Section: Obstetrics and Gynaecology

Original Research Article

A STUDY OF ANALYSIS OF THE CAUSES, COURSES AND OUTCOME OF ACUTE RENAL FAILURE IN PREGNANCY

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Abstract

Background: Acute kidney injury (AKI) is a serious complication in pregnancy caused by a sudden loss of renal function and increased creatinine levels. This study aims to analyse the causes of acute kidney injury in pregnancy, the factors affecting its course and determine the pregnancy outcome among pregnant women. **Materials and Methods:** This prospective cohort study was conducted on thirty-four women with acute kidney injuries admitted and treated at Coimbatore Medical College Hospital. A detailed history was obtained, including the patient's age, socio-economic status, booking, parity, and menstrual history. Systemic and obstetric examinations includes complete blood count, renal function tests, liver function tests, serum uric acid, urine analysis, 24-hour urinary protein, peripheral smear report and ultrasound obstetrics with maternal organs. Among 34 patients, 16 were in the age group of 21-25 years, with the highest maternal mortality (5 out of 16). 44% were in the third trimester, with increased mortality in the postnatal period. Hypertensive disorders were the most common cause of acute renal failure, with co-morbid conditions such as anaemia, hypothyroidism, obesity, SLE, bronchial asthma, tuberculosis, hypertension, and no association. Of 34 patients, 21 recovered, 11 were treated with supportive measures, ten required dialysis, and 13 died due to hemodynamic instability. Out of 21 live births, 14 were term, seven were preterm, and 2 had abortus. **Conclusion:** Acute Kidney Injury in pregnancy is associated with high maternal morbidity and mortality due to hypertensive disorders of gestation, malnutrition, poor access to antenatal care, ignorance and delay in seeking medical advice.

INTRODUCTION

Acute kidney injury (AKI), previously known as acute renal failure (ARF), is a significant and complex complication in pregnancy characterised by a sudden loss of renal function and increased creatinine levels. It seriously threatens maternal and fetal health, with AKI accounting for approximately 6% to 30% of maternal mortality. Various factors can contribute to the development of AKI during pregnancy, including pre-renal, renal, and post-renal causes.[1,2] Pre-renal factors leading to AKI in pregnancy may include bleeding, which can result from placental abruption or uterine rupture. Hyperemesis gravidarum, a severe form of nausea and vomiting during pregnancy, can also lead to dehydration and electrolyte imbalances, ultimately affecting kidney function. Additionally, conditions like congestive heart failure and sepsis can impair renal blood flow and contribute to the development of AKI.[2-5]

Renal causes of AKI during pregnancy include acute tubular necrosis (ATN), pyelonephritis, renal cortical necrosis, thrombotic microangiopathy, and glomerulonephritis. ATN, characterised by renal tubular damage, can result from various factors, including hypotension during labor or complications of pre-eclampsia. Pyelonephritis, a kidney infection, can progress rapidly during pregnancy due to anatomical and physiological changes in the urinary tract. Renal cortical necrosis is a rare but severe condition where the renal cortex experiences an ischemic injury, often associated with obstetric complications. Thrombotic microangiopathy refers to conditions like hemolytic uremic syndrome and thrombotic thrombocytopenic purpura, which can lead to renal dysfunction during pregnancy. Glomerulonephritis, an inflammation of the kidney's

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filtering units, can also manifest during pregnancy and result in AKI.[6-10]

Post-renal causes of AKI in pregnancy involve urinary tract obstruction, which can occur due to conditions like kidney stones or compression by the growing uterus.[2,3] Prompt identification and management of these factors are crucial to prevent further renal damage and improve outcomes. AKI remains a significant concern in developing countries like India, contributing to maternal and fetal mortality. However, advancements in antenatal care, early diagnosis, and the legalisation of abortion have helped reduce the incidence of AKI. Regular prenatal visits allow healthcare providers to monitor kidney function, blood pressure, and other relevant parameters, enabling early detection and intervention.

Hypertensive disorders of pregnancy, such as pre-eclampsia and HELLP syndrome (hemolysis, elevated liver enzymes, low platelet count), pose a substantial risk for AKI and are often associated with maternal mortality. If left untreated, these conditions can lead to impaired kidney function, severe hypertension, and organ damage. Anaemia frequently coexists with AKI in pregnancy and contributes to the complexity of the condition. It can result from blood loss during delivery, underlying chronic diseases, or reduced renal production of erythropoietin, a red blood cell production hormone.[11,12] Anemia further exacerbates the risk of complications and may necessitate additional interventions to manage AKI and anaemia concurrently. This study aims to analyse the causes of acute kidney injury in pregnancy, the factors affecting its course and determine the pregnancy outcome among the pregnant women treated at Coimbatore Medical College and Hospital, Coimbatore.

MATERIALS AND METHODS

This prospective cohort study was conducted on thirty-four women with acute kidney injuries admitted and treated at Coimbatore Medical College Hospital, Coimbatore, from July 2014 to July 2015.

Inclusion Criteria

All acute kidney injury pregnant patients admitted to the labour ward in Obstetrics and Gynaecology department in Coimbatore Medical College were included.

Exclusion Criteria

Previous history of hypertension, diabetes, renal disease, ultrasound findings of renal scarring, small kidneys, and increased serum creatinine levels before pregnancy were excluded.

Informed consent and ethical approval were obtained before the study started. A detailed history was obtained, including the patient's age, socio-economic status, booking, parity and details of menstrual history to arrive at the expected delivery date. Patients were enquired about their complaints like vomiting, bleeding per vaginum during the antenatal or postnatal period, headache, decreased urine output, oedema of both legs, facial puffiness, fever, yellow-coloured urine, seizures and others.

History of anaemia, intrauterine fetal death, pre-eclampsia, abortion, fever, molar pregnancy, treatment for infertility, blood transfusion etc., are obtained. Co-morbid conditions like anaemia, chronic hypertension, renal disease, pregestational hypertension, hypothyroid, obesity and heart disease are ruled out. Systemic and obstetric examinations are carried out. Investigations included complete blood count, renal function tests, liver function tests, serum uric acid, urine analysis, 24-hour urinary protein, peripheral smear report, and ultrasound obstetrics with maternal organs were carried out as and when required.

HIV screening was done for all patients. Nephrologist opinion was obtained for all the patients. Fundus examination was done for suitable cases. Labour was closely monitored for antenatal cases; if indicated, LSCS was done for some cases. Early termination of pregnancy and hemodialysis was preferred if in severe renal failure. Blood transfusion was given for indicated cases. Some patients require ventilator support also. Patients were kept in the labour ward for close observation. Renal function tests were repeated as and when needed, and hemodialysis was planned accordingly. Soon after delivery, babies were assessed by the Paediatrician. Alive or dead, term or preterm, sex, gestational age at birth, the weight of the baby, APGAR score and presence of any congenital anomalies were looked for if preterm babies were admitted to NICU and were given further care.

The maternal outcome was noted regarding the mode of delivery, maternal complications and mortality. The relation of maternal morbidity and mortality to the admission serum creatinine levels was analysed to identify the various etiologies and the distribution of acute kidney injury with age, parity and trimesters. The fetal outcome was studied by perinatal morbidity and mortality. Data analyses were employed using standard clinical methods. Data collected from the study were represented as frequency.

RESULTS

Among 34 patients, 16 were in the age group of 21-25 years, with the highest maternal mortalities (5 out of 16). 44% were in the third trimester, increased mortality in the postnatal period, and multi-gravida constituted about 35%. Out of 34 patients, 22 developed acute renal failure during the antenatal period, while 12 developed it during the postnatal period.

Out of the 22 antenatal patients, 7 were primigravida (first pregnancy), six were in their second pregnancy (G2), seven were in their third pregnancy (G3), and two were in their fourth pregnancy (G4). Among

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postnatal cases, no maternal mortality was reported in instances with a single livebirth (P1L1). However, 6 out of 7 cases with two livebirths (P2L2) and 3 out of 3 cases with three livebirths (P3L3) resulted in maternal mortality. This suggests that there is an increased incidence of maternal mortality with increasing parity. Of 34 patients, 25 had a normal nutritional status, and eight were underweight. Fourteen had natural labor, and 16 had LSCS [Table 1].

Table 1: Demographic data of the study

		Frequency	Maternal mortality
Age group	≤20	4	1
	21-25	16	5
	26-30	9	4
	31-35	5	3
Trimester	First	1	0
	Second	6	3
	Third	15	1
	Postnatal	12	9
Period	Antenatal	22	4
	Postnatal	12	9
Antenatal	Primi	7	0
	Multi	15	4
Postnatal	P1L1	2	0
	P2L2	7	6
	P3L3	3	3
Nutritional status	Normal	25	9
	Underweight	8	4
	Obese	1	0
Mode of delivery	Labour natural	14	4
	LSCS	16	7
	VBAC	1	1
	MTP	2	1
	Suction evacuation	1	0

Table 2: Distribution of etiology, factors, and co-morbid condition

	Frequency	Maternal mortality	
Etiology	Hypertensive disorders	20	6
	Abruptio placenta	1	0
	HELLP syndrome	1	1
	AFLP	1	0
	Gestational thrombocytopenia	1	0
	Transfusion reaction	1	0
	Anaemia	3	1
	Post-partum haemorrhage	4	4
	Sepsis	1	1
	Anaphylaxis	1	0
Factors	Anaemia	1	1
	Pre-eclampsia	5	3
	Intrauterine fetal death	1	1
	Thrombocytopenia	1	0
	Fever	4	1
	Abortion	7	4
	Diarrhoea	1	0
	Blood transfusion	3	2
	Antepartum eclampsia	1	1
	Infertility treatment	2	0
	Heart disease	1	0
	Miscellaneous	0	0
Co-morbid condition	Anaemia	12	5
	Hypothyroid	1	0
	Obesity	1	0
	Renal donor	1	1
	SLE	1	0
	Bronchial asthma	1	1
	TB treated	1	1
	Hypertension	1	1
	No association	15	4

Hypertensive disorders were the most common cause, accounting for 20 cases. The factors observed in the patients with acute renal failure include anaemia, pre-eclampsia, intrauterine fetal death, thrombocytopenia, fever, abortion, diarrhoea, blood transfusion, antepartum eclampsia, infertility treatment, heart disease,

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miscellaneous. Co-morbid conditions observed in the patients include anaemia, hypothyroidism, obesity, renal donor, systemic lupus erythematosus (SLE), bronchial asthma, tuberculosis (TB) under treatment, hypertension, and no association [Table 2].

Of 34 patients, 14 had a blood pressure < 140/90, and 14 had a blood pressure ≥140/90. 11 had nil proteinuria, and 15 had proteinuria between 1-3 g/dl. Eight had urea levels < 40, and 20 had urea levels between 40-100. 8 had diuresis < 40, and 20 had diuresis between 40-100.

Eleven had creatinine levels between 1-5, and 22 had > 5. Electrolyte abnormalities observed in the patients include hyponatremia, hyperkalemia, hypernatremia, and hypocalcemia. 13 had uric acid levels between 6-8, and 8 had uric acid levels between 8-10. Fifteen had normal liver function tests, and 19 had elevated liver function tests [Table 3].

Table 3: Biochemical parameters of the study

		Frequency	Maternal mortality
Blood pressure	Hypotension /shock	6	5
	<140/90	14	6
	≥140/90	14	2
Proteinuria	Nil	11	6
	<1 g/dl	7	1
	1-3 g/dl	15	6
	>3 g/dl	1	0
Urea	<40	8	1
	40-100	20	9
	100-200	3	3
	>200	3	0
Diuresis	<40	8	1
	40-100	20	9
	100-200	3	3
	>200	3	0
Creatinine	<1	1	0
	1-5	11	10
	>5	22	3
Electrolyte abnormality	Hyponatremia	4	0
	Hyperkalemia	8	5
	Hypernatremia	2	3
	Hypocalcemia	4	3
Uric acid	<6	6	3
	6-8	13	4
	8-10	8	2
	>10	7	4
Liver function tests	Normal	15	5
	Elevated	19	8

Out of 34 patients, 9 were hypertensives who were not on drugs, while the remaining 25 were hypertensives who were on drugs. Sixteen had hypertension for < 4 weeks, 5 had hypertension for 1-6 weeks, 4 had hypertension for 4-8 weeks, and 9 had hypertension for > 8 weeks.

Table 4: Maternal and fetal outcome of the study

Maternal Outcome	Frequency	Treatment	Total
Recovered	21	Supportive measures	11
		Dialysis	10
Death	13	Dialysis done	7
		Not done due to hemodynamic instability	6
Fetal outcome	Frequency	Maturity	Frequency
Live birth	21	Term	14
		Preterm	7
Dead	11	Term	0
		Preterm	11
Abortus	2	-	-

Of 34 patients, 21 recovered, 11 were treated with supportive measures and ten required dialysis. Among the 13 deaths, dialysis was done for seven patients, while six died due to hemodynamic instability. In fetal outcomes, out of 21 live births, 14 were term and seven were preterm. Of 11 fetal deaths, 11 were preterm, and 0 were term. Additionally, two patients had abortus [Table 4].

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DISCUSSION

The incidence of acute kidney injury among the pregnant women attending our hospital was reported at 4.6 per 1000 deliveries. In comparison, Khanal N et al.[3] reported 2-3 per 1000 deliveries in 1980, and Arrayhani M et al.[13] (Morocco) reported 1-2.84 per 1000 deliveries in 2012. In the present study, hypertensive disorders of pregnancy were found to be the most common cause, accounting for about 58%, the next being post-partum haemorrhage, about 12% and the third being anaemia, about 9%. Patients with hypertensive disorders of pregnancy were the major group contributing to AKI in pregnancy. 75% had severe pre-eclampsia and eclampsia. The study by Prakash J showed the incidence to be more in patients with pre-eclampsia.[14] Similarly, the study by Maurya et al.[15] in 2014 showed more incidence in cases of abruption placenta. In 2006, the study by Danai PA et al.[16] showed the incidence to be high in sepsis cases. Because of the widespread use of antibiotics in septic abortion and the legalisation of abortion, the incidence has decreased due to sepsis. Nowadays, hypertensive disorders of pregnancy remain the major cause of AKI in pregnancy.

In the present study, 47% of individuals were between 21 to 25 years. There is more incidence in multi gravidas and 44% of the patients presented in the third trimester. This correlates with the study of Godara et al.[17], 2014. This is due to factors such as the high fertility rate at a young age, early marriage, illiteracy, and low economic status. In developed countries, the age group is between 25- 32 years reported by Arrayhani M et al.[13] In our study, 68% of the patients had proteinuria, with serum creatinine levels ranging from 5 to 10 in about 47% and >11 in about 18%. During their presentation, 35% of the patients had an initial urea of about 60 to 100 mg/dl. 77% of the maternal mortality is observed in the group with a serum creatinine of 1 to 5 mg/ dl. In the study by Arrayhani M et al.[13], mean serum creatinine leading to AKI ranged between 14 to 100 mg /dl.

In this study, 12 patients had anaemia; 5 had severe anaemia with haemoglobin <7 g% and the rest between 7-10g%. Four of the five patients died due to PPH, and anaemia and pre-eclampsia will worsen the prognosis. Delivery by LSCS 47% of the patients due to obstetric indication and 41% by natural labour. Most of them are preterm delivery. Early delivery by caesarean section is also done in severe cases. However, the risk of anaesthesia and the complications due to disease severity persist and account for high morbidity. About 62% of patients had live births; 14 were term, and seven were preterm. Eleven patients had preterm deliveries, which were dead born. Godara et al.[17] reported 25 individuals (43.8%) had received antenatal care, while 23 patients (40.4%) had opted for home delivery or abortion, and 34 patients (59.6%) had chosen hospital delivery. Among the participants, 32 individuals (56.14%) were multi-gravida, and 25 individuals (43.86%) were primigravida.

Out of 34 AKI pregnant patients in this study, 13 died. Three died due to pulmonary edema, four to DIVC (Atonic PPH), and 2 died of ARDS, HUS-2, and CVT-2. Of these 13 patients, hemodialysis was done for seven patients who did not recover from renal failure and died. A favourable outcome in the population when certain conditions were met. These conditions include maintaining blood pressure below 130/90 mmHg, meeting biochemical parameters such as urea <60mg/dl, creatinine <2mg/dl, uric acid <7 mg/dl, normal LFT, and Hb >9 g/dl, replacing blood loss correctly in time, and avoiding a combination of anaemia and pre-eclampsia as it had a bad prognosis.

The study by Godara et al.[17] reported the serum creatinine was 6.5 ± 2.5 mg/dL. Out of the 57 study patients, nine individuals (15.78%) passed away. Among the remaining patients, 30 individuals (52.64%) achieved complete renal recovery, while 12 (21.05%) experienced partial recovery. Unfortunately, in 15 patients (26.31%), no recovery of renal function was observed. Other studies have the following mortality rates Najar MS et al.[18] (20%), Goplani KR et al.[19] (18%), and Patel ML et al.19 (15%). In our study, 62% of patients recovered from the illness and 38% died. Of those who survived, 52% recovered completely, and 48% developed chronic renal disease requiring multiple hemodialysis.

CONCLUSION

Acute Kidney Injury in pregnancy is associated with high maternal morbidity and mortality, with hypertensive disorders of gestation being the commonest cause. Factors responsible include malnutrition, poor access to antenatal care, ignorance and delay seeking medical advice. Renal failure developing in the postnatal period has a poor prognosis and a high mortality rate. Patients with shock, anuria, high creatinine levels, electrolyte disturbances, high uric acid levels, and abnormal LFT have a bad prognosis. Early identification of acute kidney injury, early termination of pregnancy, transfusion of blood and blood components, avoidance of nephrotoxic drugs and early initiation of hemodialysis are associated with better outcomes. Perinatal mortality is high due to the complications of preterm (32 weeks).

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