

ORIGINAL RESEARCH**Etiology and recovery outcomes in patients with pregnancy-related acute kidney injury**¹Dr. Akshata P J, ²Dr. Pranchil Pandey, ³Dr. Rohan Dwivedi¹Consultant Physician, Department of Medicine, Vindhya Hospital & Research Centre, Rewa, M.P., India²Senior Resident, Department of Anaesthesia, Shyam Shah Medical College, Rewa, M.P., India³Associate Professor, Department of Nephrology, Superspecialty Hospital & Shyam Shah Medical College, Rewa, M.P., India**Corresponding author**

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ABSTRACT**Background:** Pregnancy-related acute kidney injury (PRAKI) is a significant global health concern, causing severe AKI in young women during pregnancy, labor, and the postpartum period, leading to adverse maternal and fetal outcomes. Identifying contributing factors is essential for better management and outcomes.**Methods:** A prospective observational study was conducted in pregnant women above 18 years of age who were admitted with PRAKI and post-delivery. Patients with pre-existing renal disease or AKI unrelated to pregnancy were excluded. Data was collected on demographics, urinary output, antenatal care, laboratory investigations, hospital stay, mode of delivery, etiological factors, and recovery outcomes.**Results:** Among 46 patients, 58.7% were primigravida, and 41.3% were in the postpartum period. Obstetric complications, including postpartum hemorrhage (32.6%), and pregnancy-specific disorders like pre-eclampsia (26.1%) were the main causes of PRAKI. Most patients experienced oliguria (71.7%), and common laboratory abnormalities included elevated serum creatinine (91.3%) and uric acid (82.6%) levels. Most patients achieved complete recovery (47.8%) or partial recovery without dialysis (41.3%), while 10.9% progressed to chronic kidney disease, and 13.0% unfortunately passed away. Fetal survival rate was observed to be 69.6%.**Conclusion:** Pregnancy related AKI is a serious concern with risks to both mother and fetus. Understanding its causes and improving management are essential for better outcomes. This study offers valuable insights into PRAKI's etiology and outcomes, emphasizing the importance of early intervention.**Keywords:** Acute kidney injury, pregnancy-related AKI, obstetric complications, pre-eclampsia, chronic kidney disease.

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INTRODUCTION

Acute kidney injury (AKI) during pregnancy, delivery, and the postpartum period, known as pregnancy-related AKI (PRAKI), is a significant health concern worldwide. In industrialized countries, the incidence of AKI requiring dialysis during pregnancy is relatively low, occurring in approximately 1 in 20,000 births.¹ In India, the occurrence PRAKI varied between 0.02% to 11.5%.^{2,3,4} Pregnancy related renal injury has been identified as the most common cause of severe AKI requiring dialysis in young women, leading to adverse maternal and fetal outcomes, prolonged hospitalization, and increased mortality rate. Preeclampsia, a pregnancy-specific disorder, is frequently associated with multisystemic manifestations, including renal afflictions.⁵ In normal pregnancies, serum creatinine levels typically decrease due to an increase in glomerular filtration

rate. Elevated serum creatinine levels exceeding 0.9 mg/dL during pregnancy indicate abnormal renal function and require critical evaluation.⁶ Despite a decline in the incidence of PRAKI in recent years, it remains a serious health issue with substantial risks to both mother and fetus. Identifying the underlying factors contributing to PRAKI's development is essential for effective management and improved outcomes. Obstetric complications such as postpartum haemorrhage, placenta previa, and puerperal sepsis have been found to significantly contribute to the development of PRAKI, along with pregnancy-specific disorders like pre-eclampsia, eclampsia, HELLP (hemolysis, elevated liver enzymes and low platelet count) syndrome, and acute fatty liver of pregnancy.⁷ The management of PRAKI involves treating the underlying cause, supporting renal function, and utilizing renal replacement therapy, such as hemodialysis, if necessary.⁸ To gain deeper insights

into the etiology and recovery outcomes of PRAKI, we conducted a prospective observational study. This study aims to explore the various factors associated with the development of AKI during pregnancy and post-delivery and evaluate recovery outcomes.

METHODS

Study design and ethical considerations: This was a prospective observational study. This study was conducted in accordance with ethical principles that are consistent with the Declaration of Helsinki. The study protocol was approved by the Institutional Review Board/Ethics Committee. Written informed consent was obtained from all the patients prior to study commencement.

Inclusion/exclusion criteria: The study included pregnant women above 18 years of age who were admitted with AKI during both pregnancy and post-delivery. Exclusion criteria included pre-existing renal disease, AKI without pregnancy, and unwillingness to participate.

Data collection and statistical analysis: Data was collected on pre-designed proforma. Details regarding demographics, parity, urinary output, antenatal care, laboratory investigations, hospital stay, mode of delivery, etiological factors causing AKI along with maternal and fetal outcomes were recorded during hospital admission and over a 3-month follow-up period post-delivery. Descriptive statistics (frequency and percentages) and (mean and standard deviation [SD]) were used for analysis. For categorical variables, such as demographics, parity, antenatal care, mode of delivery, etiological factors, urinary output and outcomes, frequency and percentages were calculated. On the other hand, continuous variables, such as laboratory investigations, hospital stay, and age, were summarized using mean and standard deviation (SD).

RESULTS

This study consisted of 46 women with pregnancy-associated AKI. The average age of the patients was 27.6 years. Among these patients, 58.7% were primigravida and 41.3% were multigravida. In terms of pregnancy stage, 23.9% were in the second trimester, 34.8% were in the third trimester, and 41.3% were in the postpartum period. Only 19.6% of the patients received antenatal care. The laboratory investigations revealed a mean haemoglobin level of 9.8 mmHg and mean serum creatinine level was 1.8 mg/dL. The prevalence of various laboratory abnormalities found was as follows: elevated serum creatinine (91.3%), elevated uric acid (82.6%), anemia (73.9%), leucocytosis (67.4%), hyperkalemia (60.9%), abnormal liver function tests (LFT) (45.7%), and thrombocytopenia (43.5%). Regarding urine output, 71.7% of the patients experienced oliguria, while 28.3% had anuria. In terms of mode of delivery, 54.3% underwent a caesarean section, 43.5% of the patients had a vaginal delivery. The average duration of ICU stay was 2 days, and the average duration of hospital stay was 13 days. The most common causes of AKI were obstetric complications. Postpartum haemorrhage accounted for 32.6% of patients, followed by placenta previa (6.5%) and puerperal sepsis (17.4%) [Table 2]. Among pregnancy-specific disorders, pre-eclampsia was responsible for AKI in 26.1% of patients, followed by eclampsia (10.9%), HELLP syndrome (4.3%), and acute fatty liver of pregnancy (AFLP) in 2.2% of patients. Among the 46 patients, the maternal outcomes were as follows: 22 (47.8%) experienced complete recovery, 19 (41.3%) had partial recovery, 5 (10.9%) progressed to CKD, one patient underwent hysterectomy (2.2%) and 6 (13.0%) unfortunately passed away. For the fetus, 32 (69.6%) survived, while mortality was reported in 14 (30.4%).

Table: 1 Baseline characteristics of study population

Parameters	Number of patients (N=46)
Age, years, mean (SD)	27.6 (5.1)
Parity	
Primigravida	27 (58.7)
Multigravida	19 (41.30)
Pregnancy stage	
Second trimester	11 (23.9)
Third trimester	16 (34.8)
Post-partum period	19 (41.3)
Antenatal care received	9 (19.6)

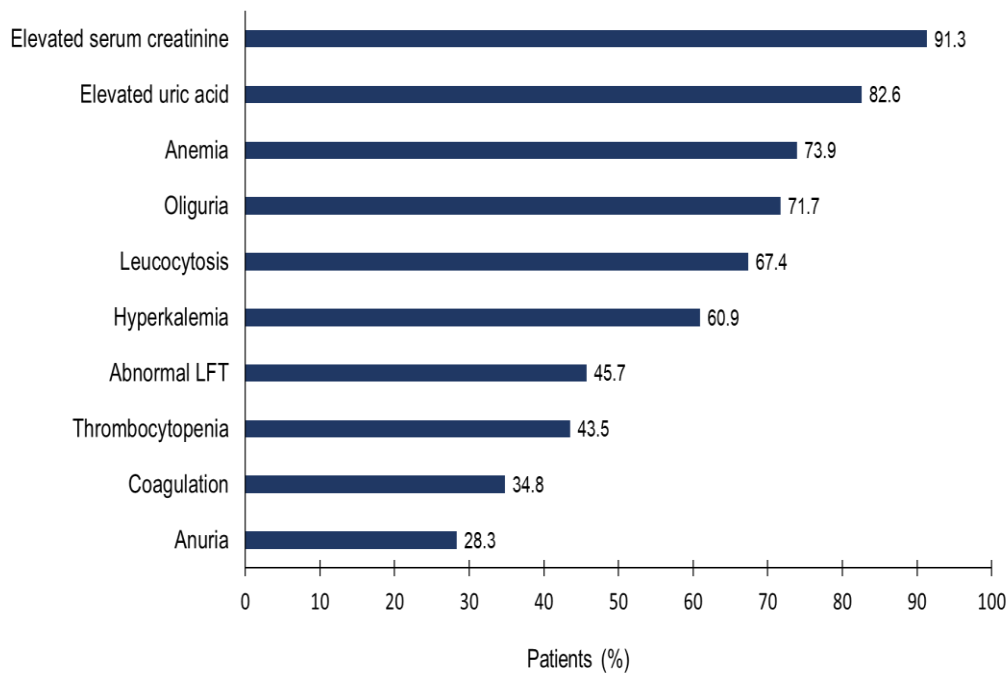
Mode of delivery	
Vaginal	20 (43.5)
Caesarean	25 (54.3)
Duration of ICU stay, days, mean (SD)	2 (0.4)
Duration of hospital stay, days, mean (SD)	13 (2.4)
Data presented as n (%), unless otherwise specified.	

Table 2: Etiology of pregnancy related AKI

Causes of pregnancy-related AKI	Number of patients (N=46)
Obstetric Complications	
PPH	15 (32.6)
Placenta Previa	3 (6.5)
Puerperal sepsis	8 (17.4)
Pregnancy specific disorders	
Pre-eclampsia	12 (26.1)
Eclampsia	5 (10.9)
HELLP syndrome	2 (4.3)
AFLP	1 (2.2)
Data presented as n (%). AFLP, acute fatty liver of pregnancy; AKI, acute kidney injury; HELLP, Hemolysis, Elevated Liver enzymes, and Low Platelet count, PPH, Postpartum haemorrhage.	

Table: 3 Recovery outcomes in study population

Outcomes	Number of patients (N=46)
Maternal	
Complete recovery	22 (47.8)
Partial recovery	19 (41.3)
Progressed to CKD	5 (10.9)
Death	6 (13.0)
Fetus	
Survival	32 (69.6)
Death	14 (30.43)
Data presented as n (%). CKD, chronic kidney disease.	



LFT, liver function test.

DISCUSSION

Obstetric AKI commonly results from septic abortions during early pregnancy and conditions like pregnancy toxemia, antepartum haemorrhage, postpartum haemorrhage, and HELLP syndrome in late pregnancy.^{2,3} Nonetheless, in developing countries, the occurrence of obstetric AKI remains more prevalent, with an incidence ranging from 4.2% to 15%. This higher incidence is primarily attributed to limited access to antenatal care and emergency obstetric healthcare facilities in those regions.⁹ Preeclampsia, a hypertensive disorder of pregnancy, is commonly encountered in both developed and developing countries.¹⁰ Obstetric AKI contributes to approximately a quarter of dialysis centre referrals in such regions, posing significant risks of maternal and fetal mortality.¹¹ This study aimed to identify factors related to AKI development during pregnancy and post-delivery, and evaluate recovery outcomes. The findings of this study were as follows: i) Majority patients were primigravida and post-partum stage, ii) Only 19.6% received antenatal care; iii) Most patients presented with elevated serum creatinine, elevated uric acid, anemia, oliguria; iv) Higher number of patients underwent caesarean delivery; v) Majority of patients presented with obstetric complications followed by pregnancy related pre-eclampsia; vi) Most patients recovered completely followed by those with partial recovery; vii) Fetal survival rate was higher than mortality. The average age of participants in the current study was 27.6 years, and most of them were primigravida (58.7%), indicating their first pregnancy. Additionally, a significant portion of patients (41.3%) were in the postpartum stage, which is the period following childbirth. Similarly, in a study

conducted by Hamze IR, et al. the mean age was 26.84 years, and 41.3% were in postpartum stage.¹² Another study conducted by Tyagi A, et al. revealed mean age 26.3 years and majority were primigravida (51.9%) which was on parallel lines with present study.¹³ Insufficient antenatal care is a significant contributing factor to the high incidence of AKI in developing countries, as evidenced by our study, where only 19.6% patients received antenatal care. This finding is in line with previous studies conducted by Khanal et al.⁹ and Mishra et al.¹⁴ which reported that 68% and 80.8% of patients, respectively, did not receive antenatal care. In this study, patients presented with following laboratory abnormalities; elevated serum creatinine, elevated uric acid, anemia, leucocytosis, abnormal LFT, thrombocytopenia, oliguria and anuria. Similarly, a previous study revealed patients with PRAKI had anemia, thrombocytopenia, leucocytosis, hyperkalemia and abnormal LFT.¹⁵ In another study, diagnosis of PRAKI was based on sudden increase in serum creatinine of more than 1 mg/dl, oliguria and anuria.¹⁶ In this study, it was found that majority of the patients underwent a caesarean section (54.3%), followed by normal vaginal delivery in 43.5% patients. On parallel lines with this study, another showed that most patients with PRAKI underwent normal vaginal delivery (77.42%).¹² In contrast, study conducted by Mishra V, et al.,¹⁴ found that majority of the patients underwent normal vaginal delivery (53.84%), followed by LSCS (38.06%). The mean (SD) duration of hospital stay in patients with PRAKI was 13 (5.4) days in the current study which was similar to other study conducted by Tyagi A, et al.¹³ In this study, obstetric complications were the major

cause of PRAKI like postpartum haemorrhage (32.6%), followed by pregnancy specific disorders like pre-eclampsia (26.1%).¹⁷ A multicentre prospective observational study in South Africa reported a high incidence of AKI among 157 women with preeclampsia.⁵ Another study reported that haemorrhage was a leading etiological factor for the development of PRAKI followed by, haemorrhage combined with sepsis (17.30%) and puerperal sepsis (15.38%).¹⁴ A study conducted by XXX revealed that common cause of PRAKI was eclampsia (36.11%), sepsis (13.39%) and haemorrhage (11.11%). In this study, AFLP was the cause of PRAKI in 2.2% and HELPP syndrome in 4.3%. In contrast to this study finding, AFLP (5.56%) and HELPP (2.78%).¹⁹ Another study found that in the second and third trimesters, the causes of AKI are more likely to be specifically related to isolated pregnancy-related complications which was similar to present study.¹⁷ A study conducted by Prakash J, et al.¹⁶ reported that 91.6% of the cases occurred in the third trimester and postpartum period due to puerperal sepsis. A complete recovery was observed in 47.8% patients while 10.0% progressed to CKD and 13.0% passed away. Another study showed a complete recovery in 55.76% patients and CKD in 7.69% patients while, mortality rate of 32.69% patients which in contrary to this study.¹⁴ Other study conducted by Banerjee A, et al.¹⁹ showed that 95.65% patients survived with improved kidney function and only 1 death (4.35%) in patients receiving the standard treatment of PRAKI. A multicentre prospective observational study in South Africa revealed a high incidence PRAKI, which was associated with increased maternal and perinatal mortality rates.⁵ A foetal mortality rate was reported as 30.4% in the present study. Likewise, other study reported that PRAKI in the third trimester and the postpartum period is associated with a high (39%) incidence of fetal/neonatal mortality.²⁰ On the contrary, other study has reported a higher mortality rate (85.71) in PRAKI patients receiving standard therapy as compared to early initiated renal replacement therapy.¹⁹ Additional research is warranted to identify early diagnostic markers and improve the management of PRAKI.

CONCLUSION

In conclusion, this prospective observational study sheds light on the significant burden of PRAKI and its various etiological factors. Obstetric complications and pregnancy-specific disorders remain major contributors to PRAKI. The study highlights the importance of early recognition and appropriate management strategies to improve maternal and fetal outcomes in cases of PRAKI. Further research is warranted to identify markers for early diagnosis and enhance management approaches for this critical condition.

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