RESEARCH ARTICLE

Acute Kidney Injury in Pregnancy – A Prospective Observational Study

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Abstract

Background: Pregnancy-related acute kidney injury (PR-AKI) is an important entity and is responsible for 15–20% of AKI in developing countries. It is a serious obstetric complication with significant risk to maternal and fetal health. In India, the maternal mortality due to pregnancy related AKI is 5.8%. In developed countries like the USA, there is a renewed increase in the incidence of pregnancy-related AKI from 0.04 to 0.12%. Thus, robust epidemiological studies are needed to determine the prevalence, risk factors and regional variations of AKI during pregnancy. In our study, we studied the etiology, presentation, and fetal and maternal outcomes of PRAKI in a tertiary care center.

Materials and methods: This was a prospective observational study that was conducted on patients admitted to Vani Vilas Hospital and Bowring and lady Curzon Hospital, Bengaluru medical college and research institute (BMCRI), Bengaluru, from November 2014 to May 2016. About 60 patients were included during the study period, and kidney disease improving outcomes (KDIGO) criteria were applied for the diagnosis of PRAKI. The data was collected using a predesigned proforma. Urine output and serum creatinine levels were monitored. The renal biopsy was done in selected cases. The details of therapeutic measures and hospital stay along with the maternal and perinatal outcomes are recorded and discussed.

Results: In our study, the mean age was 23.9 years. Acute kidney injury was found to be more common in primigravida (53.3%) with the majority of them occurring in the third trimester (41.6%), followed by puerperal period (30%). Hypertensive disorders of pregnancy (60%) and obstetrical hemorrhage (46.6%) were the two main causes for PRAKI and sepsis was a contributing factor in 28.3% of the cases. Maternal outcome was favorable, 73.3% had complete renal recovery, 8.3% attained partial recovery, but none progressed to irreversible renal failure. Around 65% of the patients were managed conservatively, and 16.6% required dialysis. Cases of 31 (51.7%) required an intensive care unit (ICU). The maternal mortality was 11 (18.3%). About 51.6% had preterm births, and 14 (27.45%) intrauterine fetal deaths. Neonatal intensive care unit (NICU) admission accounted for 41.7% of births.

Conclusion: Pregnancy-related acute kidney injury is a preventable condition. According to our study, hypertensive disorders of pregnancy and obstetrical hemorrhage were the major cause for PRAKI, with early detection and timely management, the complication of AKI can be mitigated. As the peak incidence of AKI was between 21 – 25 years in our study, educating this age-group regarding the importance of regular antenatal care, identification of high risk factors and prompt intervention plays a vital role.

Keywords: Acute kidney injury, Pregnancy, Maternal and fetal outcome.

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Introduction

The term acute kidney injury (AKI) represents a broader spectrum of disorders, that can range from minor changes in renal function markers to the need for renal replacement therapy (RRT).[1] Pregnancy related AKI (PR-AKI) is an important entity and is responsible for 15–20% of AKI in developing countries.[2] It is a complex and serious obstetric complication with significant risk to maternal and fetal health. In developing countries, the incidence and mortality rate have reduced significantly over the past few decades due to the availability of better antenatal care.[3] In India, the maternal mortality due to pregnancy related AKI is 5.8%.[4]

The etiology for AKI includes prerenal azotemia, renal causes like acute glomerular nephritis, acute interstitial nephritis, renal ischemia, nephrotoxic drugs and post renal obstructive pathology.[1] However, the etiology for pregnancy related AKI differs slightly from that of the general population. The cause can vary according to the trimester. *Hyperemesis gravidarum*, or septic abortion is a common cause of AKI in the first trimester of pregnancy. In later weeks of pregnancy, the causes include pre-eclampsia, HELLP syndrome, abruptio placenta, thrombotic thrombocytopenic purpura, acute fatty liver of pregnancy.[5] Postpartum hemorrhage, and puerperal sepsis account for postpartum cases of AKI.

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Identification of the risk factors, and accurate and timely diagnosis of PR-AKI are of utmost significance. The risk factors can range from pre-existing medical conditions to gestational complications. Recognizing these factors early on can facilitate

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targeted preventive measures, thus reducing the likelihood of AKI and its long-term complications. The diagnosis of PR-AKI is quite challenging due to the hemodynamic changes of pregnancy. The risk, injury, failure, loss and end stage (RIFLE) criteria, the kidney disease improving outcomes (KDIGO) guidelines and the AKI Network (AKIN) criteria are well-defined for the diagnosis of AKI in general population.[1,6] However, the accuracy of these criteria for PR-AKI is not validated, thus making it difficult to diagnose AKI in pregnancy.

In developed countries like the United States of America, there is a renewed increase in the incidence of pregnancy-related AKI from 0.04 to 0.12%.[7] This is mainly attributed to an increase in high-risk pregnancies, an increase in obesity rates, better detection and improved antenatal surveillance.[8,9] Thus, robust epidemiological studies are needed to determine the prevalence, risk factors and regional variations of AKI during the pregnancy. In our study, we studied the incidence, etiology, presentation, and the fetal and maternal outcomes of PRAKI in a tertiary care center.

Materials and Methods

This was a prospective observational study that was conducted on patients admitted to Vani Vilas Hospital and Bowring and lady Curzon Hospital, department of obstetrics and gynaecology (OBG), attached to bengaluru medical college and research institute (BMCRI), Bengaluru, from November 2014 to May 2016. Around 60 pregnant women who developed AKI during the course of pregnancy or during the immediate postpartum period (<7 days), without any preexisting renal diseases, were included in the study. Kidney disease improving global outcomes modifications of the AKIN definition were applied for the study population, as described below.

Kidney disease improving outcomes modifications of the AKIN define AKI as any of the following:[6]

- Increase in serum creatinine by X 0.3 mg/dL (X 26.5 lmol/l) within 48 hours; or
- Increase in serum creatinine to X 1.5 times baseline, which is known or presumed to have occurred within the prior 7 days; or
- Urine volume 0.5 mL/kg/h for 6 hours

The data was collected using a predesigned proforma. Each case was thoroughly evaluated on the basis of age, parity, gestational age, presenting complaints, mode of delivery, and any intrapartum complications. After a thorough physical examination, baseline investigations like complete hemogram, urine analysis, blood biochemistry, and coagulation profile were recorded. Septic workup included urine culture, high vaginal swabs, and blood culture. Urine output and serum creatinine levels were monitored. The renal biopsy was done in cases of persistent renal failure for more than 3 weeks. The details of therapeutic measures and hospital stay along with the maternal and perinatal outcomes are recorded and discussed.

Results

During the study period, 60 cases of acute kidney injuries according to the KDIGO definition were included in the study. The age of the women ranged from 18 to 35 years, with peak incidence of AKI in the age-group of 21–25 years (48.3%). The mean age was 23.9 years. In our study, AKI was found to be more common in primigravida (53.3%) with the majority of them occurring in the third trimester (41.6%), followed by puerperal period (30%) (Table 1).

Table 1: Distribution of study participants according to demographic characteristics

Demographic factors	*Number (n)*	*Percentage (%)*
Age (in years)		
15–20	10	16.7
21–25	29	48.3
26–30	17	28.3
31–35	4	6.7
Parity		
Primigravida	32	53.3
Gravida 2	12	20
Gravida 3 or more	16	26.6
Trimester		
First	11	18.3
Second	6	10
Third	25	41.6
Puerperal	18	30

Table 2: Risk factors for AKI

Risk factors	*Number (%)*
DIC	24 (40)
Severe pre-eclampsia	23 (38.3)
Postpartum hemorrhage	18 (30)
Sepsis	17 (28.3)
IUD	14 (23.3)
Antepartum hemorrhage	10 (16.7)
Septic abortion	9 (15)
HELLP syndrome	8 (13.3)
Non-severe preeclampsia	8 (13.3)
Eclampsia	5 (8.3)
Hyperemesis gravidarum	3 (3.4)
HUS	1 (1.6)

Hypertensive disorder of pregnancy was the most common risk factor for AKI in our study, which constituted 60% collectively. Severe pre-eclampsia accounting for 38.3% of cases, whereas HELLP and eclampsia accounting for 13.3 and 8.3% respectively. Obstetric hemorrhage (APH and PPH) was the second most common cause, responsible for 46.6% of the cases. Sepsis due to chorioamnionitis, puerperal sepsis, was a contributory factor in 28.3% of the cases. Septic abortion alone was a risk factor in 15% of the cases. DIC due to various etiologies was a contributory factor in 40% (Table 2).

Most common organism found on high vaginal swab in cases of septic abortion was *E. coli* accounting for 55.5%, followed by *Staphylococcus aureus* (33.3%) and *Klebsiella* (11.11%), whereas in puerperal sepsis, Group B *streptococcus* was common (37.5%), with *E. coli* and *S. aureus* accounting for 25% each, followed by *Klebsiella* (12.5%).

Table 3 shows the clinical profile of AKI in our study. Decreased urinary output was the most common presentation. About 33.3% presented with oliguria while 6.7% presented with anuria. 25% presented with grade III edema. Fever was noted in 23.3% and jaundice in 21.7% of the cases.

Maternal outcome as shown in Table 4, 73.3% of the women had complete renal recovery, while 8.3% attained partial recovery, but none progressed to irreversible renal failure. 65% of the patients were managed conservatively without the need for dialysis,

Table 3: Clinical profile of AKI

Clinical features	*Number (%)*
Oliguria	20 (33.3)
Anuria	4 (6.7)
Grade II edema	9 (15)
Grade III edema	15 (25)
Fever	14 (23.3)
Vomiting	2 (3.3)
Pain abdomen	11 (18.4)
Diarrhea	1 (1.7)
Dyspnea	3 (5)
Convulsion	5 (8.3)
Hyperemesis	2 (3.4)
Jaundice	13 (21.7)
Uterine bleeding	20 (33.3)

Table 4: Maternal and perinatal outcome in study group

Outcomes	*Number*	*Percentage (%)*
Maternal outcome		
Complete renal recovery	44	73.3
Partial renal recovery	5	8.3
Recovery without dialysis	39	65
Recovery with dialysis	10	16.6
Irreversible renal failure	0	0
Death	11	18.3
Perinatal outcome		
Term	20	33.3
Preterm	31	51.6
Abortions	9	15
IUD (term)	2	3.3
IUD (preterm)	12	20

Table 5: Type of AKI and deaths

Type of AKI	*Alive (%)*	*Deaths (%)*	*Total number (%)*
Oliguric AKI	19 (79.2)	5 (20.8)	24 (40)
Non-oliguric AKI	30 (83.3)	6 (16.7)	36 (60)
Total	59	11	60
Chi-square value – 0.167; *p*-value = 0.68			

whereas 16.6% required dialysis. Around 31 (51.7%) of the cases required an intensive care unit (ICU).

Patients with persistent renal failure for more than 3 weeks were subjected to renal biopsy. In our study, 10 patients underwent renal biopsy. Cases of 4 (6.7%) showed acute tubular necrosis (ATN) who recovered completely at the end of the third month follow-up. 5(8.3%) cases had patchy cortical necrosis (PCN), who recovered partially, i.e. urine output was adequate, but serum creatinine levels were slightly above the baseline. One (1.7%) patient's report showed interstitial nephritis, which was treated with steroids, and she attained complete renal recovery.

The maternal mortality in our study was 11 (18.3%). Women presenting with oliguric AKI (20.8%) had higher mortality when compared to non-oliguric AKI (16.7%) (Table 5). DIC (72%) and sepsis (45.45%) were the major contributory factors leading to maternal mortality.

As shown in Table 4, 51.6% had preterm births, mainly attributing to early termination of pregnancy due to various reasons such as severe pre-eclampsia, APH, and deteriorating renal function. 14 (27.45%) intrauterine fetal death noted, including both term and preterm. Neonatal intensive care unit admission accounted for 41.7% of births, with prematurity being the major cause for NICU admission.

Discussion

In our study, the mean age for PRAKI was 23.9, with peak incidence between 21 and 25 years. Sandilya S et al. study,[10] 56% belonged to the age-group 21–25 years. In Prakash et al. study,[11] the mean age was 26.80, and in Mahesh et al. study,[12] the age was 25.0. whereas the studies from the United States and Egypt had mean ages of 28 and 28.7 ± 5.9 respectively.[8,13] 41.6% of PRAKI occurred in the third trimester and 30% in puerperal period. This is mainly attributed to late obstetrical complications leading to AKI, as determined by the causes. Hypertensive disorders of pregnancy (60%) and obstetrical hemorrhage (46.6%) were the two main causes for PRAKI in the present study, which was similar to Yadav S et al.[14] study. Thakur A et al.[15] also found hypertension complicating pregnancy (42.85%) as leading causes for AKI followed by hemorrhage in pregnancy (28.57%). This emphasizes the need for good antenatal care and timely intervention to prevent the development of pregnancy related kidney injury. However, septic abortion was the commonest cause for AKI in Najar et al.[16] study. Similarly, in our study sepsis was a contributory factor in 28.3% of the cases. This may be attributed to lack of asepsis, unhygienic environment, illegal and unsupervised abortions leading to septic shock and AKI. The common presentation in these patients was oliguria/anuria. 33.3% presented with oliguria and 6.7% with anuria. The clinical presentation may vary widely, ranging from mild symptoms like fatigue to more severe manifestations like oliguria, edema and hypertension. Overlapping symptoms related to pregnancy often makes it difficult to diagnose AKI in pregnancy. Thus, one should have high index of suspicion and perform necessary investigation to confirm the diagnosis.

Maternal outcomes were generally favorable, with a majority of women (73.3%) achieving complete renal recovery. Conservative management was effective in a significant proportion of cases, although few patients 16.6% required dialysis and ICU support (51.7%). Trakarnvanich et al.[17] study also had favorable maternal outcomes with 70.6% complete renal recovery, 14.7% partial recovery, and 8.5% required dialysis. Renal biopsy was utilized in selected cases, which provided an insight into the underlying pathology. Renal cortical necrosis accounted for 8.3%, 6.7% showed ATN and 1.7% showed interstitial nephritis. This is similar to Eswarappa et al. study,[18] in which 8 patients (8%) of 99 cases of PRAKI had renal cortical necrosis. The maternal mortality in our study was 18.3%, as compared to other studies like Mahesh E et al.[12] with 20% and Yadav S et al.[15] with 23.5% maternal mortality. In our study, DIC (72%) and sepsis (45.45%) were the major contributory factors leading to maternal mortality. Mirani P and Wibowo N[19] showed that neonatal delivered from severe preeclampsia complicated AKI group were smaller in weight (median 1970 gm) and were having mild asphyxia. However, the fetal outcome was satisfactory in our study, with 61.6% survival rates. There were 33.3% term deliveries, 51.6% preterm deliveries due to early termination of pregnancy in cases such as severe pre-

eclampsia, APH, deteriorating renal function, 27.45% intrauterine fetal demise and 41.7% NICU admission.

Conclusion

Pregnancy-related acute kidney injury is a preventable condition. According to our study, hypertensive disorders of pregnancy and obstetrical hemorrhage were the major cause for PRAKI, with early detection and timely management, the complication of AKI can be mitigated. As the peak incidence of AKI was between 21 and 25 years in our study, educating this age-group regarding the importance of regular antenatal care, identification of high risk factors and prompt intervention plays a vital role. A general awareness about kidney disease in pregnancy and collaborative care between obstetricians and nephrologist helps in improving maternal and fetal outcomes.

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