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INCIDENCE OF PREGNANCY RELATED ACUTE KIDNEY INJURY DUE TO SEPSIS AT SIR GANGA RAM HOSPITAL, A PROSPECTIVE STUDY USING THE SEPSIS IN OBSTETRICS SCORE

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Abstract

Background: *Pregnancy-related acute kidney injury (PR-AKI) is a serious complication that increases maternal and fetal morbidity and mortality, particularly when associated with sepsis. Early identification using clinical scoring systems such as the Sepsis in Obstetrics Score (SOS) can improve outcomes.* ***Objective:*** *To determine the incidence, clinical characteristics, and outcomes of sepsis-induced pregnancy-related acute kidney injury using the Sepsis in Obstetrics Score.* ***Methods:*** *This descriptive case series was conducted at Sir Ganga Ram Hospital, Lahore from January 2025 to March 2025, and included 246 pregnant or postpartum patients admitted with sepsis.*

Patients were followed for the development of AKI, defined as serum creatinine ≥1 mg/dL or a 0.5 mg/dL rise within 48 hours. Clinical and laboratory data were collected and analyzed using SPSS. ***Results:*** *Among the 246 participants, 108 (44%) developed AKI. Patients with AKI had significantly higher SOS scores (14.9 ± 3.2 vs. 10.4 ± 2.9, $p < 0.001$), lower systolic blood pressure, and higher lactic acid and WBC counts. A strong correlation was observed between SOS score and AKI stage (rho = 0.63, $p < 0.001$). Dialysis was required in 17.6% of AKI cases, and 5.6% resulted in maternal death. AKI incidence was significantly higher among patients without antenatal care (87.2%) and those who underwent cesarean delivery (57.9%).* ***Conclusion:*** *Sepsis is a leading cause of PR-AKI in low-resource settings. The Sepsis in Obstetrics Score is a valuable tool for early identification and risk stratification. Prompt recognition and multidisciplinary management may help reduce adverse maternal and fetal outcomes.*

INTRODUCTION

During pregnancy, acute kidney injury (AKI) significantly increase mortality and morbidity is caused by pregnancy-induced hypertension, hemorrhage, and sepsis [1]. Acute kidney injury (AKI) can occur in pregnant women with healthy kidneys due to factors such as bacterial and unskilled abortions, obstetrical issues including sepsis, intrauterine fetal mortality, placental abruption, and uterine hemorrhage. Additionally, conditions like hyperemesis gravidarum, preeclampsia/eclampsia,

HELLP syndrome, and puerperal sepsis can contribute to AKI in this population [2][3]. In the first trimester, conditions such as hyperemesis gravidarum and the onset or exacerbation of glomerulonephritis, including lupus-related flare-ups, can lead to acute kidney injury (AKI) at any point during pregnancy. Moreover, a thrombotic microangiopathy known as HELLP syndrome, which manifests in the second and third trimesters, is complicated by AKI in 3–15% of affected patients. Another rare cause of AKI during pregnancy is acute fatty liver. Thrombotic thrombocytopenic purpura, typically caused by ADAMTS13 (von Willebrand factor protease) deficiency, is known to induce AKI, particularly in the late second and third trimesters. Atypical hemolytic uremic syndrome or NSAID use should be suspected when AKI occurs postpartum. Because the gravid uterus presses against the ureter during these trimesters, obstructive AKI is frequently seen [4].

The diagnosis of Pregnancy-Associated Acute Kidney Injury (P-AKI) relies on the rise in serum creatinine levels. Investigation for evidence of AKI is warranted when the creatinine level reaches ≥1 mg/dl or shows a rapid increase, defined as a 0.5 mg/dl elevation above baseline within a 48-hour period [5][6]. Sepsis and hemorrhage cause >50% of PRAKI cases in developing nations, compared to chronic hypertension, renal failure, preeclampsia, and eclampsia in developed countries [7]. India and Pakistan reported 0.02–11.5% AKI during pregnancy. PR-AKI contributes for 5%–20% of AKI cases in poor nations [8]. The Sepsis in Obstetrics Score (S.O.S.) is designed to assess sepsis while considering the physiological changes associated with pregnancy. This scoring system amalgamates SIRS criteria, including systolic blood pressure, leukocyte count, percentage of immature neutrophils, and lactic acid, with the APACHE II (Acute Physiology and Chronic Health Evaluation II) and REMS (Rapid Emergency Medicine Score) tests. The pregnancy-specific score is determined by adjusting systolic blood pressure, heart rate, and leukocyte count based on pregnancy-related factors. Each characteristic is assigned a value ranging from 04 to 28 in the scoring process. 0 is typical. It predicts severe sepsis with 68.9% sensitivity, 80.9% specificity, and 83% positive predictive value [9]. Agarwal et al. studied the Sepsis in Obstetrics Score for critical care assistance, focusing on pregnancy-associated sepsis severity and culture positivity. They found that the score had 68.9% sensitivity, 80.9% specificity, 83% positive predictive value, and 65% negative predictive value in predicting severe sepsis in pregnant women. The study did not link culture positivity to the Sepsis in Obstetrics Score, but found a high positive predictive value of 83% for severe sepsis [10][11].

Trakarnvanich et al. conducted a meta-analysis to determine PR-AKI prevalence and clinical outcomes. Combined PR-AKI incidence was 2.0% [12]. Liu Y et al. found that women with PR-AKI had a higher risk of hemorrhage, cesarean delivery, HELLP syndrome, placental abruption, DIC, and maternal death, but a lower risk of eclampsia. They also spent longer in the ICU and had higher rates of stillbirth/perinatal death, lower birth weight, and lower gestational age at delivery. PR-AKI remains a critical complication, associated with heightened maternal and fetal mortality [13]. The study will employ SOS to assess the occurrence of sepsis in pregnant women and determine the incidence of sepsis-induced pregnancy-related acute kidney injury (AKI). The research will additionally investigate the clinical features and outcomes of sepsis-induced pregnancy-related AKI to formulate efficient prevention and treatment approaches for obstetric patients. By understanding pregnancy-related AKI incidence and management, the study hopes to improve maternal and fetal outcomes.

OBJECTIVES

To describe the incidence and clinical characteristics of pregnancy-related acute kidney injury due to sepsis at Sir Ganga Ram Hospital, Lahore.

Methodology

This descriptive case series was conducted at Sir Ganga Ram Hospital, Lahore from January 2025 to March 2025-, and included 246 pregnant or postpartum patients admitted with sepsis.

Inclusion Criteria:

Pregnant females aged between 18 to 40 years

Pregnant and six weeks post-partum females admitted in obstetrics uints with sepsis as identified by SOS during a specified period of time.

Exclusion Criteria:

Females with pre-existing renal disease, chronic hypertension, diabetes mellitis or autoimmune diseases.

Known co-morbidities such as Peripheral vascular disease, renal artery stenosis, immunodeficient conditions, congestive heart failure

Females on nephrotoxic drugs

Previous medical history of hemolytic uremic syndrome, hyperemesis gravidarum, acute fatty liver disease of pregnancy, thrombotic thrombocytopenic purpura, and placental abruption.

Females not willing to participate.

Data Collection

After obtaining ethical approval from the College of Physicians and Surgeons Pakistan (CPSP), data collection was conducted over a period of six months in the obstetrics wards of Sir Ganga Ram Hospital, Lahore. Pregnant women aged 18 to 40 years, as well as those up to six weeks postpartum, who were admitted with clinical suspicion of sepsis were screened for inclusion. Sepsis was confirmed using the Sepsis in Obstetrics Score (SOS), a pregnancy-specific scoring system based on physiological parameters. Eligible participants were enrolled using a non-probability convenient sampling technique. Exclusion criteria included any history of chronic kidney disease, diabetes mellitus, chronic hypertension, autoimmune diseases, known nephrotoxic drug use, and obstetric conditions previously associated with AKI, such as HELLP syndrome or placental abruption. Each patient was monitored for the development of acute kidney injury, defined as a serum creatinine level ≥1 mg/dL or an increase of 0.5 mg/dL within 48 hours. Patients developing AKI were referred to nephrology and managed according to international guidelines. Demographic data, clinical findings, laboratory values, and outcomes were recorded on a predesigned data collection form.

Statistical Analysis

The collected data were analyzed using SPSS (latest version). Continuous variables such as age, weight, height, BMI, gestational age, and laboratory parameters (e.g., serum creatinine, SOS score) were summarized as means and standard deviations. Categorical variables such as parity, mode of delivery, antenatal care status, presence of AKI, and clinical outcomes (e.g., ICU admission, dialysis, mortality) were presented as frequencies and percentages. The Chi-square test was used to assess associations between categorical variables, such as antenatal care and AKI development, or delivery mode and AKI occurrence. Spearman's rank correlation test was applied to assess the relationship between ordinal variables like AKI stage and SOS score, as well as to examine associations between SOS scores and outcomes such as dialysis requirement or mortality. A p-value of ≤0.05 was considered statistically significant.

Results

Among the 246 enrolled patients, those who developed AKI had a slightly higher average age (30.2 years) and body weight (70.1 kg) than those without AKI (28.7 years and 66.5 kg, respectively). Height was comparable in both groups. The mean BMI was also higher in the AKI group (27.9 kg/m²) than the non-AKI group (26.7 kg/m²), suggesting a potential link between higher body mass and AKI risk. While the number of pregnancies (parity) was similar, the average gestational age was slightly lower in AKI patients (30.3 weeks vs. 31.8 weeks). Statistically significant differences were observed in weight ($p = 0.03$), BMI ($p = 0.04$), and gestational age ($p = 0.07$), indicating these factors may contribute to AKI risk during pregnancy.

Table 1: Demographic Characteristics of Participants

Characteristic	Total (n=246)	AKI Present (n=108)	AKI Absent (n=138)
Age (years)	29.4 ± 5.8	30.2 ± 5.6	28.7 ± 6.0
Weight (kg)	68.2 ± 9.7	70.1 ± 10.2	66.5 ± 9.1
Height (cm)	158.4 ± 6.2	157.9 ± 6.0	158.9 ± 6.3
BMI (kg/m²)	27.2 ± 3.5	27.9 ± 3.7	26.7 ± 3.2
Parity	2 (IQR 1–3)	2 (IQR 2–4)	2 (IQR 1–3)
Gestational Age (weeks)	31.1 ± 3.2	30.3 ± 3.1	31.8 ± 3.3

AKI patients had markedly worse clinical parameters. Their average systolic blood pressure was significantly lower (92 mmHg vs. 108 mmHg), and their white blood cell count (15.2 vs. 11.6 x10^9/L) and lactic acid levels (2.8 vs. 1.9 mmol/L) were significantly higher, all with p-values <0.001. The mean SOS score in the AKI group was 14.9, compared to 10.4 in the non-AKI group, showing a clear association between high SOS scores and kidney injury. Elevated serum creatinine levels (139 µmol/L vs. 82 µmol/L) and reduced urine output (<500 ml/day in 16.7% vs. 2.9%) were also much more common among those with AKI, further confirming renal compromise. All differences were statistically significant.

Table 2: Clinical Characteristics and SOS Score

Variable	AKI Present (n=108)	AKI Absent (n=138)	p-value
Systolic BP (mmHg)	92 ± 14	108 ± 12	<0.001
WBC Count (x10^9/L)	15.2 ± 3.8	11.6 ± 2.7	<0.001
Lactic Acid (mmol/L)	2.8 ± 0.9	1.9 ± 0.5	<0.001
SOS Score	14.9 ± 3.2	10.4 ± 2.9	<0.001
Serum Creatinine (µmol/L)	139 ± 40	82 ± 18	<0.001

Among the 108 patients with AKI, 54 were in Stage 1, 32 in Stage 2, and 22 in Stage 3. ICU admission rates increased with severity, affecting 22% in Stage 1 and up to 82% in Stage 3. Dialysis was required in 4% of Stage 1, 16% of Stage 2, and 55% of Stage 3 patients. Maternal mortality rose progressively with severity: 2% in Stage 1, 6% in Stage 2, and 14% in Stage 3. Fetal loss followed the same pattern, from 11% in Stage 1 to 41% in Stage 3. This pattern illustrates a clear relationship between AKI severity and poor maternal and fetal outcomes.

Table 3: AKI Stage and Associated Outcomes

AKI Stage	Patients (n=108)	ICU Admission	Dialysis Required
Stage 1	54	12 (22.2%)	2 (3.7%)
Stage 2	32	10 (31.3%)	5 (15.6%)
Stage 3	22	18 (81.8%)	12 (54.5%)

AKI was more common in patients who had cesarean sections, with 66 out of 114 (57.9%) developing AKI, compared to only 42 of 132 (31.8%) in those who delivered vaginally (p = 0.01). Similarly, antenatal care was protective. Among those who received ANC, only 40 out of 168 (23.8%) developed AKI, while a staggering 68 out of 78 patients without ANC (87.2%) developed AKI (p < 0.001). These findings emphasize that both mode of delivery and lack of antenatal care are strongly associated with increased risk of AKI.

Table 4: Mode of Delivery and Antenatal Care vs AKI

Group	Total (n)	AKI Present	AKI Absent
NVD	132	42	90
C-section	114	66	48
Antenatal Care Received	168	40	128
No Antenatal Care	78	68	10

Among the 108 patients with AKI, over half (54.6%) recovered without needing dialysis. However, 17.6% required dialysis, and 22.2% required ICU admission. Maternal death occurred in 6 patients (5.6%), and fetal loss was reported in 28 cases (25.9%). A smaller portion (6.5%) progressed to chronic kidney disease. These outcomes highlight the severity of sepsis-induced AKI and the critical importance of early detection and management.

Table 5: Clinical Outcomes of AKI Patients

Outcome	Frequency (n=108 AKI Patients)
Recovered without dialysis	59 (54.6%)
Required dialysis	19 (17.6%)
Transferred to ICU	24 (22.2%)
Maternal Death	6 (5.6%)
Fetal Demise	28 (25.9%)
Progression to CKD	7 (6.5%)

Discussion

This prospective study was conducted to determine the incidence, clinical characteristics, and outcomes of pregnancy-related acute kidney injury (PR-AKI) secondary to sepsis in obstetric patients using the Sepsis in Obstetrics Score (SOS). Among the 246 patients included, 44% (n=108) developed AKI, a proportion significantly higher than the pooled global incidence of PR-AKI (2–5%) reported in previous research, highlighting the disproportionate burden in low-resource settings [14]. Demographic data revealed that patients who developed AKI had a slightly higher mean age (30.2 ± 5.6 years) and higher BMI (27.9 ± 3.7 kg/m²) compared to non-AKI counterparts. These findings are consistent with previous research that has shown increasing maternal age and BMI to be risk factors for AKI during pregnancy, likely due to associated comorbidities and obstetric complications [15].

Clinically, patients with AKI had significantly lower systolic blood pressure (92 ± 14 mmHg), higher white blood cell counts (15.2 ± 3.8 $x10^9$/L), and elevated lactic acid levels (2.8 ± 0.9 mmol/L). These abnormalities were reflected in the higher SOS scores (14.9 ± 3.2) in the AKI group compared to those without AKI (10.4 ± 2.9). This aligns with prior studies which demonstrated that septic pregnant women with higher SOS scores are more likely to develop organ dysfunction, including renal impairment [16]. A strong positive correlation (rho = 0.63, $p < 0.001$) was found between SOS score and AKI stage, affirming its utility in predicting not just the occurrence, but also the **severity** of AKI. Additionally, SOS scores were **moderately correlated**with dialysis requirement (rho = 0.51) and **maternal mortality (rho = 0.45)**. These findings mirror previous research where higher sepsis scores were linked with poorer maternal outcomes, suggesting that SOS can be a reliable tool in triaging and risk stratification. Analysis of AKI staging showed that Stage 3 AKI patients had the poorest outcomes, with 54.5% requiring dialysis**,** 81.8% needing ICU care**,** and 13.6% resulting in maternal death**.** Furthermore, fetal loss occurred in 40.9% of Stage 3 AKI cases. These numbers reflect a steep rise in complications with increasing AKI severity, a pattern corroborated by earlier studies which reported similar associations between AKI stage and adverse maternal-fetal outcomes [17][18].

In terms of care and prevention, our study found that patients without antenatal care (ANC) were at significantly higher risk of developing AKI (68 out of 78 ANC-negative patients developed AKI, $p < 0.001$). This supports previous research that emphasized the

protective role of structured antenatal surveillance in early identification and management of infections and hypertensive disorders, thereby reducing the progression to multi-organ dysfunction including AKI [19]. Delivery mode was another significant factor. The incidence of AKI was higher in patients who underwent cesarean section (66/114) than those who delivered vaginally (42/132), with a p-value of 0.01. This finding is consistent with prior research that has linked cesarean delivery with increased risk of postpartum infections and hemodynamic instability, both of which predispose to renal injury [20]. Outcomes in the AKI group were concerning: 17.6% required dialysis, 22.2% were admitted to ICU, 5.6% experienced maternal mortality, and 25.9% had fetal demise. These rates are higher than those reported in high-income countries but align with findings from previous research conducted in low- and middle-income countries where limited access to critical care and delayed intervention often contribute to poorer outcomes [21]. Overall, our results reinforce that sepsis remains a major cause of PR-AKI, and the Sepsis in Obstetrics Score is a valuable, sensitive tool for early identification of at-risk patients. Early recognition and aggressive management based on clinical scoring systems like SOS may lead to improved outcomes in resource-constrained obstetric settings.

Conclusion

This study highlights that sepsis remains a major contributor to pregnancy-related acute kidney injury (PR-AKI), with an incidence of 44% among obstetric patients admitted with sepsis. The development of AKI was significantly associated with higher Sepsis in Obstetrics Score (SOS), lower blood pressure, elevated white blood cell count, and increased lactic acid levels. Lack of antenatal care and cesarean delivery were major risk factors for AKI. Higher SOS scores strongly correlated with the severity of AKI and moderately with adverse outcomes such as dialysis requirement and maternal death. These findings affirm the clinical utility of the SOS score in early identification and risk stratification of patients at risk for PR-AKI. Timely recognition and multidisciplinary management can significantly improve maternal and fetal outcomes in this high-risk population.

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