Original Article

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Renal Challenges in Pregnancy: Investigating Acute Kidney Failure and Perinatal Well-being- A Prospective Descriptive Study

Obstetrics and Gynaecology Section

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ABSTRACT

Introduction: Acute Kidney Injury (AKI) poses life-threatening risks in pregnancy, leading to adverse perinatal and maternal outcomes.

Aim: To estimate the incidence of Pregnancy-Related Acute Kidney Injury (PRAKI) and describe maternal and foetal outcomes in cases of Acute Renal Failure (ARF) at a tertiary care institute.

Materials and Methods: A prospective descriptive study was conducted on 104 antenatal women with ARF attending King George Hospital, Visakhapatnam, Andhra Pradesh, India, from January to December 2020. A total of 7,409 deliveries occurred during the study period, and antenatal women with evidence of pre-existing renal disease were excluded. A detailed history was obtained, and evaluation included renal function tests and a total abdominal scan. Mode of delivery, foetal deaths, stillbirths, maternal deaths, and APGAR scores were analysed. Laboratory findings were also reported. Data analysis was performed using coGuide statistical software, and results were expressed in terms of frequency and percentages.

Results: The incidence of PRAKI was 14 per 1,000 deliveries (1.4%). The mean age of the participants was 24.05±4.11 years. The majority (78 out of 104, 75%) were in the third trimester. Out of the 104 cases of PRAKI, 77 (74%) were due to hypertension. There were 16 (15.4%) maternal deaths and 19 (21.8%) perinatal deaths.

Conclusion: Pregnant women with ARF experienced increased morbidity and mortality. Urgent improvements in antenatal care, early detection of complications, effective management, and timely referrals to tertiary centres are crucial.

Keywords: Foetus, Maternal death, Mothers, Outcome, Renal injury

INTRODUCTION

AKI, also known as ARF, is a life-threatening complication in pregnancy, with an increased risk of adverse perinatal and maternal outcomes [1]. PRAKI can occur during the antenatal, intrapartum, and postpartum periods [2]. AKI can be caused by obstetric complications such as preeclampsia, eclampsia, HELLP syndrome (Haemolysis, Elevated Liver Enzymes, Low Platelets), septic abortion, placental abruption, hyperemesis gravidarum, sepsis, etc., even in pregnant women without a history of renal dysfunction [3]. Maternal and neonatal mortality from traditional causes has been decreasing, with a 34% improvement in maternal care from 2000 to 2020, according to UNICEF [4]. However, conditions like PRAKI are emerging as significant contributors to maternal and foetal mortality and morbidity, reflecting changing trends [5,6]. A Systematic Review and Meta-Analysis (SRMA) reported that women with PRAKI had a 1.49 times higher likelihood of caesarean delivery, 1.26 times higher risk of haemorrhage, 1.86 times higher risk of HELLP syndrome, 3.13 times higher risk of placental abruption, 3.41 times higher risk of Disseminated Intravascular Coagulation (DIC), and 4.5 times higher risk of maternal death compared to women without PRAKI, but had a lower risk of eclampsia. The rate of end-stage renal disease requiring dialysis was 2.4% in PRAKI cases [6].

The incidence of PRAKI has been declining in developing countries but remains a significant contributor to foetal and maternal mortality [7]. The projected incidence of PRAKI in developed countries is one in 20,000 deliveries [8]. ARF complicated 1.78% of total deliveries in the third trimester of pregnancy [9]. The incidence of ARF is relatively low in developing countries compared to developed countries, but the overall mortality rate is reported to be high at 20% [9]. Despite the declining incidence rates, higher maternal and perinatal morbidity and mortality continue to be a concern in developing countries. There is also a lack of literature in the present study area, Visakhapatnam, to guide policy decisions and actions regarding AKI in pregnancy. Hence, the present study aims to estimate the incidence of PRAKI and describe maternal and foetal outcomes in cases of ARF at a tertiary care institute.

MATERIALS AND METHODS

A prospective descriptive study was conducted on antenatal women attending King George Hospital, Visakhapatnam, Andhra Pradesh, India, from January to December 2020. Ethical approval was obtained from the institutional review board (Ref: 136/IEC/KGH/Sep/2019) of the concerned centre. Informed written consent was obtained from the participants or their legal representatives before the study started, and confidentiality was maintained throughout.

Inclusion criteria: Previously healthy pregnant women with serum creatinine levels >1.2 mg/dL, oliguria (24-hour urine output <400 mL), and anuria were included in the study.

Exclusion criteria: Antenatal women with a previous history of chronic hypertension, Diabetes Mellitus (DM), pre-existing renal disease, increased serum creatinine levels before pregnancy due to other causes, and ultrasound findings indicating chronic kidney disease such as renal scarring or shrunken kidneys were excluded from the study.

The study population consisted of a total of 7409 deliveries that occurred during the study period. Out of these, 104 antenatal women were identified to have ARF.

Procedure

Data was collected regarding socio-demographic variables and baseline characteristics including the patient's age, trimester during the visit, and parity. Systemic and obstetric examinations were performed. Investigations such as complete blood count, peripheral

smear, renal function tests including serum electrolytes, serum uric acid, urine analysis, 24-hour urine protein, and total abdominal scan were carried out. Cases progressing into labour were closely monitored, and a Lower Segment Caesarean Section (LSCS) was performed when indicated. In cases of severe renal failure with indications, pregnancy was terminated and haemodialysis was performed. Ventilatory support and/or blood transfusion were provided as necessary for specified cases with indications. Subjects were closely monitored by keeping them in the labour ward. Renal function tests were performed and haemodialysis was planned accordingly when needed. Mode of delivery, maternal deaths, cause of death, foetal deaths, stillbirths, perinatal deaths, and APGAR scores were recorded.

STATISTICAL ANALYSIS

Data entry and analysis were performed using "coGuide Statistics software, version 1.0" [10]. Foetal and maternal variables were considered as outcome parameters, while age, parity, etc., were considered as other relevant variables. Continuous variables were expressed as mean and standard deviation, while categorical variables were expressed as proportion and frequency.

RESULTS

The majority of participants were in the age group of 21 to 25 years (47.1%) and were primigravida (46%) [Table/Fig-1].

Hypertension (74%) was the major aetiological factor, and 87.5% presented during the antenatal period [Table/Fig-2].

Parameters	M±SD/ n (%)
Age (Mean±SD) (years)	24.05±4.11
Age (years)	
<20	26 (25)
21-25	49 (47.1)
26-30	20 (19.3)
31-35	9 (8.6)
Parity	
Primi	48 (46)
G2	35 (33)
G3	11 (11)
G4	10 (10)
Trimester	
First	6 (5.8)
Second	20 (19.2)
Third	78 (75)

[Table/Fig-1]: Baseline parameters of the study subjects (N=104).

Parameters	n (%)
Aetiology	
Hypertension	77 (74)
Atonic PPH	9 (8.6)
Sepsis	5 (4.8)
Jaundice	5 (4.8)
Ectopic	2 (1.9)
Gestational thrombocytopenia	2 (1.9)
Traumatic PPH	2 (1.9)
Hyperemesis	1 (0.9)
HUS	1 (0.9)
Hypertension (N=77)	
Preeclampsia	48 (62.3)
Antepartum eclampsia	12 (15.6)
Abruption placenta	10 (13)
HELLP syndrome	7 (9.1)
Diuresis	
Non oliguric	84 (80)
Oliguria	16 (15.4)
Anuria	4 (4.6)
Outcome	
Recovered	88 (84.6) CI [0.76, 0.9]
Death	16 (15.4) CI [0.097, 0.24]
Cause of mortality	
Antepartum eclampsia	5 (31.25)
Severe preeclampsia	3 (18.75)
HELLP syndrome	2 (12.5)
Atonic PPH	2 (12.5)
Traumatic PPH	2 (12.5)
Septic abortion	1 (6.25)
Jaundice	1 (6.25)
Co-morbidities (N=35)	
Multiple organ dysfunction syndrome	5 (14.29)
Pulmonary oedema	3 (8.57)
Hepatic encephalopathy	1 (2.86)
Meningoencephalitis	1 (2.86)
Eclamptic encephalopathy	2 (5.71)
Posterior Reversible Encephalopathy Syndrome (PRES)	2 (5.71)
Fulminant hepatitis	2 (5.71)
DIC	2 (5.71)
LV dysfunction	1 (2.86)
Anaemia	6 (17.14)
Thrombocytopenia	10 (28.57)
Period of presentation	
Antenatal	91 (87.5)
Postnatal	3 (2.88)
Postoperative	5 (4.8)
Post abortal	1 (0.96)
Abortion	2 (intrauterine) (1.92)
	2 (ectopic) (1.92)

[Table/Fig-2]: Descriptive analysis of maternal clinical parameters (N=104).
PPH: Post partum haemorrhage; HUS: Haemolytic uremic syndrom; DIC: Disseminated intravascular coagulation; LV: Left ventricle; HELLP: Haemolysis, elevated liver enzymes, low platelet count

[Table/Fig-3] shows that the majority (58%) had a serum creatinine level of 1.3 to 2 mg/dL. Hyponatremia was seen in 13.46% of cases, and hyperkalemia in 11.53%. Abnormal liver function tests were observed in 33.7% of cases.

Parameters	n (%)
Serum creatinine (mg/dL)	
1.3-2	60 (58)
2.1-3	21 (20)
3.1-4	7 (7)
4.1-5	9 (8)
>5	7 (7)
Blood urea (mg/dL)	
<40	8 (7.7)
40-100	64 (61.5)
100-200	30 (28.8)
>200	2 (2)
Serum uric acid (mg/dL)	
<6	8 (7.7)
6-8	64 (61.5)

8-10	18 (17.3)
>10	14 (13.5)
Electrolyte abnormality	
Hyponatremia	14 (13.46)
Hyperkalemia	12 (11.53)
Liver function tests	
Normal	69 (66.3)
Elevated	35 (33.7)

[Table/Fig-3]: Descriptive analysis of maternal laboratory parameters (N=104).

[Table/Fig-4] shows that there were 16 (15.4%) maternal deaths and 19 (21.8%) perinatal deaths. Of the total, 69 (75.8%) women had a vaginal delivery.

Parameters	Summary
Foetal status at presentation (N=91)	
FHS-Present	77 (84.6)
FHS-Absent	14 (15.4)
Mode of delivery (N=91)	
Vaginal	69 (75.8) CI [0.66, 0.83]
LSCS	18 (17.3) CI [0.13, 0.29]
Not delivered	4 (3.9) CI [0.017, 0.11]
The outcome of the baby (N=87)	
Livebirth	68 (78.2) CI [0.68, 0.86]
Dead	16 (18.4) CI [0.12, 0.28]
Stillborn	3 (3.4) CI [0.012, 0.097]
APGAR score	
8-10	56 (82.35) CI [0.438, 0.6367]
6-8	9 (13.23) CI [0.0403, 0.1579]
4-6	3 (4.42) CI [0.0099, 0.0820]

[Table/Fig-4]: Descriptive analysis of foetal parameters (N=104).
Out of 104 cases included in the present study, 91 presented in the antenatal period. Hence Foetal status at the time of presentation of PR AKI was recorded for 91 women only. The rest are 3 post-natal cases, 5 Postoperative cases, 1 post-aborted case, 2 abortions and 2 cases of ectopic pregnancy

DISCUSSION

The incidence of PRAKI was 14 per 1000 deliveries (1.4%). Out of the 104 cases of PRAKI, 77 (74%) were attributed to hypertension. There were 16 (15.4%) maternal deaths and 19 (21.8%) perinatal deaths. AKI has been identified as one of the main independent factors associated with maternal deaths [11]. PRAKI can also lead to long-standing cardiac, neurocognitive, and renal complications that extend beyond the postpartum period [12].

In this study, a total of 7409 deliveries were recorded during the study period. According to the present study, the incidence of AKI was 14 per 1000 deliveries. Other studies have also compared the proportion of pregnant women among subjects with ARF, and the incidence has ranged from 7-9% [13,14]. The incidence observed in the present study was higher compared to developed countries. This difference could be attributed to lower socio-economic status, decreased awareness about antenatal care, and delays in treatment in developing countries like India.

The mean age in this study was 24.05±4.11 years, as shown in [Table/Fig-1]. This finding was consistent with the study conducted by Aggarwal RS et al., where the mean age was reported as 26 years [15]. In the present study, the majority of cases (75%) occurred in the third trimester. Aggarwal RS et al., reported that 50% of cases occurred in the second trimester and 42% in the postpartum period [15]. In the first trimester, conditions such as hyperemesis gravidarum and septic abortions can result in PRAKI [1]. In the third trimester, PRAKI is mainly associated with conditions like preeclampsia, antepartum haemorrhage, and thrombotic thrombocytopenic purpura [7,9]. In the postpartum period, the main causes of PRAKI are puerperal sepsis, postpartum haemorrhage, acute fatty liver of pregnancy, and haemolytic uremic syndrome [1,7].

Out of the 104 cases of PRAKI, 77 cases were attributed to hypertension, as shown in [Table/Fig-2] in the present study. Among the hypertensive cases, 62.3% were due to preeclampsia, 15.6% were due to antepartum eclampsia, 9.1% were due to HELLP syndrome, and 13% were due to abruptio placenta. Aggarwal RS et al., reported the aetiology of AKI in pregnancy as follows: puerperal sepsis (40%), haemorrhage (30%), and preeclampsia, eclampsia, and HELLP syndrome (36%) [15]. Their study also found that antepartum haemorrhage contributed to 20% of cases, while postpartum haemorrhage contributed to 10% of cases. This reflects a trend towards an increasing incidence of hypertension and a decreasing incidence of haemorrhage and sepsis, indicating an improvement in antenatal care.

The incidence of AKI caused by sepsis has reduced due to widespread antibiotic use in sepsis management and the legalisation of abortion. Currently, hypertensive disorders of pregnancy are the major contributors to PRAKI. In a study by Aggarwal RS et al., [15] the rate of LSCS was reported as 22%, compared to 17.3% in the present study.

In the present study, the mortality rate was 15.4%, which was comparable to the 12% reported by Aggarwal RS et al., [15]. Najar MS et al., reported a maternal mortality rate of 18.57%, with sepsis accounting for 61.5% of the deaths in their study [16]. Maternal mortality appears to be higher in developing countries due to factors such as poor antenatal care, late referral, and frequent sepsis. In the study by Tripathy SS et al., 11 maternal deaths were reported, accounting for 11% of their subjects, which was relatively lower than the 15.4% observed in the present study [17].

The incidence of PRAKI was reported as 0.66% or 6.6 per 1000 deliveries in the study by Arrayhani M et al., [18]. This was comparable to the incidence of 14 per 1000 deliveries reported in the present study. Sachan R et al., [5] reported an incidence of 1.02% (or 10 per 1000 deliveries) of AKI during pregnancy and the puerperium, which was similar to present study. Poor prognosis has been associated with two factors, as highlighted by Arrayhani M et al., in their study: older age (above 38 years in their study) and advanced stage of AKI [18]. In the present study, dialysis was required in 10.6% of cases, while in the study by Aggarwal RS et al., 30% required long-term dialysis [15]. Arrayhani M et al., reported that 16.2% of cases required haemodialysis in their study [18]. In the present study, the majority (58%) had serum creatinine levels at admission in the range of 1.3 to 2 mg/dL, and only 7% had serum creatinine levels >5 mg/dL.

In the present study, the perinatal mortality rate was 21.8%, as shown in [Table/Fig-4], which was lower than the study by Drakeley AJ et al., [19]. In the present study, 82.35% of babies had a mean APGAR score in the range of 8 to 10, while 4.42% had an Apgar score in the range of 4 to 6, as shown in [Table/Fig-4]. In the present study, 3.4% were stillborn and 18.4% of babies did not survive. Tripathy SS et al., observed that 5% of deliveries resulted in stillbirth in their study [17].

In the study by Sachan R et al., reported a stillbirth rate of 38.4%, and Drakeley AJ et al., the perinatal mortality rate was 38% in their study [5,19]. They found that stillbirth or intrauterine death was more common in cases with Stage-II AKI and Stage-III AKI compared to Stage-I AKI.

AKI is a life-threatening complication. It is a serious and common complication of pregnancy, regardless of improvements in healthcare systems and reforms. Out of the 104 cases of PRAKI, 77 (74%) were attributed to hypertension. There were 16 (15.4%) maternal deaths and 19 (21.8%) perinatal deaths.

AKI in pregnancy is associated with increased foetal and maternal morbidity and mortality. Early detection of PRAKI and subsequent

early interventions improve maternal and perinatal outcomes. It is crucial to create awareness among mothers and healthcare providers, especially in rural areas. Improving antenatal care and ensuring quick referral in complex cases in limited settings is essential.

Limitation(s)

The present study was limited to a single centre, which may limit the generalisability of the findings. Hospital-based results may not fully represent the scenarios of PRAKI in the community.

CONCLUSION(S)

Kidney failure after birth has serious outcomes and an increased risk of death. Patients in shock are at greater risk. Anuria in PRAKI indicates a challenging situation. There is a higher incidence of cases in first-time pregnant women and during the final trimester.

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