ORIGINAL ARTICLE

Frequency of Acute Kidney Injury among Women Presenting with Pre-Eclampsia

HAMID ULLAH[1], SUMAIRA[2], MUHAMMAD SHAUKAT[3], MUHAMMAD ABBAS[4], HUMAIRA AMAN[5], SABOOR AHMED KAKAR[6]
[1]Assistant Professor, Department of Medicine, Mardan Medical Complex/ Bacha Khan Medical College, Mardan
[2]Medical Officer, Health department, KPK
[3]Consultant Nephrologist, DHQ Teaching Hospital, Dera Ismail Khan
[4]Assistant Professor, Department of Medicine, Prime Teaching Hospital/ Peshawar Medical College, Peshawar
[5]Senior Registrar, Department of Gynecology & Obstetrician, Kuwait Teaching Hospital/Peshawar Medical College, Peshawar
[6]Trainee Medical Officer, Department of Public Health/ Pediatric Medicine, IPH Quetta
Correspondence to: Muhammad Shaukat, Email: shaukatsayal@hotmail.com

ABSTRACT

Background: Pregnancy-related hypertension, or pre-eclampsia, is a serious risk factor for both the mother and the fetus. Acute kidney injury (AKI), one of its side effects, is a growing worry as it raises maternal morbidity and may result in long-term renal damage.

Objective: To find how common AKI is among women with pre-eclampsia.

Methods: This six-month cross-sectional study was carried out at Bacha Khan Medical College's Mardan Medical Complex-MTI between February and July of 2023. Non-probability consecutive sampling was used to recruit 142 pre-eclamptic women. A thorough clinical evaluation that included a history, physical examination, urinalysis, and testing for renal function was performed on each participant. KDIGO criteria were used to diagnose AKI. SPSS version 26 was used for data analysis, and descriptive statistics and, when applicable, Chi-square/Fisher's exact tests were used.

Results: The frequency of AKI among pre-eclamptic women was 28.9% (n = 41). A significant association was observed between AKI and the severity of pre-eclampsia (p = 0.001), with 87.8% of AKI cases occurring in women with severe disease. Primigravidas had a greater incidence of AKI than multigravidas (63.4% vs. 36.6%), although the difference was not statistically significant (p = 0.081). The incidence of AKI did not significantly correlate with age.

Conclusion: AKI is a common and serious complication in pre-eclamptic pregnancies, especially in cases with severe disease. Early detection and close monitoring of renal function in such patients are crucial to prevent long-term renal consequences and improve maternal outcomes.

Keywords: Pre-eclampsia, Acute Kidney Injury, Pregnancy Complications, Maternal Outcomes.

INTRODUCTION

The multisystem hypertensive pregnancy condition known as pre-eclampsia usually appears after the twentieth week of pregnancy and is typified by increased blood pressure and proteinuria, either with or without systemic consequences.[1] It continues to rank among the world's major causes of maternal and perinatal illness and mortality, especially in low- and middle-income nations.[2] The pathophysiology of pre-eclampsia involves endothelial dysfunction, systemic inflammation, and abnormal placentation, all of which contribute to impaired organ perfusion, including the kidneys.[3]

Acute kidney injury (AKI), a severe consequence associated with severe pre-eclampsia, is typified by a sudden loss in renal function.[4] Serious side effects from AKI during pregnancy include fluid and electrolyte imbalances, hypertensive crises, extended hospital stays, and in extreme situations, maternal death or permanent renal impairment.[5] Despite its clinical significance, the diagnosis of AKI during pregnancy remains challenging due to physiological changes in renal function during gestation and the lack of standardized diagnostic criteria tailored for pregnant women.

Various studies have highlighted a strong association between hypertensive disorders of pregnancy and renal complications.[6,7] Pre-eclampsia can result in glomerular endotheliosis, reduced renal blood flow, and elevated serum creatinine levels, all of which can contribute to AKI.[8] The frequency of AKI in pre-eclamptic women has been reported to vary widely across different populations, influenced by factors such as severity of disease, availability of prenatal care, and regional healthcare resources.[9] However, in many clinical settings, AKI is under-recognized, leading to delays in management and worse outcomes for both mother and fetus.

Given the increasing burden of pre-eclampsia and the potentially life-threatening nature of AKI, it is important to recognize the frequency and severity of this complication in pregnant women. Early identification and prompt management of AKI in pre-

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eclamptic patients can improve maternal outcomes and reduce the risk of permanent renal damage. Determining the prevalence of 'acute kidney injury' in women who present with 'pre-eclampsia' is the rationale for this study, as it will aid in the development of prompt intervention measures. This study aimed to assess how commonly AKI occurs in pre-eclamptic women and to raise awareness about the need for vigilant renal monitoring in this high-risk group.

METHODOLOGY

This descriptive cross-sectional study was conducted at the Department of Medicine, Mardan Medical Complex, MTI. The study was carried out for a time duration of six months, i-e. between February 1, 2023 and July 30, 2023.

Using OpenEpi version 3.01, the sample size was determined using a 95% confidence level, a 5% margin of error, and an estimated expected frequency of acute kidney damage in pre-eclampsia based on prior research. It was determined that 142 people were the bare minimum needed for the sample. The method of non-probability sequential sampling was applied. Until the necessary sample size was reached, all patients who met the inclusion criteria and showed up throughout the study period were enrolled.

The inclusion criteria involved pregnant women aged 18 to 45 years, those presenting with pre-eclampsia, diagnosed as 'blood pressure ≥140/90 mmHg' after 20 weeks of gestation with proteinuria ('≥300 mg/24 hr or ≥1+ on dipstick'), singleton pregnancy confirmed on ultrasound and those willing to provide informed verbal or written consent. 'Patients with a known history of chronic hypertension, chronic kidney disease', or renal anomalies before pregnancy, those with diabetes mellitus, autoimmune disorders, or other comorbid conditions that may independently affect renal function, those who were already on renal replacement therapy or dialysis, those with multiple pregnancies and those who developed eclampsia before assessment were excluded from the study.

The obstetrics department's emergency and prenatal units were used to recruit patients after receiving ethical permission from

the Bacha Khan Medical College and Mardan Medical Complex Institutional Review Boards. We acquired informed consent from each individual. Every patient received a comprehensive clinical evaluation that included a kidney function test (serum creatinine, blood urea nitrogen, estimated glomerular filtration rate, or eGFR), a urinalysis to confirm proteinuria, a physical examination (blood pressure, weight, and edema), and a detailed history (age, gestational age, parity, comorbidities, and prior labor history).

According to the 'KDIGO (Kidney Disease Improving Global Outcomes) criteria[10], AKI was diagnosed if the serum creatinine increased by ≥0.3 mg/dL in 48 hours, if it increased by ≥1.5 times the baseline in the previous 7 days, or if the urine output was less than 0.5 mL/kg/h for 6 hours'. The hospital's core diagnostic lab performed pertinent laboratory testing. A standardized proforma was used to collect data while patients were being followed for the onset or worsening of AKI during their hospital stay.

SPSS version 26 was used to enter and evaluate all of the data that was gathered. Clinical and demographic characteristics were analyzed using descriptive statistics. For continuous variables, such as age, gestational age, and serum creatinine, the mean ± SD was computed. For categorical factors (such as the presence of AKI, parity, and the severity of pre-eclampsia), frequencies and percentages were computed. To evaluate relationships between categorical factors, including age group, parity, and AKI occurrence, a chi-square test was used. Statistical significance was defined as a p-value of less than 0.05.

RESULTS

The baseline clinical and laboratory characteristics of the 142 pre-eclamptic women enrolled in the study are presented below. The mean age of participants was 29.7 ± 5.5 years, and the mean gestational age at presentation was 33.9 ± 3.2 weeks. Regarding parity, 73 women (51.4%) were primigravida, while 69 (48.6%) were multigravida. In terms of comorbid conditions, 13 patients (9.1%) had chronic hypertension, 10 (7.0%) were diagnosed with diabetes mellitus, and the majority, 119 women (83.3%), had no documented comorbidities.

Table 1: Baseline Demographic and Clinical Characteristics of Participants (n = 142)

Variable	Mean ± SD / n (%)
Age (years)	29.7 ± 5.5
Gestational Age (weeks)	33.9 ± 3.2
Parity	
- Primigravida	73 (51.4%)
- Multigravida	69 (48.6%)
Comorbidities	
- Chronic Hypertension	13 (9.1%)
- Diabetes Mellitus	10 (7.0%)
- No Comorbidities	119 (83.3%)
Blood Pressure (mmHg)	154/97 ± 12/9
Weight (kg)	71.7 ± 9.4
Edema Present	103 (72.5%)
Proteinuria on Dipstick	
- +1	37 (26.1%)
- +2	65 (45.8%)
- +3 or more	40 (28.2%)
Serum Creatinine (mg/dL)	1.25 ± 0.42
Blood Urea Nitrogen (mg/dL)	21.5 ± 6.8
Estimated GFR (mL/min/1.73 m²)	75.3 ± 18.5

The average blood pressure recorded at admission was 154/97 ± 12/9 mmHg. The mean weight of the participants was 71.7 ± 9.4 kg, and clinical edema was observed in 103 (72.5%) of the women. Urinalysis revealed that 37 women (26.1%) had +1 proteinuria on dipstick, 65 (45.8%) had +2 proteinuria, and 40 (28.2%) had +3 or more, confirming significant levels of proteinuria in a majority of cases. Laboratory evaluation of renal function showed a mean serum creatinine level of 1.25 ± 0.42 mg/dL, a mean blood urea nitrogen (BUN) level of 21.5 ± 6.8 mg/dL, and an estimated glomerular filtration rate (eGFR) averaging 75.3 ± 18.5

mL/min/1.73 m². These values highlight the potential risk of renal impairment in pre-eclamptic patients and underline the importance of early monitoring and management (Table 1).

The relationship between AKI and various clinical parameters was further analyzed. Although no statistically significant association was observed between age group and AKI (p = 0.582), and parity and AKI (p = 0.081), a significant association was found between the severity of pre-eclampsia and AKI occurrence (p = 0.001). Among those who developed AKI, 87.8% had severe pre-eclampsia, compared to 59.4% in the non-AKI group, indicating that severe pre-eclampsia markedly increases the risk of renal complications (Table 3).

The overall frequency of Acute Kidney Injury (AKI) among the study population was 28.9% (n = 41), while 71.1% (n = 101) did not develop AKI during hospitalization. Among the AKI cases, classification based on the 'KDIGO criteria showed that 20 patients (26.0%) had an increase in serum creatinine by ≥0.3 mg/dL within 48 hours, 13 patients (9.1%) met the criteria of serum creatinine ≥1.5 times the baseline within 7 days, and 8 patients (5.6%) developed oliguria with urine output <0.5 mL/kg/h for 6 hours' (Table 2).

Table 2: Frequency of Acute Kidney Injury in Pre-eclamptic Patients (n = 142)

Acute Kidney Injury (AKI) Status	n (%)
Present	41 (28.9%)
Absent	101 (71.1%)
AKI Classification (based on KDIGO Criteria, among AKI patients, n = 41)	
Criteria Met	n (%)
Serum Creatinine ↑ ≥0.3 mg/dL in 48 hrs.	20 (26.0%)
Serum Creatinine ↑ ≥1.5× baseline in 7 days	13 (9.1%)
Urine Output <0.5 mL/kg/h for 6 hrs.	8 (5.6%)

Table 3: Association of AKI with Age Group, Parity, and Severity of Pre-eclampsia (n=142)

Variable	AKI Present n (%) n = 41	AKI Absent n (%) n = 101	p-value
Age Group (years)			
≤ 30	22 (53.6%)	61 (60.4%)	0.582
> 30	19 (46.4%)	40 (39.6%)	
Parity			
Primigravida	26 (63.4%)	46 (45.5%)	0.081
Multigravida	15 (36.6%)	55 (54.6%)	
Severity of Pre-Eclampsia			
Mild	5 (12.1%)	41 (40.6%)	0.001*
Severe	36 (87.8%)	60 (59.4%)	
p-value < 0.05 considered statistically significant *Chi-square test for Age Group and Parity* *Fisher's Exact test for Severity of Pre-eclampsia (due to low expected frequencies)*			

DISCUSSION

In the present study, we observed an incidence of acute kidney injury (AKI) of 28.9% among women presenting with pre-eclampsia. This incidence aligns with findings from a prospective study in Mwanza, Tanzania, which reported an AKI incidence of 54.7% among pre-eclamptic patients.[11] Similarly, a study in Togo identified preeclampsia/eclampsia as the primary cause of AKI in 66.7% of cases.[4] However, our incidence is notably lower than the reported studies. These discrepancies may be attributed to differences in healthcare infrastructure, patient demographics, and diagnostic criteria across regions.

The association between the severity of pre-eclampsia and the development of AKI was statistically significant in our study (p = 0.001), with 87.8% of AKI cases occurring in patients with severe pre-eclampsia. This finding is consistent with a study from Uganda, which reported a 42.86% incidence of AKI among women with

severe pre-eclampsia.[12] Furthermore, research from Ferreira et al. identified pre-eclampsia as the leading cause of pregnancy-related AKI, accounting for 27.8% of cases.[13] These studies underscore the critical link between severe pre-eclampsia and renal complications.

Regarding parity, our study found a higher occurrence of AKI among primigravida women (63.4%) compared to multigravida women (36.6%), although this association was not statistically significant (p = 0.081). This trend mirrors findings reported from a study in Qatar, where nulliparity was identified as the most common risk factor for pre-eclampsia-associated AKI.[14] The increased susceptibility of primigravida women to pre-eclampsia and subsequent renal complications may be due to immunological and vascular adaptations unique to first pregnancies.

In conclusion, our findings highlight a substantial incidence of AKI among women with pre-eclampsia, particularly those with severe disease manifestations. The significant association between severe pre-eclampsia and AKI emphasizes the need for vigilant monitoring and early intervention in this high-risk group. Further multicenter studies are warranted to explore preventive strategies and optimize management protocols for pre-eclampsia-related AKI.

CONCLUSION

This study demonstrated a high frequency of acute kidney injury (AKI) among women presenting with pre-eclampsia, particularly in those with severe forms of the disease. Nearly one-third of the participants developed AKI, emphasizing the significant renal risks associated with hypertensive disorders of pregnancy. While factors such as age and parity showed trends toward association, the severity of pre-eclampsia was found to be significantly linked to the development of AKI.

These findings highlight the importance of early identification, close monitoring, and timely management of renal function in pre-eclamptic patients, especially those with severe disease. Implementation of standardized screening protocols and risk stratification may help reduce maternal morbidity and improve outcomes in this vulnerable population. Further research is recommended to explore preventive strategies and refine clinical guidelines for managing AKI in the context of pre-eclampsia.

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