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■ Original Research Article

Meconium-stained Amniotic Fluid in Labour: A Correlation with Mode of Delivery and Perinatal Outcome at Maitama District Hospital Abuja, Northcentral Nigeria.

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ABSTRACT

Background: Meconium-stained amniotic fluid (MSAF) is common in term births and especially in post-date pregnancy. MSAF, especially when significant, has been reported to be associated with higher operative intervention rates and poor perinatal outcomes. **Aim and Objectives:** To determine and compare the mode of delivery and perinatal outcomes in low-risk pregnant women at term with and without meconium-stained amniotic fluid in spontaneous labour. **Subjects and Methods:** A comparative cross-sectional study involving 260 women with low-risk pregnancy at term presenting with MSAF and clear amniotic fluid (CAF) in spontaneous labour at Maitama District Hospital, Abuja, from 7th January, 2021 through 31st July, 2021. The participants were divided into two groups:130 in the MSAF group and 130 in the CAF group. The primary outcome measures were the mode of delivery and perinatal outcomes. Data was analysed using the Statistical Product and Services Solution version 24 (SPSS 24, IBM). Statistical analysis was done using chi square test and student t-test with the level of statistical significance set at $P<0.05$ at a confidence interval of 95%. **Results:** Mode of delivery was not significantly influenced by presence of MSAF, although caesarean section rate was higher for deliveries in the MSAF (24.6% vs 15.4%, $P=0.103$). The mean Apgar scores at 1 and at 5 minutes were significantly lower in the MSAF group ($P<0.001$). The need for active resuscitation with oxygen supplementation and SCBU admission was significantly greater for the MSAF group ($P<0.001$). All three perinatal deaths (1.2%) occurred in the MSAF group. **Conclusion:** MSAF, especially when significant, is associated with higher operative intervention rate in form of caesarean section and instrumental vaginal delivery, lower Apgar scores, and a greater need for resuscitation and SCBU admission due to birth asphyxia and meconium aspiration. Increased intrapartum surveillance with early obstetric intervention is recommended for labours complicated by MSAF to reduce adverse perinatal outcomes.

Keywords: meconium-stained amniotic fluid, low-risk pregnancy, mode of delivery, perinatal outcome

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INTRODUCTION

The significance of intrauterine passage of meconium has generated considerable interest in the field of obstetrics[1]. The prevalence of meconium-stained amniotic fluid (MSAF) in labour and delivery is reported to be 8-20%.[2-4] MSAF is common in term births and especially in post-date pregnancy and may indicate a more advanced maturation of the gastrointestinal tract.[2] Traditionally, meconium-stained amniotic fluid has been considered a sign of impending or ongoing fetal compromise and a potential warning of fetal asphyxia.[5]

Several risk factors have been associated with MSAF. These include obstetric factors such as prolonged labour, post-term pregnancy, low birth weight babies, oligohydramnios, intrauterine growth restriction and hypertensive disorders of pregnancy; medical factors like diabetes mellitus, cholestasis of pregnancy and anaemia in pregnancy; as well as socio-demographic and behavioural risk factors such as higher maternal age and maternal drug abuse.[6,7]

The exact aetiology of MSAF is poorly understood. Acidosis, as a consequence of asphyxia has been suggested as a contributor to gastrointestinal motility and meconium passage by modulating the release of motilin and other gastrointestinal hormones.[8] There are theories which propose a potential pathogenetic role of intrauterine infection leading to meconium passage as the rate of intraamniotic infection is shown to be significantly higher in women with MSAF.[9] In addition, MSAF has been shown to be an independent risk factor for an adverse fetal outcome in various populations,[10] especially increased rate of neonatal resuscitation, respiratory distress, low Apgar scores, neonatal unit admissions, meconium aspiration syndrome, neonatal sepsis and pulmonary disease.[11]

There is some evidence that meconium may interfere with surfactant production and in high enough concentrations, have a direct toxic effect on type II pneumocytes, possibly contributing to meconium aspiration syndrome.[12] Meconium-laden liquor is thought to cause placental and umbilical vasoconstriction along with cerebral and fetal hypoperfusion.[13]

Maternal complications associated with MSAF include meconium-stained amniotic fluid embolism, intrapartum chorioamnionitis, puerperal endometritis, wound infection, increased risk of caesarean section and operative vaginal delivery.[14,15]

The National Institute for Health and Care Excellence (NICE) Intrapartum care for healthy women and babies classified MSAF as significant (if the liquor is dark green, or tenacious black amniotic fluid consisting of lumps of meconium), and non-significant (if the liquor is thin-yellow or greenish-tinged containing non-particulate meconium).[16]

Several studies have compared fetal and maternal outcomes of labour associated with MSAF and those with clear amniotic fluid. However, there is paucity of such studies in Nigeria. The aim of this study was to determine and compare the perinatal outcomes in low-risk pregnant women presenting in labour at term with MSAF and those with CAF in relation to the eventual mode of delivery.

SUBJECTS AND METHODS

This was a comparative cross-sectional study that involved women with low-risk pregnancy at term (37-41weeks + 6days gestation) who presented at the Department of Obstetrics and Gynaecology of Maitama District Hospital (MDH) Abuja, with MSAF in labour compared with those with CAF. MDH is a secondary healthcare facility in Abuja, Northcentral Nigeria, owned by the Federal Capital Territory Administration.

Study Design

Pregnant women at term with MSAF and without any fetal heart rate abnormalities (study group), and those with CAF (control group) presenting in the labour ward of MDH from 7th January, 2021 and 31st July, 2021 and who met the inclusion criteria were recruited for the study. All the participants were adequately screened and their low-risk status documented. The primary outcome measures were the mode of delivery and perinatal outcomes. Perinatal outcomes assessed included, Apgar scores at 1 and 5 minutes, need for active resuscitation, admission into special care baby unit (SCBU) and perinatal mortality. Written informed consent was obtained and Institutional ethical clearance was gotten for the study *(Approval Number: FHREC/2020/01/25/17-03-20)*. A diagnosis of MSAF was made following spontaneous or artificial rupture of fetal membranes.

Inclusion Criteria

Primigravidae and multigravidae with no medical conditions, no previous uterine surgeries and with singleton fetus in cephalic presentation, presenting in spontaneous labour at term were included in the study.

Exclusion Criteria

Pregnant women at term with multiple gestation, non-cephalic fetal presentation, fetal congenital anomalies, medical conditions (such as hypertensive disorders of pregnancy, diabetes mellitus in pregnancy, sickle cell anaemia in pregnancy and other haemoglobinopathies), oligohydramnios and small for gestational age babies,

previous uterine surgeries, antepartum haemorrhage, induced labours, those presenting in second stage of labour, unknown last normal menstrual period, and illicit drug use in pregnancy were excluded from the study.

Sample Size Estimation

The sample size was calculated using the formula for the calculation of sample size for two (2) independent proportions as follows:

$$N = \frac{2 (Z_{\alpha} + Z_{1-\beta})^2 \times p(1-p)}{d^2}$$

where,

N= Minimum sample size for each group

$Z\alpha$ = Percentage point of standard normal deviate (2 sided) set at 95% confidence level =1.96

$Z_{1-\beta}$ = Power of the test set at 80% (20% B error) = 0.84

P= Proportion of the factor under study from past study = 0.21 [18]

d^2= Expected difference between the two groups = 0.15

$$N = \frac{2(1.96 + 0.84)^2 \times 0.21(1-0.21)}{0.15^2} = \frac{2.60}{0.0225} = 116$$

A sample size of 116 was calculated for each arm of the study and this was rounded up to 130, given an attrition rate of 10%.

Sampling Technique

A simple random technique was used to recruit eligible consecutive subjects who were then assigned to one of two groups: those with MSAF (case group) and those with CAF (control group). The control group was recruited by assigning to each case of MSAF the next woman who fulfilled the inclusion criteria but had CAF. Written informed consent was obtained on presentation in spontaneous labour before enrolment. On admission into the labour ward, each participant was issued a serial enrolment number and an individual proforma was used to record each participant's information and written informed consent obtained. Blood and urine samples were collected from participants for baseline packed cell volume estimation, grouping and crossmatching, and urinalysis. Labour was monitored till delivery with the use of partograph, while fetal stethoscope and sonicaid were used for fetal heart rate monitoring.

Participants requiring emergency caesarean section and instrumental vaginal delivery (Forceps or Vacuum) were offered the required procedures with a Neonatologist attending the delivery. The indication for each procedure was clearly documented. The Apgar scores for all babies and any need for active resuscitation including oxygen supplementation, ambu bagging, and direct laryngoscopy with or without endotracheal intubation and suctioning, where indicated, were clearly documented. All admissions into the Special Care Baby Unit (SCBU) were followed up to discharge from the hospital.

Data Collection and Analysis

A structured proforma was used to obtain information on the sociodemographic and clinical profiles of all participants. All data were collated and keyed into a computer and analysed using the Statistical Product and Services Solution (SPSS) computer software version 24 (IBM Corporation Chicago, IL). Frequency tables, cross-tabulations and charts were generated for qualitative variables, while quantitative variables were summarized using means and standard deviations. Statistical tests (such as student t-test, chi-square test, Anova test, and Fisher's exact test) were applied to test for differences between means and proportions, and for any association between categorical variables. The level of significance was set at a P-value of less than 0.05 at a confidence interval of 95%. The participants were grouped into two with 130 participants in the MSAF group and 130 in the CAF group.

RESULTS

Two hundred and sixty (260) women (130 in MSAF group and 130 in CAF group) completed the study. Of the 130 participants in the MSAF group, 74 (56.9%) had significant MSAF while 56 (43.1%) had non-significant MSAF. There were three perinatal deaths. All occurred in the MSAF group, (two from birth asphyxia and one from meconium spiration syndrome), giving an overall perinatal mortality rate of 1.2%.

Table 1 the sociodemographic and obstetric characteristics of the study participants. The majority of the participants were in the 30-39 years age group in both arms (Mean age=MSAF 30.8±4.8 vs CAF 30.6±4.5 years, *P=0.262).* Most of the participants were civil servants with tertiary level of education and married. There was no statistically significant difference in the sociodemographic characteristics between the two groups.

The mean parity and gestational age at delivery were comparable in both groups. More participants in the CAF group had SVD (81.5% vs 73.1%). This was not statistically significant *(P=0.164).* More CS were performed in the MSAF group compared to the CAF group but this was not statistically significant (24.6% vs 15.4%, *P=0.103).* Overall, there was no statistically significant difference between the groups in terms of mode of delivery *(P=0.173).* The mean birth weights were similarly comparable in both groups (MSAF 3.4kg vs 3.3kg CAF, *P=0.138).*

Table 1: Socio-Demographic and Obstetric Profile of Study Participants

Variable	MSAF n=130 (%)	CAF n=130 (%)	Test statistic	P value
Mean Age (years)	30.8±4.8	30.6±4.5	2.680	0.262
Mean parity	1.5±0.1¥	1.7±0.1¥	1.430t	0.154
Gestational age (weeks)	39.2±1.2¥	39.5±1.5¥	1.939t	0.054
Previous history of MSAF	7(5.4)	1(0.8)	4.643χ	0.066f
Yes	123(94.6)	129(99.2)		
No				
Mode of delivery			Odds ratio (CI)	0.173
SVD	95(73.1)	106(81.5)		
IVD	3(2.3)	4(3.1)	0.6(0.4-1.2)	0.164
CS	32(24.6)	20(15.4)	0.7(0.2-3.4)	0.701
			1.7(0.9-3.3)	
Birthweight (kg)	3.4±0.4¥	3.3±0.4¥	1.488t	0.138

SVD=spontaneous vaginal delivery, IVD=Instrumental vaginal delivery, CS =caesarean section, ¥- Mean ±SD, t-t-test statistic, χ-chi-square statistic, f-fisher's exact test

Table 2 shows perinatal outcome in relation to the mode of delivery in the MSAF group. Mean gestational age was significantly higher (41 weeks) in those who had IVD compared to SVD and CS *(P=0.007)*. The mean birth weight was significantly higher in the CS group compared with SVD and IVD *(P<0.001)*. All of the three babies delivered by IVD compared to none in the CS and nine in SVD group were admitted in the SCBU *(P<0.001)*. The differences in the mean Apgar scores at 1 minute and 5 minutes for babies delivered by SVD, IVD and C/S were statistically significant with lowest scores recorded in the IVD group *(P=0.020; P=0.030 respectively)*. All the babies delivered by IVD (100%) required oxygen supplementation compared to 25.3% in SVD and 18.8% in CS group. This was statistically significant *(P=0.013)*. 5(5.3%) babies delivered by SVD and none by IVD and CS required Ambu bagging/chest compression. This was however not statistically significant *(P=0.424)*.

Table 3 shows perinatal outcome in relation to the mode of delivery in the CAF group. The mean gestational age and birth weight were comparable among the three modes of delivery. However, the mean Apgar scores at 1 and 5 minutes were significantly lower in babies delivered by IVD and CS *(P=0.001)*. The need for oxygen supplementation was also significantly greater for babies delivered by CS and IVD *(P=0.001)*. None of the babies in the three delivery groups required Ambu bagging/chest compression.

A comparison of perinatal outcomes in the MSAF group with the CAF group showed that the mean gestational age and birth weight were comparable in both groups. Significantly more babies in the MSAF group (9.2%) required SCBU admission compared to 0.8% in the CAF group *(P=0.003)*. The main indications for SCBU admission were birth asphyxia and meconium aspiration syndrome (MAS) with no statistically significant difference in the contribution of each *(P=0.488)*. The mean Apgar scores at 1 minute (6.4±0.1 MSAF vs 7.0±0.1 CAF, *P=0.025*) and at 5 minutes (7.8±1.2 MSAF vs 8.2±0.6 CAF, *P<0.001*) were significantly lower in the MSAF group. There was a significantly greater need for oxygen supplementation in the MSAF group *(P=0.019)*. Although 5(4.0%) babies in the MSAF group compared to none (0%) in the CAF group had Ambu bagging/chest compression for resuscitation, this was not statistically significant *(P=0.060)*.

Further ccomparison of the mode of delivery and perinatal outcomes between participants with significant meconium-stained amniotic fluid (SMSAF) and those with non-significant meconium-stained amniotic fluid (NSMSAF) showed that the mean gestational age was significantly higher in the SMSAF *(P=0.036)*. Similarly, the mean birthweight was significantly higher in the SMSAF *(P=0.007)*. More women in the SMSAF group had operative deliveries (CS and IVD). 29(39.2%) women in the SMSAF group had CS compared to 3(5.4%) in the NSMSAF, while 3(4.1%) women in the SMSAF group compared to none (0%) in the NSMSAF group had IVD. This was statistically significant *(P<0.001)*. 12(16.2%) babies in the SMSAF group required SCBU admission compared to none (0%) in the NSMSAF group *(P=0.001)*. More babies, 36(48.6%) in the SMSAF group had Apgar scores at 1 minute < 7 compared to none (0%) in the NSMSAF group; this was statistically significant *(P<0.001)*. At 5 minutes, 20.3% of the babies in the SMSAF group compared with 0% in the CAF group had Apgar scores < 7 *(P<0.001)*. Similarly, 33(44.6%) babies in the SMSAF group had need for oxygen supplementation compared to none (0%) in the NSMSAF group *(P<0.001)*. Although 5(6.8%) babies in the SMSAF group required Ambu-bagging/chest compression (as part of active resuscitation) compared to none in the NSMSAF group, this was not statistically significant *(P=0.064)*.

Table 2: Correlation of Mode of Delivery with Perinatal O

Variable	SVD n= 95(%)	IVD n=3(%)	C/S n=32(%)
Gestational age	39.0±1.0¥	41.0±0.0¥	39.4±1.2

Table 3: Correlation of mode of delivery with perinatal ou

Variable	SVD n=106(%)	IVD n=4(%)	C/ n=20
Mean Gestational age (weeks)	39.5±1.6¥	39.5±0.6¥	39.7±
Mean Birth weight (kg)	3.3±0.4¥	3.4±0.1¥	3.5±0
SCBU admission:			

DISCUSSION

This study was conducted to determine the perinatal outcome in low-risk pregnancies complicated by meconium-stained amniotic fluid (MSAF) in labour in relation to eventual mode of delivery. The results show that the participants had comparable sociodemographic and obstetric characteristics in both groups. The mean age was 30.8±4.8 years in the MSAF group and 30.6±4.5 years in the CAF group. This is in contrast to the lower mean ages reported by Laima et al[18] in Northeastern Nigeria (26.7±5.55 vs 28.0±5.89 years), Kathun et al[19] in Bangladesh (24.5 vs 23.6 years) and Mohapatra et al[20] in India (23.35±3.42years).

The differences could be attributed to the population of study in these areas. Our study population in Abuja, a cosmopolitan city, is characterised by heavy presence of career women with delayed age of marriage and commencement of childbearing. Laima et al[18] attributed their younger mean ages to the tendency for early marriage and childbearing among women in their hospital. In contrast to the findings in our study where 81.5% of the women in MSAF group and 73.8% in CAF group attained tertiary level of education, only 41% and 38% respectively, did so in the study by Laima et al.[18] The mean parity in this study (MSAF 1.5±0.1 vs CAF 1.7±0.1) was also lower than that reported by Laima et al (2.10±1.98 vs 2.11±1.80). The differences could also be attributed to differences in the sociodemographic characteristics of the study population. These, however, did not significantly affect the perinatal outcomes in both groups.

The mean birth weight of the neonates was comparable in both groups (MSAF 3.4±0.4kg vs CAF 3.3±0.4kg, *P=0.138)*, similar to the findings in other similar studies.[18,19]

In this study, mode of delivery was not significantly influenced by the presence of MSAF. More women in the CAF group had SVD (81.5%) compared with the MSAF group (73.1%) but this was not statistically significant (odds ratio 0.6, *P=0.164).* This is in contrast to the findings by Laima et al[18] and Kumari et al[6] where significantly more women in the CAF group had SVD. Although, more women in the MSAF group required operative delivery by way of CS (24.6%) compared to those in the CAF group (15.4%), this was not statistically significant *(P=0.103).* Parween et al[11] also reported more CS in MSAF group that was not statistically significant. In our facility, there is a low threshold for CS in labours complicated by MSAF which, along with fetal heart rate abnormalities, has traditionally been recognised as one of the cardinal clinical signs of fetal distress in labour, especially fresh MSAF.

Other similar studies, however, reported significantly higher caesarean section rates (ranging from 40 to 66%) and instrumental vaginal deliveries due to foetal distress in labours complicated by MSAF.[6,19,23-26,28-30] The non-incorporation of fetal scalp pH sampling and fetal blood gas analysis in the assessment of fetal distress, and the non-utilization of cardiotocography

(CTG) for fetal heart rate monitoring could have influenced the CS rate in our facility, compared with the other studies where these were employed.

A critical review of the correlation of the modes of delivery with perinatal outcomes in MSAF and CAF groups shows that significantly more babies delivered by operative interventions in both groups, especially by IVD, recorded the lowest 1 minute and 5 minutes Apgar scores, and had greater need for oxygen supplementation and SCBU admission. This is not surprising as all the indications for delivery by IVD were for fetal distress. In this study, fetal distress was observed in five of the fetuses in the MSAF group and three in the CAF group, with all five in the MSAF group requiring active resuscitation compared to none in the CAF group.

This study shows a strong association between MSAF and poor perinatal outcomes. 27.7% of neonates in the MSAF group had 1 minute Apgar scores <7 compared to 16.2% in the CAF group and this was statistically significant *(P=0.025).* At 5 minutes, 11.5% of the babies in the MSAF group and 0.8% in the CAF group had Apgar scores <7 *(P<0.001)*. Overall, the mean Apgar scores at 1 minute and 5 minutes were significantly lower in the MSAF group compared with the CAF group. The need for oxygen supplementation and SCBU admission was also significantly greater in the MSAF group. These findings are similar to those reported in other similar studies.[23-25,30]Although more babies in the MSAF group had Ambu bagging/chest compression, this was not statistically significant *(P=0.060).* Laima et al,[18] however, reported that the need for active resuscitation, including Ambu bagging, oxygen supplementation and endotracheal intubation, was significantly higher in the MSAF group in their study and recommended that MSAF labours should be managed in centres with facilities for advanced neonatal resuscitation and care.

Our study showed that the main indications for SCBU admission were birth asphyxia and meconium aspiration syndrome (MAS) with no statistically significant difference in the contribution of each. Laima et al[18] reported similar findings in their study as did Kathun et al.[19]

When compared with non-significant MSAF, significant MSAF was associated with increased operative interventions in form of CS and IVD, significantly lower Apgar scores at 1 and 5 minutes, higher rate of SCBU admission and greater need for oxygen supplementation. This is similar to the findings in other similar studies.[21-24,28] The study also revealed that participants in the NSMSAF group had comparable perinatal outcomes with those in the CAF group thus suggesting that the degree of meconium staining of the liquor is critical.

There were three perinatal deaths with all of them occurring in the MSAF group (2.3%) and none in the CAF group (0%), giving an overall perinatal mortality rate of 1.2%. Two of the deaths were due to birth asphyxia from fetal distress and one due to MAS. The perinatal mortality recorded in our study is comparable with that reported by Mohapatra et al[20] but lower than that reported by Laima et al[18] and other similar studies.[19,21-25]The risk of perinatal mortality is reported to be increased five to seven-fold in the presence of significant MSAF in labour due to birth asphyxia from MAS.[26-30]

CONCLUSION

MSAF, especially when significant, is associated with higher operative intervention rates in form of CS and IVD, and poor perinatal outcomes due to birth asphyxia and meconium aspiration.

Recommendations

MSAF, especially when significant, is associated with higher operative intervention rates in form of caesarean section and instrumental vaginal delivery, lower Apgar scores, and a greater need for resuscitation and SCBU admission due to birth asphyxia and meconium aspiration. This should be borne in mind when attending to women in spontaneous labour at term with MSAF, and appropriate steps taken to mitigate these untoward outcomes.

Study Limitation

Cardiotocography and fetal scalp pH sampling were not used in the study. In addition, the lack of policy for mandatory suctioning of neonates delivered by women with meconium-sained amniotic fluid in our centre was also a limitation of the study.

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