Helsinki and approved by the Institutional Ethics Committee of Patna Medical College and Hospital. Since the study was retrospective and observational, the requirement for informed consent was waived.

## RESULTS

The demographic characteristics of the postpartum AKI patients, as shown in Table 1, indicate that most patients (56.6%) were between 20-29 years old, followed by 28.3% in the 30-39 age group. A smaller proportion of patients were younger than 20 (9.4%) and older than 40 (5.7%). Regarding socioeconomic status, a significant number of patients (60.4%) were from low socioeconomic backgrounds, while 30.2% belonged to the middle

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class, and only 9.4% were from high socioeconomic status. Additionally, most patients came from nuclear families (66.0%), whereas 34.0% were from joint families. [Table 1]

Table 2 summarizes the obstetric and clinical characteristics of the patients. More than half of the patients (57.5%) were multiparous (had given birth more than once), while 42.5% were primiparous (first-time mothers). A higher proportion of patients (60.4%) delivered vaginally compared to those who had a cesarean section (39.6%). Obstetric complications were common, with preeclampsia observed in 28.3% of patients, followed by postpartum hemorrhage (20.8%), sepsis (17.0%), and acute fatty liver of pregnancy (6.6%). Nearly half of the patients (47.2%) had hypertension, and 18.9% had diabetes mellitus. In terms of BMI, most patients had a normal BMI (47.2%), with 26.4% being overweight, 13.2% underweight, and another 13.2% obese. [Table 2]

Table 3 presents the key laboratory findings for postpartum AKI patients during hospital admission. The average serum creatinine level was 2.1 ± 0.8 mg/dL, with a median value of 2.0 mg/dL (IQR: 1.5-2.7). The mean BUN was 45 ± 15 mg/dL, with a median value of 44 mg/dL (IQR: 35-55). The average hemoglobin level was 10.5 ± 2.0 g/dL, with a median of 10.3 g/dL (IQR: 9.0-12.0). The mean platelet count was $150 \pm 50 \times 10^9$/L, with a median of $145 \times 10^9$/L (IQR: 110-180). The mean WBC count was $12 \pm 4 \times 10^9$/L, with a median of $12 \times 10^9$/L (IQR: 10-15). [Table 3]

Table 4 details the outcomes for the postpartum AKI patients. A significant majority of patients (80.2%) recovered renal function. About 19.8% of patients required dialysis, indicating the severity of AKI in some cases. The average length of hospital stay was 10 ± 5 days, reflecting the considerable healthcare burden associated with AKI. The mortality rate among the patients was 10.4%, highlighting the serious nature of AKI in the postpartum period. [Table 4]

Table 5 identifies the odds ratios (OR) and associated confidence intervals (CI) for various risk factors contributing to AKI in postpartum patients. Patients aged 30 years or older had an OR of 2.5 (CI: 1.2-5.0) with a p-value of 0.02, indicating a significant risk. Low socioeconomic status had an OR of 3.0 (CI: 1.5-6.0) with a p-value of 0.01, highlighting it as an important risk factor. Hypertension had an OR of 2.0 (CI: 1.0-4.0) and a p-value of 0.05, suggesting a significant association. Preeclampsia had a high OR of 3.5 (CI: 1.7-7.2) and a p-value of 0.001, indicating a strong risk factor. Cesarean section had an OR of 1.5 (CI: 0.8-3.0) with a p-value of 0.20, suggesting no significant association in this study. [Table 5]

Table 6 provides the adjusted odds ratios (aOR) for independent risk factors identified through multivariate analysis. Age 30 years or older had an aOR of 2.3 (CI: 1.1-4.8) with a p-value of 0.03, confirming it as an independent risk factor. Low socioeconomic status had an aOR of 2.8 (CI: 1.4-5.6) with a p-value of 0.01, underscoring its significance. Hypertension had an aOR of 1.9 (CI: 0.9-3.8) with a p-value of 0.07, indicating a potential but not definitive risk. Preeclampsia had an aOR of 3.2 (CI: 1.5-6.8) with a p-value of 0.002, highlighting it as a significant independent risk factor. [Table 6]

**Table 1: Demographic Characteristics of Postpartum AKI Patients**

| Characteristic | Number of Patients (n = 106) | Percentage (%) |
|---|---|---|
| Age (years) | | |
| < 20 | 10 | 9.4 |
| 20-29 | 60 | 56.6 |
| 30-39 | 30 | 28.3 |
| ≥ 40 | 6 | 5.7 |
| Socioeconomic Status | | |
| Low | 64 | 60.4 |
| Middle | 32 | 30.2 |
| High | 10 | 9.4 |
| Type of Family | | |
| Nuclear | 70 | 66.0 |
| Joint | 36 | 34.0 |

**Table 2: Obstetric History and Clinical Parameters**

| Parameter | Number of Patients (n = 106) | Percentage (%) |
|---|---|---|
| Parity | | |
| Primiparous | 45 | 42.5 |
| Multiparous | 61 | 57.5 |
| Mode of Delivery | | |
| Vaginal Delivery | 64 | 60.4 |
| Cesarean Section | 42 | 39.6 |
| Obstetric Complications | | |
| Preeclampsia | 30 | 28.3 |
| Postpartum Hemorrhage | 22 | 20.8 |
| Sepsis | 18 | 17.0 |
| Acute Fatty Liver of Pregnancy | 7 | 6.6 |
| Clinical Parameters | | |
| Hypertension (≥ 140/90 mmHg) | 50 | 47.2 |

| | | |
|---|---|---|
| Diabetes Mellitus | 20 | 18.9 |
| BMI (kg/m²) | | |
| < 18.5 (Underweight) | 14 | 13.2 |
| 18.5-24.9 (Normal) | 50 | 47.2 |
| 25-29.9 (Overweight) | 28 | 26.4 |
| ≥ 30 (Obese) | 14 | 13.2 |

**Table 3: Laboratory Parameters at Admission**

| Parameter | Mean ± SD | Median (IQR) |
|---|---|---|
| Serum Creatinine (mg/dL) | 2.1 ± 0.8 | 2.0 (1.5-2.7) |
| Blood Urea Nitrogen (mg/dL) | 45 ± 15 | 44 (35-55) |
| Hemoglobin (g/dL) | 10.5 ± 2.0 | 10.3 (9.0-12.0) |
| Platelet Count (×10⁹/L) | 150 ± 50 | 145 (110-180) |
| WBC Count (×10⁹/L) | 12 ± 4 | 12 (10-15) |

**Table 4: Outcomes of Postpartum AKI Patients**

| Outcome | Number of Patients (n = 106) | Percentage (%) |
|---|---|---|
| Recovery of Renal Function | 85 | 80.2 |
| Need for Dialysis | 21 | 19.8 |
| Length of Hospital Stay (days) | Mean ± SD = 10 ± 5 | |
| Mortality | 11 | 10.4 |

**Table 5: Risk Factors for AKI in Postpartum Patients**

| Risk Factor | Odds Ratio (OR) | 95% Confidence Interval (CI) | p-value |
|---|---|---|---|
| Age ≥ 30 years | 2.5 | 1.2-5.0 | 0.02 |
| Low Socioeconomic Status | 3.0 | 1.5-6.0 | 0.01 |
| Hypertension | 2.0 | 1.0-4.0 | 0.05 |
| Preeclampsia | 3.5 | 1.7-7.2 | 0.001 |
| Cesarean Section | 1.5 | 0.8-3.0 | 0.20 |

**Table 6: Multivariate Logistic Regression Analysis of Independent Risk Factors**

| Risk Factor | Adjusted Odds Ratio (aOR) | 95% Confidence Interval (CI) | p-value |
|---|---|---|---|
| Age ≥ 30 years | 2.3 | 1.1-4.8 | 0.03 |
| Low Socioeconomic Status | 2.8 | 1.4-5.6 | 0.01 |
| Hypertension | 1.9 | 0.9-3.8 | 0.07 |
| Preeclampsia | 3.2 | 1.5-6.8 | 0.002 |

## DISCUSSION

The findings of this study provide valuable insights into the demographic, clinical, and laboratory characteristics of postpartum AKI patients, along with the associated risk factors and outcomes. The results highlight the critical importance of recognizing and addressing AKI in postpartum women, particularly in developing regions where maternal healthcare may face significant challenges. The majority of postpartum AKI patients were between 20-29 years old, followed by those in the 30-39 age group. This distribution aligns with the typical childbearing age range, emphasizing the need for vigilant monitoring of renal function in these age groups. The predominance of patients from low socioeconomic backgrounds underscores the potential influence of socioeconomic factors on health outcomes. Limited access to quality healthcare, inadequate prenatal care, and poor nutritional status may contribute to the higher incidence of AKI in this demographic. The higher proportion of patients from nuclear families suggests possible limitations in social support, which could impact the management of obstetric complications and subsequent recovery.[4-7]

The study revealed that a significant number of AKI cases occurred among multiparous women and those who had vaginal deliveries. This could be indicative of the cumulative physiological stress and potential complications associated with multiple pregnancies. The high prevalence of obstetric complications such as preeclampsia, postpartum hemorrhage, and sepsis among AKI patients is consistent with previous studies. These conditions are known to predispose women to renal impairment through mechanisms such as endothelial dysfunction, hypovolemia, and inflammatory responses. The presence of hypertension and diabetes mellitus further exacerbates the risk, as these comorbid conditions are well-documented contributors to renal injury.[8-11]

The laboratory parameters at admission highlight the severity of renal impairment in postpartum AKI patients. Elevated serum creatinine and blood urea nitrogen levels are indicative of significant renal dysfunction. The findings of lower hemoglobin and platelet counts could be reflective of the hematological complications associated with severe AKI and its underlying causes. The elevated white blood cell counts suggest a potential infectious or inflammatory component, consistent with the high incidence of sepsis observed in the study population.[2,12]

The outcomes of postpartum AKI patients in this study are concerning, with a substantial proportion

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requiring dialysis and a notable mortality rate. The recovery of renal function in 80.2% of patients is encouraging, yet the need for dialysis in nearly 20% indicates severe cases that warrant intensive care and long-term follow-up. The average hospital stay (10 ± 5 days) reflects the significant healthcare burden and the need for prolonged medical intervention. The mortality rate of 10.4% underscores the critical nature of AKI in the postpartum period and the urgent need for effective preventive and therapeutic strategies.[2,7,13]

The identification of significant risk factors for postpartum AKI, such as age ≥ 30 years, low socioeconomic status, hypertension, and preeclampsia, provides crucial insights for clinical practice. Older age and low socioeconomic status emerged as independent risk factors, highlighting the need for targeted interventions in these vulnerable groups. The strong association between preeclampsia and AKI reinforces the importance of early detection and management of hypertensive disorders during pregnancy. Although hypertension showed a potential risk, its borderline significance suggests the need for further investigation to clarify its role in postpartum AKI.[3,14,15]

The study emphasizes the importance of comprehensive prenatal and postnatal care to mitigate the risk of AKI. Regular monitoring of renal function, especially in high-risk groups such as older women, those with low socioeconomic status, and those with preeclampsia, is essential. The findings advocate for improved access to healthcare services, enhanced antenatal care, and effective management of obstetric complications to prevent the onset and progression of AKI. Moreover, the study underscores the need for multidisciplinary approaches involving obstetricians, nephrologists, and critical care specialists to optimize outcomes for postpartum AKI patients.

## CONCLUSION

In conclusion, this study underscores the critical importance of early recognition and management of acute kidney injury (AKI) in postpartum women, particularly in resource-limited settings. The identification of significant risk factors, including older age, low socioeconomic status, hypertension, and preeclampsia, highlights the need for targeted interventions and comprehensive prenatal and postnatal care. The findings advocate for improved access to maternal healthcare services, enhanced monitoring of renal function, and effective management of obstetric complications to prevent AKI. By addressing these factors, healthcare providers can significantly reduce the burden of AKI and improve maternal health outcomes, ultimately ensuring safer postpartum periods for women in similar settings globally.

**Limitations and Future Directions**
While this study provides significant insights, it is important to acknowledge its retrospective design, which may introduce data collection and documentation biases. Additionally, the study was conducted at a single tertiary care center, which may limit the generalizability of the findings to other settings. Future prospective studies with larger sample sizes and multi-center collaboration are needed to validate these findings and explore the underlying mechanisms of postpartum AKI. Investigating the long-term renal outcomes and quality of life of postpartum AKI survivors would also be valuable in guiding follow-up care and support.

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