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Original Research Article

A prospective observational comparative study on fetomaternal outcome and complications in obstetric patients with sickle cell disease or trait

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ABSTRACT

Background: Sickle cell disease (SCD) and sickle cell trait (SCT) are associated with increased fetomaternal morbidity and mortality, particularly in endemic regions like central India. Despite improved obstetric care, adverse outcomes persist, especially in endemic regions of central India.
Methods: This prospective observational comparative study was conducted at the department of obstetrics and gynaecology, IGGMC and Mayo Hospital, Nagpur, from January 2023 to July 2024. A total of 190 pregnant women (95 with SCD/SCT and 95 controls with normal haemoglobin) were enrolled. Maternal and fetal outcomes were assessed and compared. Statistical analysis included Chi-square test and student's t-test, with $p<0.05$ considered significant.
Results: Women with SCD had significantly higher rates of preeclampsia, severe anemia, and sickle cell crises compared with controls. Fetal outcomes such as intrauterine growth restriction, low birth weight, and preterm delivery were also significantly more frequent in the study group ($p<0.05$). Cesarean delivery and blood transfusion requirements were higher in SCD cases.
Conclusions: SCD and SCT adversely affect pregnancy outcomes, underscoring the need for multidisciplinary antenatal care, universal screening for sickle cell disease and delivery at tertiary care centres in endemic regions.

Keywords: Anemia, Fetomaternal outcomes, Pregnancy complications, Preterm labor, Sickle cell disease, Sickle cell trait

INTRODUCTION

Sickle cell disease (SCD) is one of the most common monogenic disorders globally, affecting over 6 million individuals, with India being one of the highest-burden regions.[1] Characterized by a mutation in the beta-globin gene, SCD leads to hemolytic anaemia, vaso-occlusion, and multiorgan damage.[2] Pregnant women with SCD are vulnerable to hypertensive disorders, anaemia, infections, and adverse foetal outcomes including growth restriction and perinatal mortality.[3,4] This study aimed to assess fetomaternal outcomes in pregnant women with HbSS and HbAS patterns compared to normal HbAA, particularly in a population from central India where SCD is endemic.

METHODS

Study type

It was a prospective observational comparative study.

Study place

Department of obstetrics and gynecology, Indira Gandhi Government Medical College and Mayo Hospital, Nagpur.

Study duration

This study took place for a period of 18 months (January 2023-July 2024).

Study population

Pregnant women attending antenatal OPD and admitted in ANC/PNC wards were considered.

Inclusion criteria

All consenting antenatal patients. Singleton pregnancies with SS, AS or AA hemoglobin patterns confirmed by electrophoresis.

Exclusion criteria

Patients not willing to participate. Pregnancies with haemoglobinopathies other than SCD/SCT. Cases with significant pre-existing comorbidities such as congenital heart disease, chronic kidney disease, or chronic hypertension unrelated to SCD/SCT.

Sample size

Based on prevalence estimates from Sonwane et al, the required sample size was calculated as 190 (95 cases with SCD/SCT and 95 controls).

Procedure

Data were collected using a pre-designed semi-structured study proforma.

The study was conducted on antenatal women having sickle cell disease or trait (SS/AS pattern) and ANC patients with AA pattern (controls), attending the ANC OPD, fulfilling the inclusion criteria and were willing to participate in the study. Patients were monitored during their ANC period, delivery and PNC period (up to 1 week after delivery) along with their baby status in ANC OPD and in ANC and PNC wards (in patient department). Their findings were compared with the controls which were selected on the basis of the same age group and gravida.

Upon registration, a comprehensive history was obtained, including obstetric, maternal, personal, and familial aspects, followed by a thorough general physical, systemic, and obstetric examination.

Patients diagnosed with sickle cell disease or trait were designated as cases, while controls were picked from those within the same age group and gravida.

Maternal outcome and complications faced by mother in antenatal period (PIH, preterm labor, severe anemia, sickle cell crisis infections, pneumonia, HELLP syndrome, AVN of hip, fever, congestive cardiac failure, PPH, placenta previa, DIC, UTI, chronic bronchitis, pyelonephritis and maternal death), mode of delivery (spontaneous or induced labor or elective or emergency LSCS) need for blood transfusion and need for ICU management were noted.

Fetal complications like fetal growth restriction, spontaneous or iatrogenic preterm and fetal outcomes in terms of live birth, IUD, still birth, early neonatal death and birth weight of baby were noted.

Ethics

Institutional ethics approval was obtained (IGGMC/Pharm/BORS/1332-33/2023). Written informed consent was obtained from all participants.

Statistical analysis

Data were analysed using SPSS v24. Chi-square or Fisher's exact tests were used for categorical variables, and Student's t-test for continuous variables. P<0.05 was considered statistically significant.

RESULTS

A total of 190 antenatal women were included: 95 with HbAA, 80 with HbAS, and 15 with HbSS hemoglobin patterns. The following results compare demographic parameters, maternal complications, delivery interventions, and foetal outcomes across the three groups.

Table 1: Demographics and baseline characteristics.

Parameters	AA (%)	AS (%)	SS (%)	P value	Statistical test
Age 20-25 years	52.63	56.25	33.33	0.55	Chi-square
Primigravida	41.05	41.25	40.00	1.00	Fisher's exact
Term Delivery (37-39 weeks)	81.05	61.25	60.00	0.008	Chi-square
Preterm (34-36 weeks)	8.42	23.75	33.33	0.003	Chi-square

The age distribution and primigravida status were comparable among all three groups, with no statistically significant differences. However, term delivery rates were significantly lower in AS and SS groups compared to AA (p=0.008), while preterm deliveries were significantly higher in the SS group (33.33%) followed by AS (23.75%), indicating increased risk of preterm labour in patients with SCD or trait (p=0.003).

Table 2: Maternal outcomes and complications.

Parameters	AA (%)	AS (%)	SS (%)	P value	Statistical test
Severe anemia	1.05	3.75	26.67	<0.0001	Fisher's exact
Blood transfusion	9.47	11.25	80.00	<0.0001	Chi-square
Preeclampsia	2.11	10.00	33.33	0.0006	Fisher's exact
Preterm labor	9.47	28.75	40.00	0.0005	Chi-square
Oligohydramnios	6.32	30.00	33.33	<0.0001	Chi-square

Table 3: Delivery and interventions.

Parameters	AA (%)	AS (%)	SS (%)	P value	Statistical test
Emergency LSCS	16.84	37.50	73.33	<0.0001	Chi-square
Induced NVD	28.42	17.50	0.00	0.016	Fisher's exact
Elective LSCS	12.63	8.75	0.00	0.373	Fisher's exact
Spontaneous NVD	42.11	35.00	26.67	0.219	Chi-square

Table 4: Fetal outcomes.

Parameters	AA (%)	AS (%)	SS (%)	P value	Statistical test
Low birth weight (<2.5 kg)	23.16	48.75	73.33	<0.0001	Chi-square
NICU admission	5.26	20.00	40.00	<0.0001	Fisher's exact
Stillbirth	2.11	6.25	13.33	0.041	Fisher's exact
Early neonatal death	1.05	3.75	6.67	0.093	Fisher's exact

Severe anemia was significantly more common in the SS group (26.67%), followed by a mild increase in the AS group, highlighting the hematological vulnerability in SCD ($p<0.0001$). Blood transfusion need was highest in SS (80%) versus AA (9.47%) and AS (11.25%) with statistical significance ($p<0.0001$). Preeclampsia and preterm labour showed increasing frequency from AA to SS group, with SS group having highest rates (33.33% and 40% respectively), both statistically significant. Oligohydramnios was notably higher in both AS (30%) and SS (33.33%) compared to AA (6.32%), emphasizing placental insufficiency risks ($p<0.0001$) (Table 2).

Emergency LSCS was significantly more common in SS group (73.33%), reflecting higher obstetric complications and foetal distress ($p<0.0001$). Induction of labour was least used in SS group (0%) and most frequent in AA (28.42%), possibly due to better tolerance of spontaneous or planned delivery. Elective LSCS and spontaneous vaginal delivery (NVD) did not show statistically significant differences, although trends suggest reduced spontaneous NVD in SS (Table 3).

Low birth weight was significantly more frequent in SS (73.33%) and AS (48.75%) groups, indicating intrauterine growth restriction associated with hemoglobinopathies ($p<0.0001$). NICU admissions were higher in SS group (40%), reflecting neonatal distress or prematurity ($p<0.0001$). Stillbirths occurred most in the SS group (13.33%), reaching statistical significance ($p=0.041$). Early neonatal death, although more in SS, did not reach statistical significance (Table 4).

DISCUSSION

This prospective study demonstrates that pregnant women with SCD and SCT experience significantly higher. This study reaffirms that both sickle cell disease (SCD) and trait increase the risk of adverse maternal and neonatal outcomes. The SS group had the highest rate of complications, consistent with prior research.[5-8] Moderate-to-severe anemia, transfusion requirement, and hypertensive disorders were notably more prevalent. The AS group showed intermediate risk, suggesting the need for surveillance even in carriers.[9-11] Recent population-based analyses, such as the study by Early et al, also reinforce these findings by showing increased severe maternal morbidity in SCD compared with women with other forms of anemia.[12]

Oteng-Ntim et al and Sun et al also documented higher maternal morbidity, hypertensive disorders, and perinatal mortality among women with SCD compared to controls, supporting our results.[3,4] However, unlike those studies, which observed increased maternal mortality, our cohort reported no maternal deaths, possibly due to better access to tertiary care and proactive transfusion support.

Our findings align with Desai et al and Kose et al, who reported similar trends in blood transfusion rates, caesarean deliveries, and low birth weight.[5,6] The increased NICU admissions and stillbirths in SS pregnancies further underscore the necessity of tertiary care and intensive monitoring.

Similarly, Vijay et al from south India and De Sousa et al from Brazil found increased incidence of preterm deliveries, low birth weight, and blood transfusion requirements in SCD pregnancies, paralleling our findings.[9,10] Adesina et al, in a large population-based study from California, demonstrated disparities in maternal mortality and morbidity among SCD women, emphasizing global relevance of our results.[11]

Conversely, Serjeant reported lower maternal mortality in SCD pregnancies managed with regular follow-up and prophylactic transfusions, suggesting that timely interventions could modify disease expression and improve outcomes.[13] The relatively lower maternal complication rate in our AS group also supports the hypothesis that genetic and environmental factors influence disease severity.

Limitations include smaller SS group size and single-centre data collection, potentially limiting generalizability. Long-term follow-up of the patients was not done. Accurate pharmacy records on antimicrobial and anticoagulation prescriptions, and use of disease-modifying interventions during pregnancy, which may have influenced peripartum outcomes, were not available. Nevertheless, the results highlight essential considerations for obstetricians managing SCD in pregnancy.

Based on the results of this study, it is evident that pregnant women with HbAS and HbSS hemoglobin patterns are at significantly higher risk for adverse maternal and foetal outcomes compared to those with normal HbAA patterns. Complications such as severe anaemia, increased need for blood transfusion, hypertensive disorders, oligohydramnios, preterm delivery, IUGR, and IUFD were notably more frequent in the AS and SS groups.

Effective pain control and supportive therapy are central to improved outcomes in SCD, as highlighted by Smith et al and Neumayr et al, who emphasize evolving therapeutic approaches and multidisciplinary management for women with SCD.[14,15]

Therefore, routine third-trimester foetal growth monitoring and timely blood transfusions may be necessary in high-risk cases. Greater emphasis on preconception counselling, improved antenatal care, and timely referrals to tertiary centres is essential. Future multicentric studies across India are recommended to validate these findings and guide standardized protocols.

CONCLUSION

Women with sickle cell disease and trait are at significantly increased risk of maternal complications such as anemia, preeclampsia, and vaso-occlusive crises, as well as adverse fetal outcomes including IUGR, preterm birth, and stillbirth. Early detection, close antenatal monitoring, and multidisciplinary management at tertiary care centres are essential to improve outcomes. This study provides crucial evidence from central India, highlighting the urgent need for standardized antenatal protocols in regions with high prevalence of SCD.

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