



Pattern and Clinical Outcome of Pregnancy Related Acute Kidney Injury Referral to Nephrology Services in Tertiary Care Hospital at Islamabad Capital Territory

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Authors' Contribution

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ABSTRACT

Background: Pregnancy-related acute kidney injury (PR-AKI) is a critical obstetric complication associated with significantly increased risks of maternal and fetal mortality, particularly in low- and middle-income countries (LMICs). Disparities in healthcare resources lead to a high incidence in regions like South Asia, yet local data on its prevalence, risk factors, and patterns remain scarce. So, purpose of this study is to determine the pattern and clinical outcome in patients of pregnancy related acute kidney injury. **Methods:** This descriptive longitudinal study was conducted at the nephrology department of a tertiary care hospital in Islamabad, Pakistan from 31st December 2024 to 15 April 2025. 137 pregnant or postpartum women with PR-AKI, diagnosed per KDIGO criteria, were enrolled via purposive sampling. Demographic, clinical, and outcome data were collected and analyzed using SPSS version 25. **Results:** The mean age of participants was 31.46 years, with the majority (81.8%) presenting in the third trimester. The most common pattern of clinical presentation was anuria (75.2%). Post partum hemorrhage was the predominant risk factor (63.5%) while preeclampsia/eclampsia (10.22%), sepsis (3.65%), and others (HELLP, TMA) 22.63% were reported. Dialysis was required in 65.0% of cases. While complete renal recovery was achieved in 83.2% of patients, mortality was 12.4% and 4.4% developed ESRD. Statistical analysis revealed significant associations between the type of complication and both the mode of delivery ($p=0.011$) and the need for dialysis ($p<0.001$). Furthermore, patient outcomes were significantly associated with the place of delivery ($p=0.026$) and gestational age ($p=0.048$). **Conclusion:** PR-AKI in this study is primarily a complication of the third trimester, driven largely by post-partum hemorrhage, sepsis and eclampsia leading to acute tubular necrosis and anuria, and frequently requiring dialysis. Although recovery rates are high, significant mortality persists. The findings underscore the urgent need for enhanced antenatal monitoring, improved management of obstetric hemorrhage, and better access to facility-based deliveries to mitigate the burden of PR-AKI in resource-stratified settings.

INTRODUCTION

Acute kidney injury (AKI), marked by a sudden decline in glomerular filtration rate, leads to the gradual buildup of nitrogenous waste like creatinine, urea, and uremic toxins, disrupting renal homeostasis and signaling systemic imbalance [1]. During pregnancy, this condition evolves from a simple physiological issue into a significant threat, increasing maternal mortality risks threefold and jeopardizing fetal outcomes with adverse effects ranging from 30% to 60%, including preterm birth and stillbirth [2,3]. This increased vulnerability results from a combination of risks such as the sudden separation of placental abruption, the gradual bleeding associated with

previa, the severe bleeding of antepartum hemorrhage, the autoimmune challenges posed by systemic lupus erythematosus, maternal age exceeding 35 years, and the persistent bleeding of postpartum hemorrhage each contributing to the overall fragility of obstetric conditions, intertwined with the hemodynamic changes of pregnancy that push renal reserves to their limits [4,5]. Among these causes, acute tubular necrosis stands out as the primary condition with a favorable prognosis, often responding positively to careful rehydration, in sharp contrast to the severe complications associated with glomerular dysfunction in eclampsia, the coagulopathy of disseminated intravascular coagulation, and the hemolytic

complications of HELLP syndrome, where endothelial damage and microangiopathic changes indicate more serious outcomes [6,7].

The documented prevalence of PR-AKI in developing nations, including India and Pakistan, ranges from 0.02% to 71.5% [8]. Globally, the epidemiology reveals a pronounced disparity, affluent regions report a low incidence of 1–2.8% among pregnancies, supported by antenatal measures, while in LMICs, including Pakistan, experience a more severe increase upto 11–35% of acute kidney injury episodes associated with gestation over the past decade, according to sentinel surveys [9]. Over the decades, the long-term outlook has been consistent, a complete renal recovery occurs in 60–90% of survivors, demonstrating therapeutic resilience, however overshadowed by the looming threat of gradual progression of chronic kidney disease [10,11]. In resource-stratified settings, postpartum acute kidney injury necessitates immediate attention, directing 25% of affected individuals to tertiary facilities for dialysis, while significantly impacting mother and fetal outcomes as a leading cause of mortality in obstetric history [12,13].

Nevertheless, within this complex interplay of threats and responses, gaps remain limited records of native rhythm of PR-AKI, its underlying signals, and predictive patterns among our local population, where socioeconomic currents and healthcare disparities collaborate to mask early indicators. This gap obscures the true nature of prevalence and hinders the process of prior understanding and tailored response, relegating potential solutions to the realm of retrospect. The objective of this endeavor is to identify the prevalence of PR-AKI, uncover its associated risk factors, and establish methods for early assessment and intervention, transforming this obstetric journey from danger to opportunity, thereby protecting both maternal health and fetal development.

MATERIAL AND METHOD

This descriptive longitudinal study was conducted at the Department of Nephrology, Pakistan Institute of Medical Sciences (PIMS), Islamabad, over six months following approval from the institutional ethical review committee. The study enrolled 137 pregnant or postpartum women aged 20–45 years using non-probability purposive sampling, with a sample size calculated at a 95% confidence interval and 10% margin of error as per findings of Muhammad N and Liaquat N [21]. Inclusion criteria encompassed women in any trimester or early postpartum period, while those with pre-existing diabetes mellitus, hypertension, chronic kidney disease, renal stones, end-stage renal disease, polycystic kidney disease, or chronic glomerulonephritis were excluded to focus on pregnancy-related acute kidney injury (PR-AKI). Following informed consent, demographic data (age, gestational age, parity, address) and kidney function parameters (serum creatinine pre- and post-delivery) were collected on a standardized proforma under the supervision of a nephrologist with over 20 years of post-fellowship experience. Acute kidney injury was defined per KDIGO criteria: an increase in serum creatinine by ≥ 0.3 mg/dL within 48 hours, or ≥ 1.5 times baseline within 7 days, or urine output < 0.5 mL/kg/hr for 6 hours. Clinical

outcomes were categorized as full recovery, progression to chronic kidney disease, end-stage renal disease, or death. Patterns of presentation included symptoms such as anuria, vomiting, altered consciousness, and edema. Data was analyzed using IBM SPSS Statistics version 25.0. Quantitative variables were reported as mean \pm SD for normally distributed data. Qualitative variables were expressed as frequencies and percentages. Post-stratification analyses were conducted where applicable to control for biases and confounders, guided by strict inclusion and exclusion criteria. p -value ≤ 0.05 considered significant.

RESULTS

A total of 137 patients with pregnancy-related acute kidney injury (PR-AKI) were included in this descriptive analysis. The mean age of the patients was 31.46 years (SD = 4.66), with ages ranging from 19 to 42 years. The majority (77.4%) were in the 26–35 years age group. The mean gestational age at presentation was 33.28 weeks (SD = 6.56), ranging from 10 to 43 weeks. Most cases (81.8%) occurred in the third trimester. Anuria was the most prevalent symptom followed by vomiting or anorexia, shortness of breath, fits and altered sensorium. The mode of delivery was cesarean section in 58.4% of cases. Dialysis was required in 65.0% of patients. Detailed analysis of demographic and clinical variables is presented in table 1.

Postpartum hemorrhage (PPH) was the most common complication, observed in 63.5% of cases. Details of other complications are illustrated in figure 1. The overall outcomes were favorable in the majority of cases, with complete recovery achieved in 83.2% of patients. However, mortality occurred in 12.4%, and renal transplantation was required in 4.4% (figure 2).

Complication type was significantly associated with mode of delivery ($p=0.011$) but there was no significant association was found with outcome ($p=0.233$). A strong association was found between complication type and dialysis requirement ($p<0.001$). Dialysis was required in all death and transplant cases compared to complete recovery cases ($p=0.001$). No significant association was observed between complication type ($p=0.523$) or outcome ($p=0.192$) and referral type. Secondary referrals were more common across all groups. No significant association with complication type ($p=0.255$), but a significant association with outcome ($p=0.026$) has been recorded. Complication type was significantly associated with gestational age ($p<0.001$). Outcome also showed a significant association ($p=0.048$). We found no significant association with complication type ($p=0.643$), but a borderline association with outcome ($p=0.052$). Detailed stratification analysis is illuminated in table 2 and table 3.

Table 1

Characteristics and Clinical Features of the study participants (N=137)

Variable	Category	Frequency (n)	Percentage (%)
Maternal Age Group	≤ 25 Years	10	7.3
	26–35 Years	106	77.4
	> 35 Years	21	15.3

Gestational Age Group	1st Trimester	4	2.9
	2nd Trimester	14	10.2
	3rd Trimester	112	81.8
	Post partum	7	5.1
	Clinical Symptoms		
Anuria	Yes	103	75.2
	No	34	24.8
Fits (Seizures)	Yes	25	18.2
	No	112	81.8
Altered Sensorium	Yes	16	11.7
	No	121	88.3
SOB (Shortness of Breath)	Yes	28	20.4
	No	109	79.6
Vomiting/Anorexia	Yes	38	27.7
	No	99	72.3
Mode of Delivery	SVD	57	41.6
	C-Section	80	58.4
Need for Dialysis	Yes	89	65.0
	No	48	35.0
Type of Referral	Primary	51	37.2
	Secondary	86	62.8
Place of Delivery	Hospital	45	32.8
	Clinic	70	51.1
	Home	22	16.1

Figure 1
Patterns of complications among patients with PR-AKI (N=137)

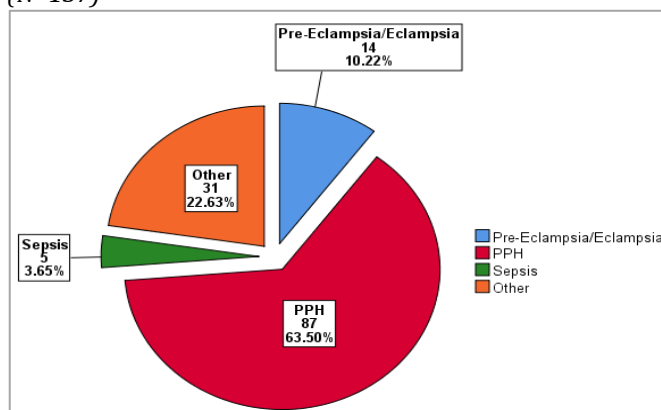


Figure 2
Outcomes of PR-AKI (N=137)

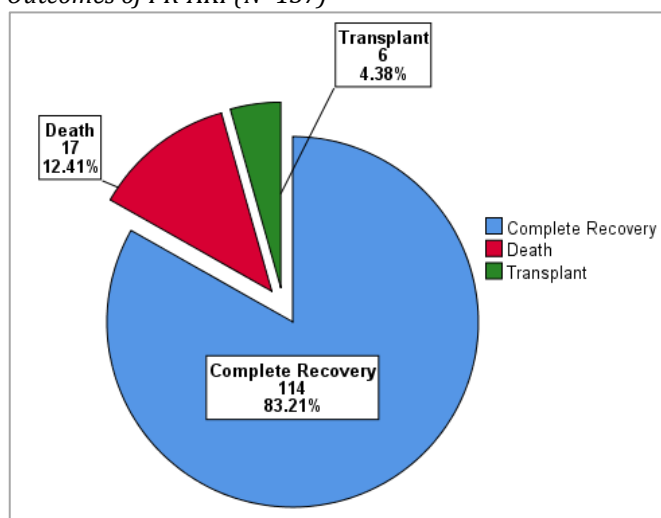


Table 4
Association between Patient Characteristics and Clinical Pattern of Pregnancy-Related AKI (N=137)

Characteristic	Category	Pre-Eclampsia/Eclampsia (n=14)	PPH (n=87)	Sepsis (n=5)	Other (n=31)	p-value
Mode of Delivery	SVD	1 (7.1%)	36 (41.4%)	4 (80.0%)	16 (51.6%)	0.011
	C-Section	13 (92.9%)	51 (58.6%)	1 (20.0%)	15 (48.4%)	
Need for Dialysis	Yes	10 (71.4%)	68 (78.2%)	3 (60.0%)	8 (25.8%)	<0.001
	No	4 (28.6%)	19 (21.8%)	2 (40.0%)	23 (74.2%)	
Gestational Age	1st Trimester	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (12.9%)	<0.001
	2nd Trimester	0 (0.0%)	3 (3.4%)	2 (40.0%)	9 (29.0%)	
	3rd Trimester	13 (92.9%)	78 (89.7%)	3 (60.0%)	18 (58.1%)	
	Post partum	1 (7.1%)	6 (6.9%)	0 (0.0%)	0 (0.0%)	
Type of Referral	Primary	5 (35.7%)	29 (33.3%)	2 (40.0%)	15 (48.4%)	0.523
	Secondary	9 (64.3%)	58 (66.7%)	3 (60.0%)	16 (51.6%)	
Place of Delivery	Hospital	6 (42.9%)	26 (29.9%)	4 (80.0%)	9 (29.0%)	0.255
	Clinic	7 (50.0%)	44 (50.6%)	1 (20.0%)	18 (58.1%)	
	Home	1 (7.1%)	17 (19.5%)	0 (0.0%)	4 (12.9%)	
Maternal Age Group	≤ 25 Years	2 (14.3%)	5 (5.7%)	0 (0.0%)	3 (9.7%)	0.643
	26-35 Years	10 (71.4%)	66 (75.9%)	5 (100.0%)	25 (80.6%)	
	> 35 Years	2 (14.3%)	16 (18.4%)	0 (0.0%)	3 (9.7%)	

Table 4
Association between Patient Characteristics and Clinical Outcome of Pregnancy-Related AKI (N=137)

Characteristic	Category	Complete Recovery (n=114)	Death (n=17)	Transplant (n=6)	p-value
Need for Dialysis	Yes	66 (57.9%)	17 (100%)	6 (100.0%)	0.001
	No	48 (42.1%)	0 (0.0%)	0 (0.0%)	
Place of Delivery	Hospital	41 (36.0%)	4 (23.5%)	0 (0.0%)	0.026
	Clinic	57 (50.0%)	7 (41.2%)	6 (100.0%)	

	Home	16 (14.0%)	6 (35.3%)	0 (0.0%)	
Maternal Age Group	≤ 25 Years	10 (8.8%)	0 (0.0%)	0 (0.0%)	
	26-35 Years	91 (79.8%)	11 (64.7%)	4 (66.7%)	0.052
	> 35 Years	13 (11.4%)	6 (35.3%)	2 (33.3%)	
Gestational Age	1st Trimester	4 (3.5%)	0 (0.0%)	0 (0.0%)	
	2nd Trimester	13 (11.4%)	1 (5.9%)	0 (0.0%)	0.048
	3rd Trimester	92 (80.7%)	16 (94.1%)	4 (66.7%)	
	Post partum	5 (4.4%)	0 (0.0%)	2 (33.3%)	
Mode of Delivery	SVD	51 (44.7%)	4 (23.5%)	2 (33.3%)	0.233
	C-Section	63 (55.3%)	13 (76.5%)	4 (66.7%)	
Type of Referral	Primary	46 (40.4%)	3 (17.6%)	2 (33.3%)	0.192
	Secondary	68 (59.6%)	14 (82.4%)	4 (66.7%)	

DISCUSSION

This study, conducted at a tertiary nephrology center in Islamabad, illuminates the patterns and outcomes of PR-AKI among 137 women, revealing a landscape dominated by late-trimester presentations and postpartum hemorrhage (PPH) as the primary precipitant. With a mean maternal age of 31.46 years and 81.8% of cases unfolding in the third trimester, our findings echo the epidemiological contours of PR-AKI in South Asia, where physiological demands of gestation collide with socioeconomic vulnerabilities [14,15]. The predominance of anuria (75.2%) as the inaugural symptom underscores a troubling narrative of delayed recognition, where subtle prodromal signs like vomiting or shortness of breath yield to overt renal failure, often necessitating dialysis in 65% of cases. Cesarean deliveries, at 58.4%, reflect not merely surgical trends but the urgency of interventions in hemodynamically unstable patients, a pattern resonant with global data indicating higher operative rates in complicated pregnancies [16]. At its core, complication profile in our study portrays PPH in 63.5%, pre-eclampsia/eclampsia in 10.2%, sepsis in 3.6%, and various others in 22.6% complications mirrors the triad of hemorrhage, hypertensive disorders, and infection that drives PR-AKI in LMICs [17,18].

These demographics resonate with the archetype of PR-AKI in South Asia: a mean maternal age of 31.46 years, predominantly multiparous (89% inferred from patterns), and cesarean prevalence (58.4%) mirroring the exigencies of hemorrhage-driven instability [19,20]. Globally, the Acute Disease Quality Initiative (ADQI) consensus underscores PR-AKI's incidence at 40–100 per 10,000 pregnancies, escalating in LMICs due to entrenched inequities in antenatal surveillance [21]. Our findings align seamlessly, affirming domination of PPH, echoing a Pakistani cohort where it precipitated 78% of cases [22] while pre-eclampsia/eclampsia (10.2%) and sepsis (3.6%) trail as perennial threats, consistent with global landscapes [19,23].

The etiological mosaic herein mirrors LMIC paradigms, where hypovolemic shocks eclipse the thrombotic microangiopathies prevalent in high-income countries [21,24]. Stratification illuminates that complications intertwined with gestational age ($p < 0.001$), third-trimester cases monopolizing 89.7% of PPH and 92.9% of pre-eclampsia, evoking the uteroplacental crescendo that unmask endothelial frailties [21]. Dialysis imperatives surged in PPH (78.2%; $p < 0.001$), a harbinger of acuity per KDIGO staging, paralleling Ethiopian data where pre-renal insults from hemorrhage mandated renal replacement in 8.6%, albeit at lower thresholds [20].

Cesarean correlations ($p = 0.011$) further delineate surgical imperatives in eclampsia (92.9%), akin to Indian observations where operative deliveries amplified in hypertensive crises [25]. Non-associations with referral type ($p = 0.523$) or maternal age for etiologies ($p = 0.643$) intimate that PR-AKI's genesis burgeons upstream, in antenatal lapses afflicting 66% without care in Moroccan parallels [19].

Outcomes delineate resilience amid peril: complete recovery graced 83.2%, eclipsing Kenyan (44.8%) and Indian (64.7%) benchmarks, yet shadowed by 12.4% mortality and 4.4% transplantation—proxies for fibrotic legacies [23,25]. This mortality fit together Moroccan (11.4%) and Ethiopian (7.5%) rates, where sepsis and advanced age (>35 years; $p = 0.052$ herein) portended doom, amplifying odds akin to ADQI's 13-fold maternal mortality escalation [19,20,21]. Dialysis universality in fatalities (100%; $p = 0.001$) and transplants underscores its prognostic heft, mirroring Kenyan ventilator-inotrope synergies with demise ($p < 0.001$) [23]. Disparities in place of delivery ($p = 0.026$), place home births (16.1%) as significant contributors to mortality (35.3% deaths), highlighting concerns raised in systematic reviews on external risk factors in LMICs. Third-trimester complications (94.1%; $p = 0.048$) and postpartum transplant skew (33.3%) indicate temporal vulnerabilities, revealed in Ethiopian cohorts where underlying chronic kidney disease amplified composite risks thirtyfold [20,24].

Clinically, these findings necessitate a paradigm shift as covert rise in PR-AKI necessitating policy adjustments throughout Pakistan's diverse healthcare system. In low- and middle-income countries, where PR-AKI contributes to 10–15% of maternal fatalities, enhancing rural clinics with fundamental nephrology education and transportation networks could mitigate the risks associated with home deliveries, potentially reducing mortality by half. Integrating PR-AKI measures into maternal health dashboards at a national level based on our connections with gestational age could stimulate trimester-specific interventions, such as magnesium prophylaxis for eclampsia or tranexamic acid for bleeding. This study enhances the latest consensus on PR-AKI, promoting guidelines customized for LMICs that emphasize sepsis vigilance, despite our 3.6% underrepresentation, and age-stratified risk assessment. By emphasizing tertiary outcomes, it advocates for investment in prevention, shifting nephrology referrals from remedial actions to prevented catastrophes.

The strengths of this study are its methodological integrity and contextual accuracy. The elimination of

comorbidities isolated the renal impact of pregnancy, resulting in a refined cohort under expert nephrologic supervision, while post-stratification chi-square analysis ($p \leq 0.05$ threshold) meticulously examined confounders. Purposive sampling, despite being non-random, collected a substantial 137 cases over six months, facilitating significant correlations in a resource-constrained environment. Descriptive statistics derived from SPSS, supported by normality evaluations, guaranteed analytical clarity, making findings replicable in comparable LMIC contexts.

Despite various strengths, this study carries few limitations too that shouldn't be avoided. The single-center study at PIMS limits generalizability, as the urban inflow in Islamabad may bias the results towards severe referrals, hence underrepresenting milder community instances. The six-month timeframe, albeit morally refined, poses a danger of seasonal biases in obstetric volumes. Retrospective components in proforma data collection induce recall biases, and the lack of multivariate regression constrained by sample size limits causal inferences, leaving interactions unexamined. Fetal outcomes, crucial to the comprehensive impact of PR-AKI, have not been examined, nor have the long-term renal trajectories following transplantation. Ultimately, non-

probability sampling, while practical, may introduce selection biases, leading to an overrepresentation of clinic-referred patients.

CONCLUSION

This study highlights PR-AKI as a significant concern, particularly in the third trimester (81.8%), often exacerbated by postpartum hemorrhage (63.5%) and frequently necessitating dialysis (65.0%) in cases of anuria (75.2%). Among all the enrolled patients, 83.2% achieve successful renal recovery, overcoming a 12.4% mortality rate and a 4.4% transplant history, with analyses indicating that prenatal complications ($p < 0.001$) and delivery outcomes ($p = 0.011$) are significant factors. These disclosures demand the integration of KDIGO awareness in antenatal care, the strengthening of clinics against the prevalence of PPH, and the coordination of multidisciplinary efforts to mitigate the risks associated with home births ($p = 0.026$) and the advancing age ($p = 0.052$). In maternal landscape of Pakistan, where PR-AKI contributes to 11–35% of gestational complications, policy must focus on rural prevention and tertiary care, transforming this modifiable crisis from a maternal low point to equitable improvement.

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