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ORIGINAL ARTICLE

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Predictors of meconium stained amniotic fluid : a possible strategy to reduce neonatal morbidity and mortality

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OBJECTIVE(S) : To identify risk factors for meconium stained amniotic fluid (MSAF).

METHOD(S) : Maternal and neonatal data was prospectively collected for consecutive singleton deliveries at term with cephalic presentation. Detection of MSAF during delivery was the primary outcome. Using univariate and logistic regression analysis, predictors of MSAF were uncovered.

RESULTS : MSAF was present in 159 (15.76%) of the 1009 deliveries studied. Thin and thick MSAF constituted 39% and 61% cases respectively. Univariate analysis identified eight risk factors ($P<0.05$) – primigravidity, postdated pregnancy, anemia, chorioamnionitis, prolonged labor, fetal distress, cord problems, and fetal growth retardation. Six risk factors were identified when thick MSAF was analyzed separately – maternal age >30, primigravidity, postdated pregnancy, prolonged labor, fetal distress, and cord problems. Logistic regression analysis identified four independent risk factors for MSAF – postdated pregnancy, fetal distress, cord problems, and fetal growth retardation (positive predictive value – 25.3%, negative predictive value - 89.7%), and three for thick MSAF – maternal age >30, postdated pregnancy, and fetal distress (positive predictive value - 19.5%, negative predictive value - 94.5%).

CONCLUSION(S) : Mothers with postdated pregnancies, cord problems in labor, and fetal distress are at increased risk of developing MSAF. Thick MSAF is likely with maternal age >30, postdated pregnancy, and fetal distress. In the absence of these factors the risk of meconium in liquor is low.

Key words: meconium stained amniotic fluid, predictors of meconium stained amniotic fluid.

Introduction

Meconium stained amniotic fluid (MSAF) is a frequent occurrence seen by health care providers in obstetric and neonatal practice. In more recent studies the overall frequency of MSAF has ranged from 5 to 24.6% (median 14%) of all deliveries [1]. Since it is a predictor of adverse perinatal outcome even in low risk pregnancies MSAF can be taken as an independent marker of fetal distress. Babies born with MSAF are hundred fold more likely to develop substantial respiratory distress than those born with clear amniotic fluid. Meconium aspiration syndrome (MAS) occurs in about 10.5% of neonates born with MSAF and carries a mortality rate of around 12 %. Moreover the rates of severe mental retardation and cerebral palsy are significantly higher among infants born with MSAF. Of those neonates who develop MAS, thick MSAF has accounted for majority of 73 to 87.6%of cases of MAS [1, 3, 4].

In the past two decades attention has been focused on the need for strengthening newborn care at primary care level. In a developing country like ours, where over 60% births are domiciliary, the role of anticipation and timely referral assumes great importance [5]. It can not only reduce neonatal morbidity and mortality but also has maternal implications. This study was undertaken with an objective to identify predictors of MSAF, particularly the thick MSAF.

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Methods

This prospective study was carried out between February and August 2001. One thousand five hundred consecutive live births were studied and those meeting the inclusion criteria of singleton pregnancy, cephalic presentation, gestation of 37 weeks or more, and absence of major congenital anomalies in the baby were enroled in the study. The live births meeting the above criteria were divided into MSAF (meconium stained amniotic fluid) and clear amniotic fluid (CAF) groups, depending on whether meconium staining of amniotic fluid was detected at any time during the course of labor or prior to it. MSAF group was further categorized on the basis of meconium consistency into thick (thick greenish meconium with particulate matter in amniotic fluid /pea soup consistency) and thin (light yellow or light green staining of amniotic fluid) MSAF. Maternal data, antenatal factors, intrapartum factors, and finally neonatal outcome were compared in the two groups - CAF (control) vs MSAF and CAF vs thick MSAF. Gestational age was based on one or more of the following – certainty of dates, ultrasound examinations, and assessment of new born using expanded new Ballard score. Anemia was taken as hemoglobin $\leq$10 g/ dL. Antenatal care was defined as three or more visits to a health care facility during pregnancy. Standard definitions were followed for defining hypertension during pregnancy, postdated pregnancy, chorioamnionitis, dystocia, prolonged labor, antepartum hemorrhage, premature rupture of membranes, and fetal growth retardation (birthweight below the 10th centile for the gestation). Cord problems included cord prolapse, cord around neck, and cord presentation. Fetal distress included fetal heart rate abnormalities (bradycardia, tachycardia, significant variable deceleration, loss of beat-to-beat variability, fetal arrhythmias), decreased or absent fetal movements, and nonreactive nonstress test.

SPSS-10 software was used for statistical calculations. Comparison of proportions was done using the chi square test. Mean and standard deviations were calculated using standard methodologies. Stepwise logistic regression analysis was used to determine the relative strengths of associations. Meconium stained amniotic fluid was taken as the dependent variable and other independent variables were assessed. A value of P less than 0.05 was considered significant.

Results

Of the 1500 consecutive deliveries studied, 1009 were included for final analysis based on inclusion criteria and completeness of data. MSAF was present in 159 (15.76%)

Table 1. Comparison of maternal, antenatal and intrapartum factors in study groups.

Variables	CAF[a] n=850	MSAF n=159	Thick MSAF n=97	MSAF vs CAF X^2 /P	Thick MSAF vs CAF X^2 /P
Teenage mother	18 (2.1)	2 (1.3)	2 (2.1)	0.51/0.475	0.001/0.97
Maternal age >30	64 (7.5)	19 (11.9)	14 (14.4)	3.47/0.063	5.49/0.019
Primigravida	385 (45.3)	90 (56.6)	56 (57.7)	6.88/0.009	4.42/0.020
Postdated pregnancy	150 (17.6)	47 (29.6)	34 (35.1)	12.09/0.001	16.85<0.001
Hypertension	77 (9.1)	17 (10.7)	10 (10.3)	0.52/0.423	0.16/0.686
Anemia	377 (44.4)	86 (54.1)	49 (50.5)	5.11/0.024	1.34/0.248
Antepartum hemorrhage	14 (1.6)	2 (1.3)	1 (1)	0.13/0.718	0.21/0.645
Urinary tract infection	13 (1.5)	2 (1.3)	2 (2.1)	0.07/0.795	016/0.691
Chorioamnionitis	0 (0)	2 (1.3)	2 (2.1)	10.71/0.001	0.92/0.375
Antenatal care	588 (69.2)	114 (71.7)	67 (69.1)	0.40/0.526	0.001/0.98
Dystocia	61 (7.2)	15 (9.4)	8 (8.2)	0.98/0.322	0.15/0.701
Prolonged labor	6 (0.7)	4 (2.5)	4 (4.1)	4.47/0.034	9.73/0.002
Oxytocin use	177 (20.8)	27 (17.0)	14 (14.4)	1.23/0.268	2.21/0.137
Fetal distress	72 (8.5)	43 (27.0)	32 (33.0)	45.76/0.001	53.54<0.001
Premature rupture of membranes	96 (11.3)	20 (12.67)	11 (11.3)	0.11/0.750	0.02/0.9
Cord problems	20 (2.4)	16 (10.1)	9 (9.3)	21.86/0.001	13.15<0.001
Normal vaginal delivery	708 (83.3)	62 (39.0)	26 (26.8)	145.42/0.001	159.37<0.001
Emergency cesarean section	88 (10.4)	78 (49.1)	58 (69.8)	145.97/0.001	159.43<0.001
Forceps delivery	37 (4.4)	16 (10.1)	11 (11.3)	8.77/0.003	8.83/0.003
Fetal growth retardation	68 (8.0)	21 (13.2)	13 (13.4)	4.52/0.034	2.59/0.10

Figure in brackets represent percentages. CAF - amniotic fluid MSAF - Meconium stained amniotic fluid

of these deliveries. Thin MSAF and thick MSAF constituted 39% (62/159) and 61% (97/159) of deliveries with MSAF respectively. The mean maternal age was 24.9 ± 3.8 years and the mean gestation 39.06 ± 1.23 weeks.On univariate analysis there were no differences in proportion of hypertensive disease, antepartum hemorrhage, genitourinary infections, antenatal care, prolonged labor, oxytocin augmentation of labor, and premature rupture of membranes between groups (Table 1). Univariate analysis identified eight risk factors (P<0.05) for MSAF – primigravidity, postdated pregnancy, anemia, chorioamnionitis, prolonged labor, fetal distress, cord problems, and fetal growth retardation. Six risk factors were identified when only thick MSAF was analyzed – maternal age >30, primigravidity, postdated pregnancy, prolonged labor, fetal distress, and cord problems.

Table 2. Results of logistic regression analysis: MSAF and thick MSAF as dependent variables.

	Adjusted odds ratio	95% CI	P value
Predictors of MSAF			
Postdated pregnancy	1.909	1.281 - 2.847	0.001
Fetal distress	3.791	2.444 - 5.882	<0.001
Cord problems	3.757	1.841 - 7.669	<0.001
Fetal growth retardation	2.039	1.184 - 3.511	0.01
Predictors of thick MSAF			
Maternal age >30 years	2.462	1.282 - 4.729	0.007
Postdated pregnancy	2.517	1.567 - 4.044	<0.001
Fetal distress	5.260	3.195 - 8.659	<0.001

MSAF - Meconium stained amniotic fluid.

With MSAF as a dependent variable, binary logistic regression analysis identified the best predictor model with four independent risk factors (Table 2) postdated pregnancy, fetal distress, cord problems, and fetal growth retardation. In our cohort the presence of one or more of these factors had a 25.3% positive predictive value and 89.7% negative predictive value. When similar analysis was done for the subgroup with thick MSAF three risk factors were identified maternal age >30, postdated pregnancy and, fetal distress (Table 2) with a negative and positive predictive value of 19.5% and 94.5% respectively.

Discussion

The incidence of MSAF greatly varies in different reports and our observation of 15.76% falls within the reported range of 5 to 24.6% [1]. Majority of observed MSAF was of thick type (56.8%), possibly because thin MSAF being more subjective is more prone for variations in incidence [6]. To eliminate selection bias we included consecutive patients. The division of cases into thin and thick MSAF groups allowed for evaluating factors specifically associated with thick MSAF.

While univariate analysis identified eight risk factors for MSAF, only four had independent predictive value on logistic analysis. This type of analysis allowed for mathematical determination of predictors, independent of confounding variables. Postdated pregnancy, fetal distress, cord problems, and fetal growth retardation were the factors identified. Fetal distress conferred the highest risk of nearly four fold. These factors when present singly or in combination had an expectedly low 25.3% positive predictive value but a high 89.7% negative predictive value.

In agreement with previous reports [7] we observed a higher proportion of MSAF in postdated pregnancies. The hormone motilin is secreted in ever increasing quantities by the fetus as gestation advances and most meconium discharges are said to occur in postdate gestations, because the motilin levels are highest then[8]. Further our observations support the view that meconium staining is more common in growth retarded babies subjected to chronic intrauterine hypoxia [2,9]. The increased occurrence of cord problems in MSAF has been reported by other workers [10,11] and can explain the hypoxic state of some babies. But one has to bear in mind that it will depend on site of placenta, cord length, depth of pelvis, and tightness of cord thus accounting for the inconsistency of this association.

The association between the occurrence of MSAF and fetal distress has been reported by several workers [2,12]. In a study by Yoder [6] infants with moderate to thick meconium stained amniotic fluid (AF) had significantly greater frequency of variables suggestive of intrapartum compromise (abnormal fetal heart pattern, fetal acidosis) compared to infants without meconium staining of AF and infants with light meconium staining of AF (P<0.01). In a study by Berkus et al [13] the moderate and thick meconium groups had significantly higher risk of an abnormal fetal heart rate tracing in each stage of labor and cord arterial pH less than 7.20 (indicators of fetal compromise) compared to the thin meconium and CAF groups combined. In our institution facilities for cord pH determination were not available, but the other parameters of fetal distress were found to have significant association with the occurrence of MSAF, especially the thick MSAF.

Thick MSAF has been consistently identified with univariate analysis as a marker of increased risk. Although it is only one of the possible signs of fetal compromise, its prompt recognition or prediction is of value in selecting the mother who requires intensive monitoring. Three risk factors were identified for thick MSAF – maternal age >30, postdated pregnancy, and fetal distress (Table 2) with a negative and positive predictive value of 19.5% and 94.5% respectively. The high negative predictive value implies the very low chances of developing thick MSAF in the absence of these factors.

In the present study, rates of cesarean section in patients with MSAF are higher than those reported by other authors [2,11,14]. The lower rates of cesarean and forceps deliveries in these studies could be due to better facilities to assess fetal well being. The significantly high rate of emergency cesarean section and consequently the low chances of having vaginal delivery with MSAF bring forth not only the maternal implications of MSAF but also the obstetric perceptions about its occurrence, a fact brought out by Nathan et al [14]. The ominous perception was heightened by absence of devices or parameters which can reassure the attending obstetrician of fetal well being. The fact remains that, apart from neonatal hazards due to MSAF, there is also significant maternal morbidity. Results of this study are to be interpreted keeping in mind the small number of cases and possible over representation of high risk cases in our study population. Hence larger studies are required before specific recommendations can be made.

There has been inclusion of essential newborn care in the national childhood survival and safe motherhood program, reproductive and child health program, and integrated management of childhood illness program. This attention has resulted in creation of infrastructure at the grass root level. Despite these developments the neonatal mortality stays at a much higher level than the goal of 20 per 1000 live births by the year 2007 [5]. Preventable causes are major contributors to neonatal mortality. Predictors of MSAF provide a possible way of early identification of high risk cases and a possible way to reduce morbidity and mortality. Most peripheral centers in our country are devoid of facilities for managing high risk deliveries or giving essential newborn care. If incorporated into basic training for health workers these predictors can facilitate early referral and proper management. Secondly, remediable or preventable causes provide opportunities for intervention and planning.

Conclusion

Postdated pregnancy, fetal distress, cord problems and fetal growth retardation are predictors of MSAF while maternal age > 30 years postdated pregnancy and fetal distress predict thick MSAF.

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