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Original Research Article

Clinical profile, etiology and outcome of patients with pregnancy related acute kidney injury attending a tertiary care hospital in Goa, India

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ABSTRACT

Background: Pregnancy-related acute kidney injury (PRAKI) remains a significant contributor to maternal morbidity and mortality in developing countries, despite a global decline in incidence. Data from Indian tertiary care centers continue to demonstrate a predominance of preventable obstetric and infectious causes.
Methods: This combined prospective and retrospective observational study included pregnant women aged 18-42 years diagnosed with PRAKI at Goa Medical College. Patients with pre- existing kidney disease were excluded. Demographic variables, obstetric profile, etiologies, severity of AKI (KDIGO criteria), need for renal replacement therapy, and renal outcomes were analyzed.
Results: Seventy-two women were included, with a mean age of 30.6±5.5 years. Most patients presented in the third trimester (88.9%). Sepsis was the most common etiology (41.6%), followed by preeclampsia (22.2%) and postpartum hemorrhage (12.5%). Severe AKI predominated with 59.7% classified as KDIGO stage 3. Complete renal recovery occurred in 55.6% of patients, partial recovery in 26.4%, while 8.3% became dialysis-dependent. Overall mortality was 9.7%. Progression to chronic kidney disease (CKD) was observed in 35% of patients during follow-up.
Conclusions: PRAKI continues to cause substantial renal morbidity and mortality. Sepsis and hypertensive disorders of pregnancy remain the leading etiologies. Early diagnosis, timely intervention, and long-term renal follow-up are crucial to improving outcomes.

Keywords: Pregnancy-related acute kidney injury, Sepsis, Preeclampsia, Chronic kidney disease

INTRODUCTION

Acute kidney injury (AKI) complicates 5-7% of hospital admissions and up to 30% of intensive care unit (ICU) admissions, with associated morbidity and mortality rates of 20-30%.

Although incidence of PRAKI has declined globally over recent decades, it persists at elevated levels in developing countries, primarily due to septic abortions, infectious complications and hemorrhagic events.[1-6]

In developing regions, obstetric renal failure exhibits a bimodal pattern: an early peak (8-16 weeks gestation) linked to septic abortions, and a late peak associated with preeclampsia, eclampsia, placental abruption, uterine hemorrhage, and puerperal sepsis. Prior to 20 weeks, AKI is uncommon, with hyperemesis gravidarum as the predominant cause. In patients with preexisting CKD; serum creatinine >1.5-2.0 mg/dL), early pregnancy may precipitate rapid progression of hypertension, proteinuria, and renal dysfunction. Additional etiologies include pregnancy-associated thrombotic thrombocytopenic

purpura (TTP), driven by ADAMTS13 deficiency or complement dysregulation, and flares of autoimmune nephritis, such as systemic lupus erythematosus, manifesting as glomerular injury.[7-9]

Beyond 20 weeks, AKI incidence rises, predominantly tied to pregnancy-specific complications. Preeclampsia, affecting 3-5% of pregnancies (primarily primigravidae or multifetal gestations), is characterized by new-onset hypertension (>140/90 mmHg), proteinuria (≥2+), and edema, often with mild glomerular filtration rate (GFR) reduction. Severe cases, complicated by HELLP syndrome (hemolysis, elevated liver enzymes, low platelets), may induce AKI in up to 10% via thrombotic microangiopathy. Management includes magnesium sulfate for seizure prophylaxis, expeditious delivery, and antihypertensive therapy. Differentiation from CKD progression may involve assessment of angiogenic markers such as soluble fms-like tyrosine kinase-1 (sFlt-1).[10-12]

Acute fatty liver of pregnancy (incidence >1/10,000) presents with abdominal discomfort, altered mental status, and disproportionate hyperbilirubinemia; AKI occurs in 30-35% due to hepatorenal syndrome or acute tubular necrosis (ATN), warranting prompt delivery and supportive care.[13,14]

Postpartum AKI typically arises from sepsis, hypovolemic shock, or hemorrhage, leading to ATN or bilateral cortical necrosis, with potential progression to CKD. Early recognition and multidisciplinary intervention are essential to mitigate adverse outcomes.[1]

METHODS

Study design, setting and period

This ambispective (retrospective-prospective) observational study was conducted in the Departments of Nephrology and Obstetrics and Gynaecology at Goa Medical College and Hospital, Bambolim, Goa, India. Data were collected over a period of 19 months. The retrospective component included patients diagnosed between December 2022 and October 2023, while the prospective component included consecutive eligible patients diagnosed between November 2023 and June 2024.

Study population

The study population comprised pregnant women aged 18-42 years diagnosed with PRAKI who attended the outpatient departments or were admitted to the Departments of Nephrology and Obstetrics and Gynaecology during the study period.

Inclusion and exclusion criteria

Pregnant women aged 18-42 years with AKI were included in the study. Patients with known pre-existing kidney disease and those unwilling to participate in the prospective arm of the study were excluded.

Sample size

The sample size was calculated using the formula for estimation of a single proportion

$$n=Z^2P[1-P]/d^2$$

An expected proportion (P) of 15.2% was used with a 95% confidence level (Z=1.96) and an absolute precision of 8%.[18] The minimum required sample size was calculated to be 72 patients.

Universal sampling was employed, and all eligible PRAKI cases identified during the study period were included in the analysis.

Study procedure

After obtaining informed consent for the prospective arm, detailed clinical history, physical examination findings, laboratory investigations, and imaging results were recorded using a structured data collection proforma. For the retrospective arm, relevant data were extracted from hospital medical records.

Data collected included demographic characteristics, obstetric history, clinical presentation, comorbidities, laboratory parameters, etiology of PRAKI, requirement for renal replacement therapy, and renal outcomes.

AKI was diagnosed and staged according to the kidney disease: Improving global outcomes (KDIGO) criteria as an increase in serum creatinine ≥0.3 mg/dL within 48 hours, an increase of ≥50% from baseline within 7 days, or urine output <0.5 mL/kg/hour for more than 6 hours.

The etiological evaluation included pregnancy-related disorders such as preeclampsia, eclampsia, HELLP syndrome, acute fatty liver of pregnancy, postpartum hemorrhage, sepsis, and abruptio placentae. Renal outcomes were categorized as complete recovery, partial recovery, dialysis dependence, or death.

Ethical considerations

The study protocol was approved by the institutional ethics committee of Goa Medical College and Hospital, Goa (IEC Approval No. GMCIEC/2023/333, dated 29/11/2023). Written informed consent was obtained from all participants enrolled in the prospective arm of the study. Patient confidentiality was maintained throughout the study, and the study was conducted in accordance with the ethical principles of the declaration of Helsinki.

Statistical analysis

Data were entered into Microsoft excel 2016 and analyzed using IBM SPSS statistics version 26. Continuous variables

were expressed as mean±standard deviation, while categorical variables were expressed as frequencies and percentages. Comparisons between groups were performed using Student's t test and Chi-square test as appropriate. A $p<0.05$ was considered statistically significant.

RESULTS

A total of 72 women with PRAKI were included in the study. The mean age was 30.64±5.5 years (median 31 years; range 19-41 years). The majority of patients belonged to the 31-35-year age group (31.9%), followed by the 26-30-year age group (29.2%) (Table 1). Half of the study population were primigravidae (50%), while 25% were gravida 2 and 20.8% were gravida 3 (Table 2). According to KDIGO criteria, most patients presented with Stage 3 AKI (59.7%), followed by Stage 2 AKI (36.1%) and Stage 1 AKI (4.2%) (Table 3).

Table 1: Age distribution of patients with PRAKI, (n=72).

Age (in years)	Categories	Valid percent (%)
<20	3	4.2
21-25	10	13.9
26-30	21	29.2
31-35	23	31.9
36-40	11	15.3
>40	4	5.6
Total	72	100

Table 2: Gravidity profile of patients with PRAKI, (n=72).

Variables	Gravida status	Valid percent (%)
Primi	36	50
Gravida 1	1	1.4
Gravida 2	18	25
Gravida 3	15	20.8
Gravida 4	2	2.8
Total	72	100

Table 3: Distribution of patients according to KDIGO AKI stage, (n=72).

KDIGO AKI stages	AKI category	Valid percent (%)
Stage 1	3	4.2
Stage 2	26	36.1
Stage 3	43	59.7
Total	72	100

Table 4: Etiological spectrum of PRAKI, (n=72).

Variables	PRAKI etiology	Valid percent (%)
Abruptio placenta	3	4.1
AFLP	2	2.8
Eclampsia	6	8.3
Help syndrome	4	5.6
Hyperemesis gravidum	2	2.8
Postpartum hemorhhage	9	12.5
Preclampsia	16	22.2
Sepsis	30	41.6
Total	72	100

Sepsis was the most common etiology (41.6%), followed by preeclampsia (22.2%) and postpartum hemorrhage (12.5%) (Table 4). Complete renal recovery occurred in 55.6% of patients, while 26.4% had partial recovery. Six patients (8.3%) remained dialysis-dependent and seven patients (9.7%) died. Progression to CKD was observed in 35% of patients during follow-up (Table 5).

Table 5: Renal and patient outcomes in PRAKI, (n=72).

Variables	Outcome	Valid percent (%)
Death	7	9.7
HD dependent	6	8.3
Partial recovered	19	26.4
Recovered	40	55.6
Total	72	100

Table 6: A comparative table summarizing the studies mentioned based on key parameters.

Studies	Primary causes of AKI	Stage 3 AKI cases	Maternal mortality	Renal recovery	Hemodialysis requirement	Key differences
Present study	Sepsis (38.9%), preeclampsia (20.8%)	59.7%	9.7%	55.6%	23.6%	More complex cases with higher mortality
Aggarwal et al[16]	Sepsis, pre-existing conditions	-	High	-	-	Focus on previously healthy women, lower mortality, higher recovery
Berhel et al[17]	Sepsis, preeclampsia, dehydration, hemorrhage	-	7.5%	76.5%	8.6%	Lower mortality, higher recovery, resource-limited setting

Continued.

Studies	Primary causes of AKI	Stage 3 AKI cases	Maternal mortality	Renal recovery	Hemodialysis requirement	Key differences
Conti-Ramsden et al[19]	Preeclampsia (15.3%)	4.1% (Stage 3)	Higher mortality (7 deaths)	Lower renal recovery (2/3 baseline recovery)	-	Focus on preeclampsia-related AKI
Liu et al[20]	Sepsis, preeclampsia, HELLP, hemorrhage	-	High maternal mortality	-	-	Larger cohort, higher maternal mortality risk
Hassan et al	Hemorrhage, Puerperal Sepsis	-	16.2%	41.4%	13.9%	More focus on postpartum hemorrhage and PPH
Ansari et al	Sepsis, preeclampsia, hemorrhage	-	26%	41.4% (ATN)	71%	Higher mortality, focus on hemorrhage and ATN
Shalaby et al	Hemorrhage (prevalent), sepsis	-	0% to 34.4%	53.1% to 90%	-	Wide variation in outcomes due to different healthcare settings

DISCUSSION

The present study demonstrates that sepsis (41.6%) and preeclampsia (22.2%) remain the leading etiologies of PRAKI, reaffirming patterns observed in earlier Indian and international cohorts. Similar etiological distributions have been reported by Aggarwal et al and Berhe et al where infectious causes and hypertensive disorders of pregnancy constituted the principal contributors.[16,17] This persistent predominance of sepsis highlights the continuing burden of preventable obstetric infections in developing healthcare settings, reflecting gaps in antenatal surveillance, intrapartum asepsis, and timely postpartum care.

Similar findings were reported by Prakash et al who observed that sepsis, hypertensive disorders of pregnancy, and obstetric hemorrhage remained the predominant causes of PRAKI in India. Their findings support our observation that infectious and hypertensive etiologies continue to account for the majority of cases despite improvements in obstetric care.[18]

A striking observation in the present study is the markedly higher proportion of stage 3 AKI (59.7%), indicating advanced renal dysfunction at presentation. This contrasts sharply with the 4.1% stage 3 incidence reported by Conti-Ramsden F and suggests delayed referral, inadequate early detection, or limited access to nephrology services in peripheral centers. As our institution functions as a tertiary referral center, referral bias likely contributed to the overrepresentation of severe cases.[19] Nevertheless, this finding underscores the need for strengthening early risk stratification and prompt nephrology consultation in obstetric patients with evolving renal dysfunction.

The maternal mortality rate of 9.7% in our cohort is comparatively higher than that reported by Berhe et al (7.5%) and appears to correlate with the higher severity of AKI and greater sepsis burden.[17] Mortality in PRAKI is multifactorial and often reflects systemic complications such as multiorgan dysfunction, disseminated intravascular coagulation, and septic shock. The association between advanced AKI stage and mortality observed in our study supports the established prognostic significance of KDIGO staging in obstetric AKI. Furthermore, unlike studies focusing primarily on preeclampsia-related AKI, where renal outcomes tend to be more favorable, our cohort included a substantial proportion of septic AKI, which is typically associated with hemodynamic instability and poorer outcomes.

Renal recovery in the present study (55.6%) was lower compared to the 76.5% recovery reported by Berhe et al likely reflecting the higher proportion of stage 3 AKI and increased requirement for renal replacement therapy (23.6% vs. 8.6%).[17] The need for hemodialysis in nearly one-fourth of patients indicates significant renal compromise and systemic illness severity. While dialysis availability has improved in tertiary centers, delayed initiation at peripheral hospitals may contribute to worse outcomes.

In contrast, Conti-Ramsden F reported lower renal recovery in predominantly preeclampsia-associated AKI, highlighting the heterogeneity of PRAKI outcomes depending on etiology.[19] Hypertensive disorders often lead to reversible renal endothelial injury when managed promptly, whereas septic AKI involves complex inflammatory and microcirculatory mechanisms that may result in sustained renal damage.

Our findings are also supported by the systematic review by Liu et al which evaluated pregnancy-related AKI across multiple populations and demonstrated significantly increased risks of maternal mortality, intensive care admission, and adverse renal outcomes. Similar to our observations, hypertensive disorders, sepsis, and hemorrhage were consistently identified as the leading

etiologies. (Table 6) The review further highlighted that delayed recognition and severe AKI at presentation are major determinants of poor maternal and renal outcomes.[20]

Limitations

The present study has certain limitations. First, it was conducted at a single tertiary care referral center, which may have resulted in referral bias and an overrepresentation of severe cases of PRAKI. Second, the relatively small sample size may limit the generalizability of the findings to other populations. Third, the ambispective study design relied partly on retrospective data collection, which may be associated with incomplete documentation and information bias. Finally, long-term follow-up was not available for all patients, which may have led to underestimation of the true burden of CKD following PRAKI. Despite these limitations, the study provides valuable data on the clinical profile, etiology, and outcomes of PRAKI from a tertiary care center in Western India.

CONCLUSION

PRAKI remains an important cause of maternal renal morbidity and mortality in India. Sepsis and hypertensive disorders of pregnancy are the predominant etiologies. A significant proportion of patients progress to CKD, highlighting the need for early diagnosis, prompt referral, aggressive management, and structured long-term renal follow-up.

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