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A descriptive study of acute kidney injury in obstetric patients at Kalafong Provincial Tertiary Hospital

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Abstract
Background: Acute kidney injury (AKI) in pregnancy presents with complexities relating to the pathophysiology of the disease. It is associated with an increased risk of maternal and perinatal morbidity and mortality. Cases may be mild or severe, requiring renal replacement therapy. The physiological changes of pregnancy make diagnosis difficult due to an increase in glomerular filtration rate and reduction in serum creatinine. Due to these physiological changes, there is inadequate information to aid the precise definition of the disease in pregnancy. In addition, data on AKI in pregnancy is limited in the South African population.
Aim of the study: The aim of the study was to describe the characteristics of obstetric patients who developed AKI from 22 weeks of gestation to 6 weeks postpartum.
Methods: Pregnant women admitted to Kalafong Provincial Tertiary Hospital (KPTH) from July 2019 to July 2020 were screened based on admission status and special investigations. The inclusion criteria were all consenting pregnant women above 18 years, gestational age of 22 weeks or more.
Results: A total of 38 patients were recruited. Twenty-five (66%) of these patients had a hypertensive disorder in pregnancy. AKI was graded as stage 1, 2 or 3 using the KDIGO classification. Seventeen patients (45%) had stage 1 AKI, 11 patients (29%) were in stage 2, and 10 (26%) were diagnosed as stage 3. Fifteen patients (39%) were admitted to the intensive care unit. Thirty-three patients (87%) recovered fully. However, two patients demised, of which one had an amniotic fluid embolus complicated by postpartum haemorrhage and another was diagnosed sepsis unrelated to the pregnancy.
Conclusion: AKI in pregnancy was associated with varying conditions, with hypertensive disorders making up most of the conditions. However, the recovery rate was good despite the degree of AKI, with only one of the patients in the study requiring dialysis.

Introduction

Acute Kidney Injury (AKI) in pregnancy presents with complexities relating to the pathophysiology of the disease. These include, but are not limited to, haemodilution, increased renal blood flow and increased glomerular filtration rate. In pregnancy, the diagnosis of AKI is generally delayed due to the above-mentioned physiologic changes. Little is known about AKI in pregnancy in the South African population.

AKI occurring in pregnancy and puerperium is an important cause of maternal and foetal mortality and morbidity. However, it poses a challenge of timeous diagnosis as there are no standardised guidelines for AKI in pregnancy.[1] Outside of pregnancy, the diagnosis and staging of AKI is made using the guidelines published by the Kidney Disease: Improving Global Outcomes (KDIGO) classification system. This classification system replaced the previously used RIFLE (Risk, Injury, Failure, Loss of kidney function and End-stage disease) and AKIN (Acute Kidney Injury Network classification) systems.[2] The KDIGO classification is shown in Table 1.

Table 1: The KDIGO Classification

Stage	Serum creatinine criteria	Urine output (u/o) criteria
1	Creatinine × 1.5 - 1.9 from baseline over seven days **OR** Creatinine increased by at least 26.4nμmol/L over 48 hrs	u/o < 0.5ml/kg/hr × 6-12 hours
2	Creatinine × 2.0-2.9 (i.e., doubled, or tripled creatinine)	u/o < 0.5ml/kg/hr × more than 12 hrs
3	Creatinine × 3.0 **OR** An increase up to creatinine of 354 μmol/L or more **OR** The initiation of RRT **OR** In patients <18 years, decrease in eGFR to <35 ml/min	u/o < 0.3ml/kg/hr × 24 hrs **OR**: Anuria for 12 hours

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Various causes of AKI are known, some related to the pregnancy and related complications and others independent of the pregnancy. AKI occurs secondary to sepsis, dehydration, or hypovolaemia in various conditions. Other pregnancy-specific conditions cause AKI by mechanisms that affect the kidney function directly, such as Preeclampsia, HELLP syndrome and acute fatty liver. Conditions not specific to pregnancy that cause AKI in pregnancy include atypical haemolytic uraemic syndrome (HUS), HIV related conditions, autoimmune diseases, diabetic nephropathy, acute pyelonephritis, and other medical conditions. The renal function outcomes after AKI vary and depend on demographics, aetiology, and availability of health services. Outcomes following AKI include complete resolution, chronic kidney disease, kidney failure requiring dialysis and/or kidney replacement and death.[3-5] The overall mortality in patients with AKI following ICU admission has remained the same over the past forty years, however, most patients who survive following AKI have a resolution of kidney function. Even so, a significant number of these patients will have subclinical kidney dysfunction, with a small proportion of them developing chronic kidney disease.[6]

Causes of AKI in pregnancy may be multimodal, and therefore it is often a challenge to determine the exact cause of the disease. It is important to recognize both the gestational age and comorbidities in pregnancy to understand the aetiology of AKI in an individual.[7]

The normal haematological and renal physiological changes that occur in pregnancy lead to a decrease in circulating levels of creatinine. There may be a significant increase in creatinine levels from baseline. However, this may still be within normal reference levels due to pregnancy-related physiological changes.[8] Known maternal factors like tobacco smoking, high body mass index, asthma and poor socio-economic status are related to increased maternal creatinine, while increased parity is associated with reduced creatinine levels.[9] The incidence of AKI in pregnancy is higher in patients who do not receive antenatal care.[10]

The worldwide incidence of AKI in pregnancy has dropped over the past few decades, but some studies have shown an increase in incidence. This finding is thought to be due to a stricter definition of the disease using the KDIGO, ADQI and AKIN classifications. There is also limited understanding of the epidemiology of AKI in pregnancy; as such, there is a great need for research in understanding the disease to aid in managing the disease and reducing the burden in the health sector.[11]

The aim of the study was to describe the demographic data and disease related characteristics of obstetric patients diagnosed with and treated for AKI at KPTH.

Methods

This was a descriptive study of obstetric patients ≥ 22 weeks pregnant with AKI. All obstetric patients admitted to KPTH who were identified as having AKI and who met the inclusion criteria were recorded into a database designed for this study. A sample size was not formally calculated. Patients' files were reviewed weekly to identify those who met the criteria of AKI for the duration of the study. The datasheet was designed to capture patient factors potentially associated with AKI in pregnancy. Physiological changes in pregnancy were not considered, as there are currently no guidelines for specifying AKI in pregnancy.

Patients were identified based on clinical findings during their care, including urine output and creatinine levels. For those who met the criteria for AKI, informed consent was obtained, and patient information that was relevant to the study was entered into the datasheet. Patients were also staged according to the KDIGO staging system.

Results

A total of 40 patients were identified over a twelve-month period at KPTH. Two patients did not meet the inclusion criteria. Thirty-eight patients were included in the study. AKI was found to be associated with different clinical conditions. The mean age of the study population was 30 years (SD = 5,9; range 19 to 41 years). The demographic data is shown in Table 2.

Twenty-four (63.2%) of the AKI patients presented an average middle upper arm circumference (MUAC) of 32 cm with a minimum of 18,5 cm and a maximum of 40 cm. One (2.6%) of the 38 patients was a smoker.

Table 2: Demographic data of the study population

Patient's characteristics (n= 38)		
Age	**n**	**%**
<35	30	78.9
≥35	8	21.1
No antenatal care	6	15.8
Attended antenatal care	32	84.2
Gestational age at the commencement of antenatal care		
<35	30	78.9
≥22 weeks	9	23.7
Unknown	5	13.2
Did not attend antenatal care	6	15.8
Antenatal Hb		
≤10.5	3	7.9
>10.5	28	73.7
Unknown	7	18.4
≥35	8	21.1
HIV status		
Negative	32	84.2
Positive	6	15.8

Hypertensive disorders were the most prevalent comorbid disease, with 25 (66%) patients presenting with hypertensive disorders. Of this group, 16 (42%) had preeclampsia, and five (14%) had eclampsia. Two (5.3%) patients had gestational hypertension, and another two (5.3%) had superimposed preeclampsia. Three (7.9%) patients had gestational diabetes. Two patients (5.3%) were on treatment for pre-existing hyperthyroidism.

Seventeen patients (44.7%) had stage one AKI, eleven (28.9%) had stage two, and ten (26,3%) had stage three AKI. Thirty-three (86.8%) of these patients recovered fully, three (7.9%) were lost to follow up and another two (5.3%) demised.

Fifteen (39.5%) patients were admitted to the intensive care unit (ICU). Four (10.5%) patients had a diagnostic stage one, three (7.9%) were stage two, and seven (18.4%) were stage three AKI. Thirteen (34.2%) patients were discharged from ICU, and two (5.3%) demised.

Hypertensive disorders were the most common aetiological conditions, present in 20 (52.6%) patients. AKI was diagnosed in six (25.2%) patients who had postpartum haemorrhage (PPH). Four of these patients were delivered by caesarean section, and two delivered normally. Five patients (13.2%) had sepsis, two of which had sepsis unrelated to pregnancy

and three had puerperal sepsis. Hyperemesis gravidarum in the late second trimester was found in two (5.3%) patients. Five (13.2%) patients had no specific diagnosis associated with AKI (Table 3).

Table 3: Final cause of AKI

	Stage 1	Stage 2	Stage 3	Total
Dehydration, hyperemesis	0	0	2	2
Hypertensive Disorders	9	8	3	20
PPH, Haemorrhagic Shock	2	1	3	6
Sepsis	2	1	2	5
Undiagnosed	4		1	5

Discussion

AKI in pregnancy is a complex condition that may be associated with maternal and fetal morbidity and mortality. Studies demonstrate increased mortality in patients with AKI compared to patients with similar diagnoses without AKI.[1] This is more evident in patients who require dialysis and subsequent development of chronic disease and progression to renal replacement therapy (RRT).

In this study, hypertensive disorders were the most prevalent cause of AKI, followed by PPH. Our findings were comparable with a study done by Cooke et al. in 2018, where they looked at 46 patients with AKI in pregnancy in Malawi.[13] They found that preeclampsia and eclampsia made up the largest portion of their patients with AKI. None of the patients in that study demised or required dialysis, and complete recovery occurred in 84.6% of cases.[12] A similar study by Bokhari et al. in a Pakistan population showed that sepsis was the leading cause of AKI, with 78% of their cases being due to sepsis. They reported mortality in 24 % of patients, with both findings being significantly higher than what this study showed.[14]

In a South African population, patients often develop AKI following the use of traditional medication.13 In this study population, none of the patients reported a history of use of traditional medicines.

It is important to identify patients at higher risk of developing AKI in pregnancy, and whether this is feasible or not may require further investigation. Patients may be identified by stratifying their risks to conditions known to cause AKI. PPH and hypertensive disorders were the most common causes of AKI in this study and similar studies. This emphasises the importance of adequate blood pressure control and appropriate resuscitation of cases with PPH. Mortality and morbidity following AKI may be decreased with early recognition and timeous intervention.

It is challenging to identify patients with AKI in pregnancy because of physiologic changes in pregnancy. Some patients even go unnoticed, as some were only picked up with active identification by the researcher. A limitation of this study is the that study population is from a single hospital and the sample size is too small to adequately reflect the larger South African population. There was also no long term follow up with the patients to determine if there was residual kidney disease. A larger multicentre study is recommended where patients are identified over a longer period including follow-up beyond puerperium to assess longer term outcomes.

Conclusion

AKI in pregnancy is a rare condition with the potential of serious maternal morbidity and mortality. It is important to understand the diagnostic criteria to allow early identification and management. In this study, most patients recovered fully. Prevention, early detection and management of hypertensive disorders and PPH and complications is vital to minimise AKI risk. Further studies are needed to determine risk stratification and prevention measures for the development of AKI.

References

1. *Van Hougenhouck-Tulleken WG, Roche N, Muranda AZ. Acute kidney injury in pregnancy. Obstetrics and Gynaecology Forum. 2016; 26(2):25-31.*
2. *Lopes JA, Jorge S. The rifle and akin classifications for acute kidney injury: A critical and comprehensive review. Clinical kidney journal. 2013; 6(1):8-14.*
3. *Jim B, Garovic VDDoN, Hypertension, Department of O, Gynecology MCRMN. Acute kidney injury in pregnancy. Semin Nephrol. 2017; 37(4):378-85.*
4. *Balofsky A, Fedarau MDoAUoRMCEBRNYUSA. Renal failure in pregnancy. Crit Care Clin. 2016; 32(1):73-83.*
5. *Adam S. The kidney in pregnancy. Obstetrics and Gynaecology Forum. 2013; 23(2):28-33.*
6. *Gopaluni S, Lines S, Lewington AJP. Acute kidney injury in the critically ill patient. Curr Anaesth Crit Care. 2010; 21(2):60-4.*
7. *Van Hook JW. Acute kidney injury during pregnancy. Clin Obstet Gynecol. 2014; 57(4):851-61.*
8. *Acharya A. Management of acute kidney injury in pregnancy for the obstetrician. Obstet Gynecol Clin North Am. 2016; 43(4):747-65.*
9. *Dickinson H, Davies-Tuck M, Ellery SJ, Grieger JA, Wallace EM, Snow RJ, et al. Maternal creatine in pregnancy: A retrospective cohort study. BJOG. 2016; 123(11):1830-8.*
10. *Mishra Vineet V, Goyal Preeti A, Aggarwal Rohina S, Choudhary S, Tanvir T, Dharaiya Nisarg D, et al. A single-centre experience of obstetric acute kidney injury. The Journal of Obstetrics and Gynecology of India. 2016; 66(1):207-11.*
11. *Lunn MR, Obedin-Maliver J, Hsu CY. Increasing incidence of acute kidney injury: Also a problem in pregnancy? American journal of kidney diseases: the official journal of the National Kidney Foundation. 2015; 65(5):650-4.*
12. *Cooke WR, Hemmila UK, Craik AL, Mandula CJ, Mvula P, Msusa A, et al. Incidence, aetiology and outcomes of obstetric-related acute kidney injury in Malawi: A prospective observational study. BMC Nephrol. 2018; 19(1):25.*
13. *Luyckx VA, Steenkamp V, Stewart MJ. Acute renal failure associated with the use of traditional folk remedies in South Africa. Ren Fail. 2005; 27(1):35-43.*
14. *Bokhari SRA, Inayat F, Jabeen M, Sardar Z, Saeed S, Malik AM, et al. Characteristics and outcome of obstetric acute kidney injury in Pakistan: A single-center prospective observational study. Cureus. 2018; 10(9):e3362-e.*