Original Article

Preconception Care and Sickle Cell Anemia in Pregnancy

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ABSTRACT

Background: Pregnancy in women with sickle cell anemia is associated with adverse outcome for mother and child, but with improvements in medical care, the outcome has greatly improved in developed countries. Despite being the most prevalent genetic disease in Africa, sickle-cell disease, along with its serious health problems in pregnancy, is largely neglected. **Objective:** To determine the effects of preconceptual care on pregnancy outcome among booked patients with homozygous sickle cell disease at Aminu Kano Teaching Hospital, Kano, Nigeria. **Materials and Methods:** A cohort study of the pregnancy outcome, among booked 39 pregnant women with homozygous sickle cell disease (Hbss), who had preconception care, and an equal number of booked pregnant women with homozygous sickle cell disease (Hbss), who did not have preconception care (controls), at Aminu Kano Teaching Hospital, between January 2000 and December 2006. **Results:** There was no statistically significant difference in the occurrence of complications between the two groups, but complications occurred with less frequency among the cases compared to the controls. **Conclusion:** This study suggest that preconception care and effective prenatal care by a multidisciplinary team, and delivery in a hospital which is accustomed to management of sickle cell disease and its complications, is associated with good pregnancy outcome in women with sickle cell anemia in pregnancy.

KEY WORDS: Multidisciplinary team management, preconception care, pregnancy outcome, sickle cell anemia

INTRODUCTION

The high prevalence of sickle cell disease in pregnancy in recent studies has been attributed to improvement in medical care, with resultant increase in the number of women who survive into adulthood and get pregnant, which makes it a disorder of public health concern in today's obstetrics.[1-4]

Sickle cell disease was first described in literature in a paper titled "Peculiar elongated and sickle-shaped red corpuscles in a case of severe anemia," which is a clear description of what happens to the hemoglobin molecule when deoxygenated.[5]

Sickle cell disease is common among the black race, with the highest incidence in the world reported from Uganda, in East Africa.[6] The hemoglobinopathies that are commonly encountered in pregnancy are homozygous sickle cell disease (Hbss) also known as sickle cell anemia, heterozygous sickle cell disease also known as sickle cell hemoglobin C (Hbsc), and sickle cell ß-thalassemia (Sß-thal).[2] The most frequently encountered variant is sickle cell anemia (Hbss).[2,7-11]

Sickle cell anemia (Hbss) occurs when there is a substitution of one amino acid by another, namely valine for glutamic acid at position 6 on the ß-chain.[2] Valine is neutrally charged while glutamic acid has a negative charge. The change in electronegativity allows hydrophobic binding when hemoglobin is deoxygenated, causing the classic distortion in the molecule, which is remedied when the hemoglobin is deoxygenated initially, but not after recurrent episodes.[1,2] This leads to gross reduction in the lifespan of these red blood corpuscles from the expected 120 days in the unaffected population to 10 to 20 days, with the sequel of chronic anemia in these patients.[2,12-14]

The increase in oxygen consumption, blood viscosity and red cell mass, which occur as normal physiological changes in pregnancy, put an extra demand on a woman with sickle cell disease and increase the frequency of crises and other complications,[2] which makes the management of pregnancies in women with sickle cell disease to be extremely taskful.[15-21] This has prompted some obstetricians

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in the past to advise them to avoid pregnancy or opt for elective termination of pregnancy.[4]

Early reports on the outcome of pregnancy in women with sickle cell anemia, depicted an almost universal adverse outcome for mother and child,[7,8] but with improvements in medical care, especially the introduction of preconception care, the outcome has greatly improved.[1,14] This improvement in fetomaternal outcome is poorly reflected in sub-Saharan Africa where the prevalence and complications of sickle cell disease in pregnancy is highest in the world, and a maternal mortality rate of 0.38 - 1.29/100,000 births and perinatal mortality rate of 1.21 - 2.50/100,000 births[7-11] are still being reported. This has been attributed to poor utilization of the scanty medical and antenatal care facilities, and poor or non-existence of preconception care facilities in most communities in sub-Saharan Africa.[14]

It is against this background that this study was designed, to assess the effects of preconception care and multidisciplinary team management on pregnancy outcome in women with sickle cell anemia in our institution, and to make recommendations that will improve future management policies and outcome.

MATERIALS AND METHODS

This is a prospective comparative study of 39 booked pregnant women with homozygous sickle cell disease (HbSS), who attended our sickle cell clinic in the non-pregnant state, had preconception care, and were referred from our sickle cell clinic to the booking clinic (cases), and an equal number of booked, age, parity and socio-economic status- matched pregnant women with homozygous sickle cell disease (HbSS), who did not have preconception care (controls). In both groups, the women were recruited at 16 weeks gestation after they gave an informed consent, and were regular in the antenatal clinic, delivered in our labor ward, and were followed up for the first 7 days post-delivery, between January 2000 and December 2006 at Aminu Kano Teaching Hospital, Kano, Nigeria. The women in both groups were managed by a multidisciplinary team, which consisted of the obstetricians, hematologists, sickle cell physicians, pediatricians, dieticians, anesthetists, and nursing staff who are trained in the management of patients with sickle cell disease in pregnancy.

The controls were the first women with sickle cell anemia (HbSS) who booked after a recruited woman and met the recruitment criteria. Age, parity, and socio-economic status were matched in the two groups, and women who carried multiple pregnancies were excluded because they are variables that may change many of the features associated with pregnancy outcome.[1,2]

Management of the cases and controls included provision of information and education about sickle cell disease, improvement in nutritional status and the use of daily folic acid and multivitamins, malaria prevention, which involved the use of malaria chemoprophylaxis (Proguanil 100 mg per oral daily) and sleeping under insecticide-treated mosquito nets. Febrile malaria infection was confirmed by peripheral blood smear for malaria parasites, and the women were treated with Artemesin-based combination therapy. Screening for and treatment of cases of urinary tract infection (mid stream urine for microscopy, culture and sensitivity) and pneumonia (chest X-ray), adequate fluid intake, and blood transfusion where required. Anemia was treated with blood transfusion if an operation is contemplated, or whenever the hemoglobin concentration was less than 6 g/dl, in-order to prevent crises and anemic heart failure.[3,4,11] Labour was managed using psychotherapy, partograph, and electronic fetal monitoring, liberal analgesia and oxytocin augmentation was employed to avoid pain and prolonged labor. Intravenous hydration was ensured, and intravenous antibiotics were commenced with rupture of the fetal membranes. Where necessary, episiotomy and/or instrumental delivery was employed to avoid delayed second stage of labor. Active management of the third stage of labor was employed to avoid postpartum hemorrhage. The women were advised to observe adequate rest with close monitoring and care in the puerperium.

For the purpose of this study, preconceptual care is the medical care that is given to a woman before pregnancy, in-order to manage conditions and behaviors, which could be a risk to her or her baby. Sickle cell crises refers to severe acute conditions like vaso-occlusive (painful) crises, hemolytic crises, sequestration crises and aplastic crises, occurring in patients with sickle cell disease. Hemolytic crises are acute accelerated drops in hemoglobin level, and painful crises are typical sickle-related bone pain of sufficient severity to require narcotic analgesia. Severe anemia was taken as hemoglobin concentration of 40% or more below the steady state level, antepartum hemorrhage (APH) as bleeding per vaginam after 28 weeks of pregnancy and before delivery of the fetus, postpartum hemorrhage (PPH) as blood loss of 500 ml or more following vaginal delivery, and 1000 ml or more following cesarean section. Febrile malaria infection refers to a temperature rise of 37.5°C or more due to malaria infection in the absence of symptoms/signs of other infections. Malaria infection was said to be present if there was at least one asexual parasite per 200 white blood cells in a thick film while a negative slide was one in which no asexual form was found after counting 1000 white blood cells. Pneumonia was defined as pulmonary symptoms and signs that were associated with a new pulmonary infiltrate on chest X-ray that was done with

abdominal shielding while urinary tract infection referred to urinary symptoms with positive urine culture. Pre-eclampsia was the development of hypertension and proteinuria in the second half of pregnancy in a woman who was normotensive and non-proteinuric in the first half of pregnancy. Proteinuria was defined by dipstick as trace proteinuria or more. The difference in definition is because of the less concentrated urine in homozygous sickle cell disease.[1] Retained placenta was said to occur if the placenta has not been delivered 5 minutes after the delivery of the baby because active management of the third stage of labor was employed in the management of all the patients. Spontaneous abortion was taken as demise of the pregnancy before 28 weeks of gestation while preterm delivery was termination of the pregnancy between 28 weeks and 36 completed weeks of gestation. Low birth weight (Lbwt) was taken as birth weight of 2.5 kg or less, and birth asphyxia as an APGAR score of less than 7 at 5 minutes of life. Pregnancy was confirmed in all the cases by ultrasound scanning.

At booking, as part of the routine tests, hemoglobin genotype is determined by hemoglobin electrophoresis that is performed in the hematology laboratory in our hospital. The socio-economic status of the women was derived from their educational status and husband's occupation.

The study variables of interest were pregnancy and delivery complications: Spontaneous abortions, crises, infections, pre-eclampsia/eclampsia, severe anemia, antepartum and postpartum hemorrhages, retained placenta, birth asphyxia, preterm delivery, low birth weight babies, mean gestational age at delivery, mean birth weight, and perinatal deaths (stillbirths and early neonatal deaths). Mode of delivery was spontaneous vaginal delivery (SVD), instrumental vaginal delivery, and cesarean section (C/S).

Sample size determination

Odum *et al*,[8] in a study done in Lagos, Nigeria, found a complication rate of 96.6%, among pregnant women with sickle cell anemia in pregnancy, who did not receive preconception care. Using the result obtained in this study, and accepting a study power of 80%, confidence interval of 90%, study to control ratio of 1:1, and an acceptable dropout rate of 10%, the sample size for each group was then determined using the statistical formula for comparison of proportions as follows:

$$n = \frac{1}{1-f} \times \left\{ \frac{(2 \times (Za + zb)^2 \times P \times (1-P)}{(P_0 - P_1)^2} \right\}$$

Where n=minimum sample size

P_o=the proportion of participants in the control group that are expected to develop complications=0.966.

P_1=the proportion of participants in the study group that are expected to develop complications. The efficacy of preconception care among women with sickle cell anemia in pregnancy would be determined if the complication rate among the cases is reduced by 50% of that of the controls.

$$= \frac{50}{100} \times 0.966$$

$$= 0.483$$

P=is the pooled value. $P = \frac{P_o + P_1}{2} = 0.725$

Zα=1.96; for the significance level of 0.05, that is used in this study.

Zβ=0.84; for the power of the test of 80% that was used in this study to compare between the 2 groups.

f=the proportion of study participants who are expected to be lost to follow-up in this study (attrition)=10% (0.1)

Therefore, the minimum sample size required for each study group for it to be statistically significant was:

$$n = \frac{1}{(1 - 0.1)} \times \frac{2 \times (1.96 + 0.84)^2 \times 0.725 \times (1 - 0.725)}{(0.966 - 0.483)^2}$$

$$= 1.1 \times \frac{2 \times 7.84 \times 0.725 \times 0.275}{0.233}$$

$$= 1.1 \times 13.42$$

= 15 subjects per group (not sufficient to propound null hypothesis)

= 15 × 2.5 = 39 subjects per group approximately.

The data obtained were recorded on a pro-forma and were entered into the computer using EPI INFO version 6.0 software packages. Statistical analysis was done using Chi-square test to compare qualitative variables for significant differences while student's t-test was used to compare means and standard deviations. Odds ratio (OR) and 95% confidence interval (CI) were determined where appropriate.

RESULTS

Among the cases and the controls, the mean age of the women was 23.4 (1.5) years with a range of 14 to 30 years, and the mean parity was 3.0 (0.62) with a range of 0 to 6. The mean hemoglobin concentration at 34 weeks gestation of 7.75 (0.54) g/dl among the cases and 7.68 (0.75) g/dl among the controls did not

show statistically significant difference (t=0.44, df=72, *P*=0.660). There was no statistically significant difference in the prevalence of spontaneous abortions between the two groups (OR=0.49, CI=0.02 - 7.31, *P*=1.000). Vaginal delivery (OR=1.62, CI=0.53 - 5.00, *P*=0.492), instrumental deliveries (OR=0.85, CI=0.31 - 2.33, *P*=0.909), and cesarean delivery (OR=0.83, CI=0.25 - 2.78, *P*=0.250) did not show statistically significant difference between the two groups. Among the cases, 62.5% (5/8) of the cesarean sections were carried out as elective and 37.5% (3/8) as emergences. Indications for elective cesarean section were previous cesarean section (2 patients), breech presentation (2 patients), and placenta previa (1 patient) while for emergency cesarean section were failed induction of labor (1 patient), fetal distress (1 patient), and severe pre-eclampsia (1 patient). Among the controls, 55.6% (5/9) of the cesarean sections were carried out as elective and 44.4% (4/9) as emergencies. Indications for elective cesarean section were previous cesarean section (2 patient), placenta previa (2 patients) and transverse lie (1 patient) while for emergency cesarean section were severe pre-eclampsia (2 patients), fetal distress (1 patient), failed induction of labor (1 patients). The mean gestational age at delivery (t=7.40, df=67, *P*<0.001) and the mean birth weight of the babies (t=3.04, df=67, *P*=0.003) were statistically significantly higher among the cases. Preterm delivery (OR=0.31, CI=0.01 - 3.55, *P*=0.358), low birth weight babies (OR=0.68, CI=0.24 - 1.87, *P*=0.548), birth asphyxia (OR=0.46, CI=0.65 - 0.3.21, *P*=0.430), perinatal mortality (OR=0.47, CI=0.02 - 7.12, *P*=0.430), and maternal mortality (OR=0.00, CI=0.00 – 17.66, *P*=1.000) did not show statistically significant difference between the cases and the controls, but occurred more frequently among the controls. There were 2 neonatal deaths among the controls, but one among the cases from birth asphyxia. There was one maternal death from severe pre-eclampsia (26 maternal deaths/1000 deliveries) among the controls, and none among the cases Table 1.

There was no statistically significant difference in the frequency of hemolytic crises (OR=0.63, CI=0.07 - 5.06, *P*=0.674), bone pain crises (OR=0.36, CI=0.09 - 1.31, *P*=0.142), pneumonia (OR=0.47, CI=0.02 - 7.12, *P*=0.615), urinary tract infection (OR=0.97, CI=0.18 - 5.15, *P*=1.000), malaria infection (OR=0.83, CI=0.29 - 2.35, *P*=0.881), pre-eclampsia (OR=0.55, CI=0.09 - 2.95, *P*=0.480), severe anemia (OR=0.46, CI=0.05 - 3.21, *P*=0.430), antepartum hemorrhage (OR=0.63, CI=0.07 - 5.06, *P*=0.674), postpartum hemorrhage (OR=1.25, CI=0.26 - 6.20, *P*=1.000), retained placenta (OR=0.31, CI=0.01 - 3.58, *P*=0.358) between the two groups. There was no case of eclampsia among the cases and the controls Table 2.

Table 1: Pregnancy outcome

Variable	Cases (%) n=39	Control (%) n=39	OR	CI	P value
Spontaneous abortion	1 (2.6)	2 (5.1)	0.49	0.02 - 7.31	1.000
Mode of delivery	n=38	n=37			
Spontaneous vaginal delivery	13 (34.2)	9 (24.3)	1.62	0.53 - 5.00	0.492
Instrumental delivery	18 (47.4)	19 (51.4)	0.85	0.31 - 2.33	0.909
Cesarean section	8 (21.1)	9 (24.3)	0.83	0.25 - 2.78	
New born					
Mean gestational age	37.5 (2.8)	36.0 (2.5)	–	–	<0.001
Mean birth weight	2.8 (0.5)	2.4 (0.6)	–	–	0.003
Preterm delivery	1 (2.6)	3 (8.1)	0.31	0.01 - 3.58	0.358
Low birth weight	20 (52.6)	23 (62.2)	0.68	0.24 - 1.87	0.548
Birth asphyxia	2 (5.3)	4 (10.8.)	0.46	0.05 - 3.21	0.430
Perinatal mortality					
Neonatal deaths	1 (2.6) n=39	2 (5.4) n=39	0.47	0.02 - 7.12	0.615
Maternal mortality	–	1 (2.6)	0.00	0.00 - 17.66	1.000

Table 2: Complications during pregnancy, labor, and the first 7 days of puerperium

Variable	Cases (%) N=38	Control (%) n=37	OR	CI	P value
Crises					
Hemolytic	2 (5.3)	3 (8.1)	0.63	0.07 - 5.06	0.674
Bone pain	5 (13.2)	11 (29.7)	0.36	0.09 - 1.31	0.142
Infections					
Pneumonia	1 (2.6)	2 (5.4)	0.47	0.02 - 7.12	0.615
Urinary tract infection	4 (10.5)	4 (10.8)	0.97	0.18 - 5.15	1.000
Malaria fever	23 (60.5)	24 (64.9)	0.83	0.29 - 2.35	0.881
Pre-eclampsia	3 (7.9)	5 (13.5)	0.55	0.09 - 2.95	0.480
Severe anemia	2 (5.3)	4 (10.8)	0.46	0.05 - 3.21	0.430
Antepartum hemorrhage	2 (5.3)	3 (8.1)	0.63	0.07 - 5.06	0.674
Postpartum hemorrhage	5 (13.2)	4 (10.8)	1.25	0.26 - 6.20	1.000
Retained placenta	1 (2.6)	3 (8.1)	0.31	0.01 - 3.58	0.358

DISCUSSION

The mean age of the pregnant women with sickle cell anemia in this study of 23.4 years is lower while the mean parity of 3.0 is higher than the mean age of 27.3 years and mean parity of 1.7 reported from Benin City in Southern Nigeria.[4] This may probably be due to an early marriage in our predominantly Islamic society in North western Nigeria[22] while delay in marriage in Benin City, which is a predominantly Christian society, has been attributed to female educational pursuits and economic attainment before marriage.[4]

The higher mean parity among women, with sickle cell anemia in recent studies, has been attributed to improved antenatal and health care delivery services,[3,4,14] and may herald the advent of high parity among women with sickle cell anemia in pregnancy.

The frequency of spontaneous abortion did not show significant difference between the cases and the controls, probably because of late booking after the first trimester, which is the peak period of spontaneous abortion.[4] Serjeant *et al*,[1] found a spontaneous abortion rate of 80%

among women with sickle cell anemia in pregnancy before 12 weeks of gestation, which may explain the low frequency of spontaneous abortion in this study and other studies from sub-Saharan Africa[4] where majority of the women book late for antenatal care.

The mean hemoglobin concentration at 34 weeks gestation, which did not show any significant difference between the cases and the controls, may probably be because the women in the two groups had hematinics and malaria chemoprophylaxis in pregnancy, and were advised to sleep under insecticide-treated nets during the critical period of 16th to 36th weeks of gestation. The low mean hemoglobin concentration of 7.75 g/dl among the cases and 7.68 g/dl among the controls in this study is similar to 7.71 - 7.78 g/dl that was reported in other studies from West Africa,[4,8,14,18] 7.65 g/dl from India,[3] and 7.50 g/dl from West Indies.[1] This may be due to the shorter life span of the red blood cells, from 120 days in the normal population to 10-20 days in women with sickle cell anemia. This physiological process of low mean hemoglobin concentration is meant to avoid increased viscosity of the blood, which could precipitate crises.[2]

The higher mean hemoglobin concentration in some studies from developed countries[23,24] has been attributed to routine prophylactic *top-up* blood transfusion from 20th week of gestation to ensure adequate maternal hemoglobin levels with HbAA red cells, in-order to reduce the frequency of crises and ensure better maternal well-being.[13,16-21] This is not the policy in Aminu Kano Teaching Hospital and in some health facilities in West Africa[4] because it may improve maternal well-being, but it does not significantly improve the perinatal outcome,[1-4,13-19] and it may be associated with the risk of developing rare antibodies, which may adversely affect cross-matching of donor's blood and increase the frequency of blood transfusion reactions.[2,13-19]

Bone pain crises were commoner than hemolytic crises, which agrees with the findings of other authors.[3,4,7,8] This may be due to the increase in blood viscosity and red cell mass, which occur as normal physiological changes in pregnancy.[2] The frequency of bone pain crises and hemolytic crises, which did not show any significant difference between the two groups in this study, may be the effect of active prenatal care by a multidisciplinary team that was given to the women in the two groups, but the lower frequency of these complications among the cases may be the effect of preconceptual care that was given to the women in the study group, which was also the experience of Ogedengbe *et al*,[10] from Lagos, Nigeria.

There was no statistically significant difference in the occurrence of infectious morbidities between the two groups, which agrees with other similar studies from West Africa.[14,18] This may probably be because the women in the two groups were managed by a multidisciplinary team, had hematinics and malaria chemoprophylaxis in pregnancy, with treatment for malaria infection in event of malaria fever, screening for pneumonia, which was based on symptoms and signs from history and physical examination at each visit, and urinary tract infection, and early intervention with appropriate antibiotics in event of infection. Also, they were encouraged to sleep under insecticide-treated mosquito nets. These present day interventions may have accounted for why it does not agree with the poor findings in earlier studies from Nigeria while preconceptual care may account for the lower frequency of infectious morbidities among the cases, which agrees with other recent similar studies from West Africa.[14,18] Malaria infection with *Plasmodium falciarum* was the commonest morbidity, probably because this study was conducted in a malaria endemic area.[4]

The frequency of vaginal, instrumental, and cesarean deliveries did not show statistically significant difference between the two groups, which is also the experience of other authors.[14] This may be because the women in the two groups were managed by a multidisciplinary team, which ensured that they were in good state of health at the time of delivery, and labor was managed using partograph and electronic fetal monitoring as well as augmentation of labor with oxytocin to avoid prolonged labor. This does not agree with the findings of earlier studies from West Africa[7] where the poor state of the women made cesarean delivery to be the commoner mode of delivery, which has been attributed to inadequate management of the patients because the present day interventions were not employed in their management.

The high number of instrumental vaginal deliveries in the two groups agrees with the findings of other studies,[7-10,14] and is attributed to prophylactic forceps and vacuum deliveries that were employed to minimize maternal efforts in the second stage of labor as the stress could precipitate crises.[1]

The frequency of retained placenta did not show significant difference between the cases and the controls, which agree with similar studies from sub-Saharan Africa.[14,18] The high prevalence of retained placenta among women with sickle cell anemia in pregnancy has been attributed to vaso-occlusive crises, which cause sickle-induced scarring of the endometrium from ischemia that leads to binding of the placenta more firmly to the underlying uterus.[1] This may explain the lower frequency of retained placenta among the cases who had preconceptual care compared to the controls in this study, and among the women in this study who had active prenatal care by a multidisciplinary team, compared to earlier studies from sub-Saharan Africa.[7]

The frequency of neonatal complications of preterm delivery, low birth weight babies, and birth asphyxia, as well as obstetric and medical complications of severe anemia, pre-eclampsia, antepartum and postpartum hemorrhage did not show any significant difference between the two groups, probably because the women in the two groups had effective and active prenatal care by experienced multidisciplinary team, and delivered in our hospital, which is accustomed to the management of women with sickle cell anemia in pregnancy. This agrees with recent similar studies from West Africa.[14,18] The lower frequency of complications among the cases may be because the women had preconceptual care.

The high frequency of low birth weight babies among the cases and controls agree with the findings of Serjeant *et al,*[1] who found that better maternal health during pregnancy, despite reducing the frequency of maternal painful crises and degree of anemia, had no effect on birth weight because the physiologic demands of pregnancy will increase the frequency of vaso-occlusive crises and chronic anemia more than in the non-pregnant state, with resultant chronic fetal hypoxia from uteroplacental insufficiency.

Although differences in patient's characteristics may have contributed, preconceptual care may be responsible for the lower frequency of preterm delivery among the cases, which may account for why the mean gestational age and the mean birth weight among the cases were significantly higher than among the controls. This agrees with other studies.[10,14]

Perinatal and maternal mortality did not show any significant difference between the two groups, probably because of effective and active prenatal care by a multidisciplinary team, with appropriate and relevant prenatal interventions, and management of labor and puerperium by experienced team of specialist obstetricians, with back up by relevant medical staff in the two groups. The maternal mortality rate of 2.6% (1/39) among the controls, who had only prenatal multidisciplinary team management, is similar to 1.8% (7/42) that was reported in a recent similar study by Rahimy *et al,*[14] from Cotonou, in Benin Republic, a neighboring West African country, but did not agree with 9.2% (4/44) that was reported in an earlier study in 1992 by Dare *et al,*[7] from Ile-Ife from south western Nigeria. The poor pregnancy outcomes, previously reported for sickle cell disease in pregnancy in West Africa, reflect inadequate management of these patients rather than the intrinsic severity of the disease.[14]

There was no maternal mortality among the women that had preconceptual care, in addition to prenatal care by a multidisciplinary team in this study. This agrees with the findings of Ogedengbe *et al,*[10] where booked women who had preconceptual care had no maternal mortality as against 33.3% (2/6) among booked women who did not have preconceptual care, and booked women who had preconceptual care had better pregnancy outcome, compared to booked women who did not have preconceptual care. This may be because preconception care may have ensured that the women were in good state of health when they got pregnant, which is our strongest defense against the disorder in pregnancy.[1] Rahimy *et al,*[14] in West Africa, found that the pregnancy outcomes among women with sickle cell disease that had preconceptual care, and were managed by an experienced multidisciplinary team, was similar to that of developed countries.

Public health education about the importance of preconception care, early booking for antenatal care by a multidisciplinary team, and hospital delivery should be intensified, especially in sub-Saharan Africa where as a result of poverty, ignorance, and socio-cultural barriers to utilization of the available health care facilities, most of the women do not have preconception care, and book late or are unbooked for antenatal care.[4,7-10]

Measures to prevent sickle cell disease in the community and hence in pregnancy, like premarital genetic counseling, the use of the adult human stem cell therapy, bone marrow/cord blood transplant, pre-implantation selection should be intensified.[19,25] Human stem cell research is still in the rudimentary stage in most developing countries today, and when available, it may be unaffordable by majority of the populace. Premarital genetic counseling, which is affordable, and can be made widely available in low resource settings, should be encouraged in developing countries like Nigeria.

Prenatal diagnosis and selective termination of pregnancies carrying affected fetuses may not be feasible in our center because of the restrictive abortion laws in Nigeria[26] and its unacceptability in our predominantly Islamic community.

Large multicenter studies will be required to confirm the findings of this hospital-based study.

CONCLUSION AND RECOMMENDATIONS

Pregnant women with sickle cell anemia, who had preconceptual care in addition to prenatal care by a multidisciplinary team, and delivery with follow-up in the puerperium, had fewer pregnancy complications when compared to their counterparts who had only prenatal care by a multidisciplinary team, and delivery with follow-up in the puerperium at Aminu Kano Teaching Hospital.

The current trend in sub-Saharan Africa should be that of preconception care, expert prenatal care with effective interventions by a multidisciplinary team, and delivery with follow-up in the puerperium at an institution accustomed to management of sickle cell disease and its complications in order to reduce fetomaternal morbidity and mortality from this condition. This will contribute towards the achievement of Millennium Development Goals (MDGs) 4 and 5.

Provision of free or subsidized medical/antenatal care and hospital delivery will be needed in order to achieve this goal. Premarital genetic counseling should be encouraged in the community in order to reduce the future population of women with sickle cell disease.

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