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# Epidemiological Profile and Outcome of Pregnancy Associated Acute Kidney Injury

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## Abstract

**Background: In developing countries, pregnancy-associated acute kidney injury (PAAKI) is a significant cause of maternal and neonatal mortality and morbidity. A systematic evaluation is essential to understand its frequency and severity in our setting.**

**Objectives: Primary aim of our study was to evaluate the epidemiological profile and outcome of patients with pregnancy-associated acute kidney injury.**

**Patients and Methods: The study was conducted in the Department of Nephrology, Rajshahi medical college hospital, from January 2019 to March 2020. A total of 83 patients with pregnancy-associated acute kidney injury were evaluated. Patients who had a history of chronic kidney disease or were diagnosed as a case of chronic kidney disease were excluded from the study.**

**Result: The mean age±SD was 25.39±5.90 years. The majority were <30 years of age (56.6%). Only 24.1% had completed regular antenatal checkups. Preeclamsic toxaemia was present in 10.8% of patients. 85.5% of delivery was performed at hospitals/ clinics, and 75.9% of delivery was done by cesarean section. Unskilled birth attendants did 9.7% of delivery. Anaemia was present in 41.0% of patients at presentation, and 67.5% received a blood transfusion. Maternal mortality was 32.5%, and neonatal mortality was 21.7%. Renal replacement therapy was given in 56 (67.5%) patients. Among them, 47 (83.9%) received hemodialysis. Common causes of pregnancy-associated acute kidney injury were found to be sepsis (77.1%), postpartum hemorrhage (41.0%), disseminated intravascular coagulation (21.7%), severe preeclampsia (16.9%), HELLP syndrome (2.4%) and transfusion reaction (7.2%). 31.4% of patients recovered completely, and 10.8% of patients developed chronic kidney disease.**

**Conclusion: Providing good quality perinatal care is essential to reduce the frequency of pregnancy-associated acute kidney injury and maternal and neonatal mortality related to this.**

**Keywords: Pregnancy, AKI, Renal failure.**

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## Introduction

Acute kidney injury (AKI) is a clinical syndrome that primarily presents as a rapid decline in kidney function. AKI often present with other medical condition in critically ill patients. It is also responsible for high mortality and morbidity.[1,2]

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Sociodemographic and clinical profiles and frequency of AKI were reported by several studies in different countries.[2,3,4,5]

AKI was regarded as a rare but severe complication during pregnancy and delivery. It is associated with an increased risk of fetomaternal mortality and morbidity. Its incidence and severity vary widely in published studies, from mild impairment of renal function to the requirement of dialysis.[1,6] Incidence of pregnancy-associated AKI (PAAKI) has reduced from 1/3000 to 1/20000 in the developed countries. The decline was due to the improvement in antenatal care, decline in septic abortion, and improved management of other pregnancy complications.[2,6,7] However, the burden and risk profile of PAAKI in developing countries differs from that in developed countries.[2,8,9,10] In India, 1 PAAKI was reported in 50 pregnancies, representing up to 20% of all cases of AKI. It was also found to be associated with high fetal (39%) and maternal (20%) mortality.1 Moreover, AKI in pregnancy bears a high risk of developing bilateral renal cortical necrosis and, consequently, chronic renal failure.[11]

The burden of PAAKI in our setting is still very high. AKI related to pregnancy and delivery leads to poor outcomes and exerts a high economic burden. A systematic evaluation of those cases is essential to understand the frequency, etiological features, and outcome of PAAKI in our setting. So we evaluated patients with PAAKI in the Department of Nephrology, RMCH.

## Materials and Methods

This was a cross-sectional type of observational study performed in the Department of Nephrology, Rajshahi medical college hospital, Rajshahi. The study was conducted from January 1, 2019, to March 31, 2020. Any women admitted with AKI (defined by RIFLE criteria) during pregnancy and within 45 days after delivery were included. After meeting the inclusion and exclusion criteria, a total of 83 patients were evaluated. Patient with a history of CKD or diagnosed as a case of CKD on admission was excluded from the study. Patients were followed up daily during inpatient. At six weeks, repeat clinical evaluation and estimation of serum creatinine were done.

## Results

**Table 1: Socio-demographic characteristics. (N=83)**

| | | Frequency | % |
|---|---|---|---|
| **Age group** | 1. <20 years | 13 | 15.7 |
| | 2. 20-24 years | 20 | 24.1 |
| | 3. 25-29 years | 27 | 32.5 |
| | 4. 30-34 years | 14 | 16.9 |
| | 5. 35-39 years | 7 | 8.4 |
| | 6. >40 years | 2 | 2.4 |
| **Education** | 1. Illiterate | 9 | 10.8 |
| | 2. < 5 years | 4 | 4.8 |
| | 3. 5-7 years | 36 | 43.4 |
| | 4. 8-9 years | 21 | 25.3 |
| | 5. 10-11 years | 6 | 7.2 |
| | 6. >12 years | 7 | 8.5 |

| | | | |
|---|---|---|---|
| **Occupation** | 1. Housewife | 78 | 94.0 |
| | 2. Service | 5 | 6.0 |
| **Residence** | 1. Urban | 14 | 16.9 |
| | 2. Rural | 69 | 83.1 |
| | Total | 83 | 100 |

The mean age in our study was 25.39±5.90 years. The majority (56.6%) of the patients were <30 years of age and the highest frequency was observed in the 25-29 years age group (27, 32.5%) [Table 1]. Most of our patients had completed five years of education (84.4%), 15.6% had completed ten years, and only 8.5% had education above the HSC level. More than 90% of our patients were homemakers, and more than 80% were from rural areas.

**Table 2: Obstetric history. (N=83)**

| | | Frequency | % |
|---|---|---|---|
| **Antenatal checkups** | 1. Regular (≥ five times) | 20 | 24.1 |
| | 2. Irregular (1-4 times) | 51 | 61.4 |
| | 3. None | 12 | 14.5 |
| **PET** | 1. Present | 9 | 10.8 |
| | 2. Absent | 74 | 89.2 |
| **NSAID use** | 1. Yes | 49 | 59.0 |
| | 2. No | 26 | 31.3 |
| | 3. Unknown | 8 | 9.7 |
| **Delivery at** | 1. Home | 12 | 14.5 |
| | 2. Hospital/clinic | 71 | 85.5 |
| **Birth attendants** | 1. Skilled | 68 | 81.9 |
| | 2. Unskilled | 8 | 9.7 |
| | 3. Not sure | 7 | 8.4 |
| **Mode of delivery** | 1. NVD | 15 | 18.1 |
| | 2. CS | 63 | 75.9 |
| | 3. Abortion | 5 | 6.0 |
| | Total | 83 | 100 |

NVD- Normal vaginal delivery.

CS- Ceasarean section.

**Table 3: Clinicopathological characteristics.**

| | Frequency | % |
|---|---|---|
| **Anemia at presentation** | 34 | 41.0 |
| **PPH** | 40 | 48.2 |
| **History of Blood transfusion** | 56 | 67.5 |
| **Features of hemolysis** | 15 | 18.1 |

PPH- Postpartum hemorrhage.

Only 24.1% of patients received regular antenatal care (ANC) (≥ five times), and 14.5% had no history of ANC. PET was present in 10.8% of the patients with PAAKI. The use of NSAID was reported by 59.0% of patients, and 9.7% of patients were unaware of NSAID use. Most of the delivery was taken place at hospitals/ clinics (85.5%), and in 81.9% of cases, birth attendants were skilled. Home delivery was performed in 14.5% of patients. Mode of delivery was NVD in 18.1%, Caesarean section (C/S) in 75.9%, and abortion in 6.0% [Table 2].

Anemia at presentation was found in 41.0% of individuals, and postpartum hemorrhage (PPH) occurred in 48.2%. Among them, 67.5% received a blood transfusion. On blood film examination, 18.1% were found to have features of hemolysis [Table-3]. In our study, preterm delivery occurred in 9.6%, and the retained placenta was present in 7.2% [Table-4].

**Table-4: Pregnancy outcome. (N=83)**

| | | Frequency | % |
|---|---|---|---|
| **Maternal mortality** | 1. Yes | 27 | 32.5 |
| | 2. No | 56 | 67.5 |
| **Pregnancy outcome** | 1. Preterm | 8 | 9.7 |
| | 2. Term | 68 | 81.9 |
| | 3. Abortion | 7 | 8.4 |
| **Retained placenta** | 1. Yes | 6 | 7.2 |
| | 2. No | 77 | 92.8 |
| **Neonatal mortality** | 1. Yes | 18 | 21.7 |
| | 2. No | 65 | 78.3 |

**Table-5: Renal replacement therapy and stages of renal failure. (n=83)**

| | RIFLE criteria category | | | | Total | p |
|---|---|---|---|---|---|---|
| | 1. Injury | 2. Failure | 3. Loss | 4. End-stage | | |
| **Conservatively treated** | 1 (3.7) | 26 (96.3) | 0 (0) | 0 (0) | 27 (100) | <0.01 |
| **Treated with RRT** | 0 (0) | 37 (66.1) | 18 (32.1) | 1 (1.8) | 56 (100) | |
| **Total** | 1 (1.2) | 63 (75.9) | 18 (21.7) | 1 (1.2) | 83 | |

RRT- Renal replacement therapy.

**Table-6 : Renal replacement therapy and stages of renal failure. (n=56)**

| | RIFLE criteria category | | | | Total | p |
|---|---|---|---|---|---|---|
| | 1. Injury | 2. Failure | 3. Loss | 4. End-stage | | |
| **Peritoneal dialysis** | 0 (0) | 9 (100) | 0 (0) | 0 (0) | 9 (100) | >0.05 |
| **Hemodialysis** | 0 (0) | 28 (59.6) | 18 (38.3) | 1 (2.1) | 47 (100) | |

Patients with PAAKI were categorized with RIFLE criteria, and the majority of patients were in the 2-Failure stage (75.9%). 27 (32.5%) patients were treated conservatively, and dialysis was given in total 56 (67.5%) patients. Among them, 16.1% had received peritoneal dialysis, and all of them were at the 2-Failure stage. 83.9% had received hemodialysis (HD). 59.6% of patients who received HD were in the 2-Failure stage, 38.3% were in the 3-Loss stage, and 2.1% were in the 4-End stage (Table-5, 6).

**Table-7 : Death and recovery rates in different causes of PAAKI.**

| **Causes** | **Death n (%)** | **Complete recovery n (%)** | **Partial recovery n (%)** | **No recovery (CKD) n (%)** | **Total n (%)** | **p** |
|---|---|---|---|---|---|---|
| **Sepsis** | 22 (34.4) | 20 (31.3) | 18 (28.1) | 4 (6.2) | 64 (100) | >0.05 |
| **PPH** | 5 (14.7) | 18 (52.9) | 9 (26.5) | 2 (5.9) | 34 (100) | <0.05* |
| **DIC** | 3 (16.7) | 5 (27.8) | 2 (11.1) | 8 (44.4) | 18 (100) | >0.05 |
| **PET** | 6 (42.9) | 5 (35.7) | 3 (21.4) | 0 (0) | 14 (100) | >0.05 |
| **HELLP** | 1 (50.0) | 0 (0) | 0 (0) | 1 (50.0) | 2 (100) | <0.05* |
| **Transfusion reaction** | 3 (50.0) | 3 (50.0) | 0 (0) | 0 (0) | 6 (100) | >0.05 |

DIC- Disseminated intravascular coagulation.

PET- Toxemia of pregnancy.

HELLP- HELLP (Hemolysis, elevated liver enzyme, and low platelet count) syndrome

*- Significant.

**Table-8 : Causes of PAAKI.**

| Causes of PAAKI | Frequency | % |
|---|---|---|
| **Sepsis** | 64 | 77.1 |
| **PPH** | 34 | 41.0 |
| **DIC** | 18 | 21.7 |
| **PET** | 14 | 16.9 |
| **HELLP** | 2 | 2.4 |
| **Transfusion reaction** | 6 | 7.2 |
| **Other causes** | MOF, NSAID, Hypotension, Unknown | |

MOF- Multi-organ failure.

NSAID- Nonsteroidal anti-inflammatory drugs.

Leading causes attributed to PAAKI in our study were severe sepsis (77.1%), PPH (41.0%), DIC (21.7%), PET (16.9%), HELLP syndrome (2.4%) and transfusion reaction (7.2%). Other causes are MOF, NSAID, and hypotension, and 2 cases had unknown causes of AKI. In a few cases, more than one cause was found to be associated with AKI. More severe renal failure was found to be associated with DIC and sepsis. The latter was the most common cause of PAAKI in our study. Higher mortality rates were found in patients with HELLP syndrome (50%), transfusion reaction (50%), and sepsis (34.4%). Although in 41.0% of patients, the cause of PAAKI was PPH, its recovery rate was significantly higher ($p<0.05$), but the recovery rate of HELLP syndrome was significantly lower [Table-7 & 8].

**Table-9: Outcomes.**

| | Frequency | % |
|---|---|---|
| **Maternal mortality** | 27 | 32.5 |
| **Recovery rate** | | |
| **1. Complete recovery** | 26 | 31.4 |
| **2. Partial recovery** | 21 | 25.3 |
| **3. No recovery (CKD)** | 9 | 10.8 |
| **Total** | 83 | 100 |

Maternal mortality was 32.5% in our study. 31.4% of patients recovered completely, and 25.3% had partial recovery. CKD developed in 10.8% of patients (Table-9). Neonatal mortality was also high (21.7%) in our study (Table-4).

## Discussion

The mean age in our study was lower than their studies, but a similar age range was observed by Godara et al. 11 In Ontario, Canada, only 9.6% were from rural areas.[9] In Canada, women with PAAKI was found to be older, had a lower socioeconomic condition, and had fewer prenatal visit than the general population.[9] High frequency of PAAKI in the lower age groups may be explained by the lower age of marriage in our country compared to Canada. Although the

frequency of patients with fewer antenatal visits was very high in our study, the evaluation of its association with AKI was beyond the scope of our study.

Godara et al. 2014 reported that 43.8% received ANC, and Liu et al. reported that 40.9% of cases had regular ANC.[2,11] Frequency of regular ANC visits in our study was almost half compared to other developed countries. In India, it was found that 40.4% of patients with PAAKI had a history of home delivery. [11] In China, C/S was performed in 17 out of 22 patients (77.3%).[10] During the past few years, awareness regarding ANC and the benefits of hospital delivery reduced the frequency of home delivery as a whole. On the contrary frequency of C/S was increased.

In China, it was found that the requirement for dialysis in PAAKI was only 0.75%.[10] Godara et al. reported 50 cases (87.7%) received HD, and 7 cases (12.3%) were treated conservatively.[11] In our study, 32.5% of patients were treated conservatively. After suffering from AKI, maternal mortality was very high (32.5%) in the current study, which was no way closer to other studies on PAAKI in another part of the world. Among other countries, the highest was India in 2010, which was 28.1%.[10] Neonatal mortality in patients developing PAAKI was similar to other studies. [10,11]

In China, the most common cause of PAAKI was found to be PET which is 15.9%; DIC, sepsis, and PPH were found to cause AKI in only 0.3%, 0.4%, and 0.9%, respectively.[2] In India pattern of different causes of PAAKI was more or less similar to our study, i.e., PET 33.3%, PPH 22.7%, sepsis 78.8%, and DIC 8.7%, the most common being sepsis (78.8%). [11] In other studies in China, main cause of PAAKI was found to be PET (49.2%), Other causes especially DIC and sepsis was low (2.8% and 12.5% respectively).[10] sepsis and DIC frequency remain lower in Canada than in our study (13.3% and 18.1%) but higher than in China. PET was found in 21.3% of patients, similar to our study.[9] A small number of cases were found to have CKD in studies done in China and Canada.[9,10]

In our study, maternal mortality was high (32.5%), 31.4% recovered completely, and 25.3% partially recovered. 10.8% of patients developed CKD. Godara et al. recorded complete recovery in 52.6% of patients, partial recovery in 21.1%, and no recovery (CKD) in 26.3%. The frequency of development of CKD in Canada was similar to our study but much higher in India.[9,11]

## Conclusion

Although specific pregnancy-related diseases can cause PAAKI, the leading causes of PAAKI in our population were sepsis, PPH, and DIC. These are also the most frequent causes in other developing countries. Therefore, along with the improvement in antenatal care, our healthcare system needs to address good quality perinatal and postnatal care to reduce the frequency of PAAKI and related mortality. Furthermore, a periodic evaluation is also needed to improve maternal and neonatal outcomes.

**Conflict of interest:** None declared

## References

1. Prakash J, Niwas SS, Parekh A, Pandey LK, Sharatchandra L, Arora P, Mahapatra AK: Acute kidney injury in late pregnancy in developing countries. Ren Fail 2010; 32:309-13.
2. Liu D, He W, Li Y, Xiong M, Wang L, Huang J, Jia L, Yuan S, Nie S. Epidemiology of acute kidney injury in hospitalized pregnant women in China. BMC Nephrology 2019;20:67.
3. Kaddourah A, Basu RK, Bagshaw SM, Goldstein SL, AWARE Investigators, Epidemiology of acute kidney injury in critically ill children and young adults. N Engl J Med 2017;5:11-20.
4. Bellomo R, Kellum JA, Ronco C. Acute kidney injury. Lancet 2012;25:756-66.
5. Uchino S, Kellum JA, Bellomo R, et al. Acute renal failure in critically ill patients; a multinational, multicenter study. J Am Med Assoc 2005;294:813-8.
6. Fakhouri F, Vercel C, and Frémeaux-Bacchi V. Obstetric Nephrology: AKI and Thrombotic Microangiopathies in Pregnancy. Clin J Am Soc Nephrol 2012;7:2100-06.
7. Praveen C, Kaul A, Sharma RK. Acute kidney injury in pregnancy. Clin Queries Nephrol 2016;5:8-15.
8. Liu Y, Ma X, Zheng J, Liu X, Yan T. Pregnancy outcomes in patients with acute kidney injury during pregnancy: a systematic review and meta-analysis. BMC Pregnancy Childbirth 2017;17:235.

9. Hildebrand AM, Liu K, Shariff SZ, Ray JG, Sontrop JM, Clark WF et al. Characteristics and outcomes of AKI treated with Dialysis during pregnancy and the postpartum period. J Am Soc Nephrol 2015;26:3085-91.

10. Liu Y, Bao H, Jiang Z, Huang Y, Wang N. Pregnancy-related acute kidney injury and a review of the literature in China. Intern Med 2015;54:1695-703.

11. Godara SM, Kute VB, Trivedi HL, et al.. Clinical Profile and Outcome of Acute Kidney Injury Related to Pregnancy in Developing Countries: A Single-Center Study from India. Saudi J Kidney Dis Transpl 2014;25(4):906–11.

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