Risk Factors of Meconium-Stained Amniotic Fluid in Term Pregnancy - A Case Control Study

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ABSTRACT

BACKGROUND

Meconium stained amniotic fluid is a significant contributor to perinatal and neonatal morbidity and mortality. The study was conducted to determine the risk factors of meconium stained amniotic fluid in term pregnancy.

METHODS

This study is a prospective case control study done in a tertiary care hospital in South India over a period of one year. 100 women with meconium stained amniotic fluid detected at any time during the course of labour, prior to it or meconium detected in hind waters were enrolled in the study group. The inclusion criteria were term pregnancy, cephalic presentation and singleton pregnancy. 200 women who satisfied the same set of inclusion criteria with clear amniotic fluid, selected on random basis were taken as controls. A standardised pretested proforma was used for data collection.

RESULTS

In the study, incidence of grade 1, grade 2 and grade 3 meconium were 31 %, 42 % and 27 % respectively. 83 % of cases were in the 20 – 24 year age group and advanced maternal age was not a risk factor in the study. Primiparity (86 % cases vs. 47 % controls) and advanced gestational age (56 % cases and 33 % controls) were significant risk factors. Maternal obesity, socioeconomic status and treatment for infertility were not significant risk factors. Among medical disorders, gestational diabetes mellitus (21 % cases vs. 5 % controls), gestational hypertension (12 % vs. 3.5 %) and hypothyroidism (13 % cases vs. 4.5 % controls) showed statistical significance. Oligoamnios (9 % vs. 1 %), fetal growth restriction (13 % vs. 4.5 %) and maternal infection (12 % vs. 2 %) were significant risk factors. Induced labour and prolonged labour were the significant intrapartum risk factors. Caesarean section rates were nearly doubled in cases (40 %) compared to controls (21.5 %). Babies born to mothers with meconium stained amniotic fluid had low Apgar scores at birth (25 %) and increased neonatal intensive care unit (NICU) admission.

CONCLUSIONS

Meconium stained amniotic fluid is associated with increased rates of maternal morbidity due to higher rates of operative deliveries and increased incidence of perinatal asphyxia, perinatal morbidity and mortality. Meticulous antenatal care and early identification of risk factors help in reducing the incidence of meconium stained amniotic fluid and preventing adverse maternal and neonatal outcome.

KEYWORDS

Risk Factors, Meconium, Amniotic Fluid, Term Pregnancy, Caesarean Section, Perinatal Outcome

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BACKGROUND

The word meconium is derived from the Greek word "meconium arion,"[1] meaning "opium-like." Meconium is the first secretion from fetus and meconium passage in newborn is a normal developmental event and 98 % of newborns pass meconium in the first 48 hours after birth. It is composed of materials ingested by the fetus from amniotic cavity such as epithelial cells, lanugo, blood and amniotic fluid and it is pigmented with bile.

Meconium stained amniotic fluid occurs when the fetus passes meconium before birth and such infants are at high risk for aspiration of meconium in utero or after birth. Meconium aspiration syndrome (MAS) is diagnosed if an infant born through meconium stained amniotic fluid develops respiratory distress after delivery which cannot be attributed to another cause.[2]

Many maternal factors contribute to meconium passage before birth which includes maternal age, prolonged gestation, hypertensive disorders, anaemia, fetal growth restriction and prolonged labour.[2]

It has been associated with poor perinatal outcome including low APGAR scores, increased incidence of neonatal intensive care admission and high rate of perinatal death.

Globally, meconium stained amniotic fluid is present in about 7 - 22 % of all live births. Meconium aspiration syndrome (MAS) occurs in 4 - 6 % of all cases of meconium stained amniotic fluid and is dependent on the presence of both meconium and fetal hypoxia and thought to be caused by gasping actions of the fetus causing aspiration of meconium into the lungs.[3]

MAS remain one of the commonest causes of perinatal asphyxia and death with mortality ranging from 5 - 12 %.

Meconium passage is rare before 34 weeks of gestation and incidence increases beyond 37 weeks of gestation. Globally there has been a considerable decline in under-five and infant mortality in past decades. However neonatal mortality remained unchanged especially in developing countries.

The Sustainable development goal 3 (SDG) is to end preventable deaths of new-borns, aiming to reduce neonatal mortality as low as 12 per 1000 live births. Babies born through meconium stained amniotic fluid are 6 times prone for perinatal asphyxia. The key for reducing perinatal morbidity in term new-borns is timely identification of risk factors.

Objectives

We wanted to determine the risk factors, intrapartum complications and perinatal outcome associated with meconium stained amniotic fluid. Primary objective of the study is to determine the risk factors of meconium stained amniotic fluid in term deliveries at a tertiary care centre in south Kerala. Secondary objectives of the study are to determine the intrapartum complications and outcome of labour in meconium stained amniotic fluid (MSAF) and the perinatal outcome in meconium stained amniotic fluid.

METHODS

This study is a prospective case control study done in a tertiary care hospital in South India over a period of one year (Oct 2019 to Sept 2020). 100 women with meconium stained amniotic fluid detected at any time during the course of labour, prior to onset of labour or meconium detected in hind waters after delivery were enrolled in the study group. The inclusion criteria were term pregnancy, cephalic presentation, singleton pregnancy and women giving consent for the study. Meconium stained amniotic fluid is classified into three grades by obstetric convention. Grade 1 - large volume of amniotic fluid lightly stained with meconium. Grade 2 - good volume of amniotic fluid heavily stained with meconium. Grade 3 - absent or reduced volume of amniotic fluid with very thick meconium. Exclusion criteria include women not consenting to the study and pregnancy with anomalous babies. Controls were women with clear amniotic fluid with singleton pregnancy, cephalic presentation and term gestation. For each case two controls who deliver on the same day were selected on random basis. Study was conducted after ethical committee clearance.

Data was collected in a standardised pretested proforma. Maternal age, parity, gestational age, antepartum complications like hypertension in pregnancy, gestational diabetes mellitus, anaemia, hypothyroidism, fetal growth restriction, oligohydramnios, and antepartum haemorrhage were noted. Labour details which include onset of labour whether spontaneous, induced with prostaglandins or augmented with oxytocin were noted. Intrapartum complications noted were non reassuring fetal heart rate patterns, prolonged labour, nuchal cord and prolonged rupture of membranes. Fetal outcome studied include live born or still born, weight of the baby, APGAR score at 5 minutes, respiratory distress for the baby, incidence of meconium aspiration syndrome and resuscitation needs for the baby, admission to NICU and need for ventilation. Babies were followed up till discharge.

Cases and controls were compared with variables like maternal age, duration of pregnancy, antenatal complications like hypertension (diagnosed as systolic BP more than or equal to 140 mm of Hg and diastolic BP more than or equal to 90 mm of Hg on two occasions 6 hours apart), fetal growth restriction (estimated fetal weight or abdominal circumference less than 10^{th} centile), oligohydramnios (amniotic fluid index less than 5 cm), anaemia (haemoglobin less than 11 g / dl, mild: 10 - 10.9, moderate: 7 - 7.9, and severe: less than 7 gm / dl), intrapartum complications like prolonged labour (labour lasting for more than 20 hrs. in a primipara and 14 hrs. in a multipara after getting into active phase, 4 cm cervical dilatation and adequate–contractions) and prolonged rupture of membranes (ruptured membranes for more than 18 hours). Perinatal outcome studied are low Apgar scores (5 minute Apgar less than 7), birth asphyxia (5 minute Apgar score less than or equal to 3), meconium aspiration syndrome (presence of meconium below vocal cords, clinical respiratory distress in the first 24 hours of life, abnormal chest x-ray consistent with aspiration pneumonitis, need for

supplemental oxygen and ventilator support)[4] and perinatal mortality.

Statistical Analysis

Statistical analysis was done using frequencies and percentages. Chi-square test was done for comparison. SPSS software version 16 was used. A 95 % limit and 5 % level of significance was adopted. A P-value of less than 0.05 was considered significant.

RESULTS

Grade 1, grade 2 and grade 3 meconium constituted 31 %, 42 % and 27 % respectively. 83 % among the cases were in the 20 – 24 year age group which corresponds to the age group with maximum reproductive potential. 86 % in the meconium group were primigravidas compared to 47 % in controls (P - < 0.001) showing primiparity as a significant risk factor for meconium stained amniotic fluid (Table 1). No gravida in the meconium group was treated for infertility compared to 1.5 % controls (P - 0.218). 46 % in cases were in lower middle class of socioeconomic status compared to 60 % in controls (P - 0.059). 2 % women among cases and 9 % in controls were obese (P - 0.067). 56 % women with meconium stained amniotic fluid had gestational age more than 39 weeks compared to 33.5 % in controls which was statistically significant (P - < 0.001). 56 % cases and 33 % controls had gestational age more than 39 weeks (P < 0.001). Gestational diabetes mellitus (GDM) was the commonest medical disorder, 21 % in cases vs 5 % in controls. 12 % women among cases and 3.5 % controls had gestational hypertension. Hypothyroidism was present in 13 % cases and 4.5 % controls. Anaemia was present in 36 % in cases and 28.5 % in controls (Table 2).

Oligoamnios was present in 9 % cases and 1 % controls. 13 % cases had fetal growth restriction compared to 4.5 % controls and both oligoamnios and fetal growth restriction were statistically significant risk factors. Abruptio placenta was found in 2 % cases. Another significant risk factor was maternal infection which was present in 12 % cases and 2 % controls. Urinary tract infection was the commonest maternal infection followed by maternal vaginitis and lower respiratory tract infection. Prolonged rupture of membranes (> 18 hours) was seen in 4 % cases and 2 % controls and showed no significant difference. Prolonged labour leading to fetal distress occurred in 20 % cases and 5 % controls showing significant statistical difference. Cases and controls showed no difference in the presence of nuchal cord in the study (Table 3). 36 % cases and 19 % controls had their labour induced (P - 0.001) and extra amniotic saline instillation and prostaglandin E1 were the most common agents. Abnormal fetal heart patterns were common in the meconium group, 33 % cases and 6.5 % controls, (P - 0.024). Commonest fetal heart rate abnormality was persistent late deceleration (20 % in cases) and the results showed statistical significance.

49 % cases and 67.5 % controls delivered vaginally. Caesarean section rates were doubled in cases (40 %) than controls (21.5 %). Commonest indication for Caesarean section among cases was non-reassuring fetal heart rate pattern. Instrumental delivery was done for 10 % cases and 3.5 % controls (Table 4). Mode of delivery between cases and controls showed high statistical significance (P - < 0.001).

Low Apgar score at 5 minutes was present in 25 % babies among cases compared to 4.5 % in controls which was statistically significant (P - 0.001) (Table 5). 6 cases had severe birth asphyxia which required mechanical ventilation, all of them belonging to grade 3 meconium group. Babies in the meconium group had more NICU admissions (35 %) than the control group (5 %), P - < 0.001.

	Parameters	Case (%)	Control (%)	P-Value
Age in Years	< 20	4 (4 %)	10 (5 %)	< 0.001
	20 - 24	83 (83 %)	70 (35 %)	
	25 - 29	9 (9 %)	90 (45 %)	
	30 - 34	4 (4 %)	23 (11.5 %)	
	> 35	0	7 (3.5 %)	
Parity	Primigravida	86 (86 %)	94 (47 %)	< 0.001
	P1	12 (12 %)	91 (45.5 %)	
	P2	2 (2 %)	12 (6 %)	
	P3	0	3 (1.5 %)	
BMI	18.5 - 24.9	10 (10 %)	16 (8 %)	0.067
	25 - 29.9	88 (88 %)	166 (83 %)	
	> 30	2 (2 %)	18 (9 %)	
Gestational age in weeks	37 wks. - 38 wks. 6 days	44 (44 %)	133 (66.5 %)	< 0.001.
	39 wks. - 40 wks. 6 days	56 (56 %)	67 (33.5 %)	

Table 1. Demographic Characteristics

Medical Disorders	Case (%)	Control (%)	P-Value
Hypertensive disorders	12 (12 %)	7 (3.5 %)	0.004
Gestational diabetes mellitus	21 (21 %)	10 (5 %)	0.001
Anaemia	36 (36 %)	57 (28.5)	0.185
Bronchial asthma	2 (2 %)	2 (1 %))	0.477
Seizure disorders	2 (2 %)	2 (1 %)	0.477
Hypothyroidism	13 (13 %)	9 (4.5 %)	0.008

Table 2. Medical Disorders

Risk Factors	Cases (%)	Controls (%)	P-Value
Oligoamnios	9 (9 %)	2 (1 %)	0.01
Fetal growth restriction	13 (13 %)	9 (4.5 %)	0.008
Maternal infection	12 (12 %)	4 (2 %)	< 0.001
Abruptio placenta	2 (2 %)	2 (1 %)	0.477
Prolonged rupture of membranes	4 (4 %)	4 (2 %)	0.311
Prolonged labour	20 (20 %)	10 (5 %)	0.001
Nuchal cord	2 (2 %)	1 (0.5 %)	0.616

Table 3. Antepartum and Intrapartum Factors

Mode of Delivery	Case		Control		P-Value
	N	%	N	%	
Normal	49	49	135	67.5	< 0.001
Instrumental	10	10	7	3.5	
Emergency LSCS	40	40	43	21.5	
Elective LSCS	1	1	15	7.5	
Total	**100**	**100**	**200**	**100**	

Table 4. Mode of Delivery

5` APGAR	Case		Control		P-Value
	N	%	N	%	
< 3	6	6	1	0.5	< 0.001
3 - 7	19	19	8	4	
> 7	75	75	191	95.5	
Total	**100**	**100**	**200**	**100**	

Table 5. Apgar Score at 5 Minutes

DISCUSSION

The purpose of present study was to determine the significant risk factors for meconium staining of amniotic fluid. Incidence of grade 1, grade 2 and grade 3 meconium

were 31 %, 42 % and 27 % respectively, similar findings were noted by Addisu[5] et al. in his study. 83 % cases were in 20 – 24 year age group, similar to studies by Sandu ss[6] et al. and Manohar[7] et al. this may be due to the fact that this age group corresponds to the age group with maximum reproductive potential. In a study by Addisu et al. advanced maternal age was a significant risk factor, but in our study no elderly gravida was present in the case group and this may be due to the practice of early marriage and conception in Kerala. In our study primiparity was a significant risk factor for meconium stained amniotic fluid and constituted 83 % cases, similar to studies by Priti Singh[8] et al. and Manohar[7] et al. whereas in a study by Vidya[9] et al. and Samiappa DP[10] et al. parity was not a significant risk factor. In our study obesity, socio economic class and treatment for infertility were not statistically different between cases and controls. 56 % cases had gestational age more than 39 weeks compared to 33 % controls. This shows advanced gestational age as a significant risk factor similar to studies by Mundhra[11] et al. Manohar et al and Becker[12] et al.

Among medical disorders gestational diabetes mellitus, gestational hypertension and hypothyroidism were significant risk factors for meconium. Commonest medical disorder was gestational diabetes mellitus with 21 % incidence among cases. Gestational diabetes mellitus was associated with increased incidence of meconium aspiration syndrome in a study by Jain[3] et al. 12 % cases had gestational hypertension, similar findings noted by Bhide[13] et al. Mundhra et al. and Priti Singh et al. and the incidence of hypertensive disorders in women with meconium stained amniotic fluid in their studies were 13 %, 16.97 % and 18.4 % respectively. Hypothyroidism was a significant risk factor for meconium in a study by Nirmala[14] et al. and same findings were noted in this study. This may be due to the placental insufficiency which is common with these medical disorders leading to intrauterine fetal hypoxia. There was no difference in the prevalence of anaemia between cases and controls, this was similar to a study by Mundhra et al. Maternal infection was a significant risk factor and similar findings were noted by Nirmala[14] et al. Ascending maternal infection may lead to infection of placenta and amniotic membranes leading to fetal asphyxia.

In the study oligoamnios showed statistical significance, same finding noted by Manohar et al. in his study. Oligoamnios may lead to cord compression and subsequent fetal hypoxia leading to meconium passage. Fetal growth restriction was present in 13 % cases and was statistically significant. Studies by Debdas[15] et al. and Sundaram[16] et al. showed similar results and the incidence of fetal growth restriction was 12 % in both studies.

Labour induction (36 % cases and 19 % controls) was another significant risk factor, similar findings noted by Addisu et al. but another study by Sundaram et al. showed no difference between spontaneous and induced groups. Increased meconium passage in induced group may be due to the intrauterine hypoxia induced by the tetanic uterine contractions caused by prostaglandins which was the commonest method of induction in our study. The disparity in findings among different studies may be due to variations in the method of induction practised at different institutions. Prolonged labour also contributed to meconium staining of amniotic fluid and this may be due to increased peristalsis and relaxation of fetal anal sphincter due to stressful environment. 33 % cases had abnormal fetal heart rate patterns, commonest being persistent late deceleration. Almost similar incidence of 36 % was noted by Sundaram et al. and a study by Samiappa DP et al. showed the incidence of fetal heart rate abnormalities to be 50 %.

Caesarean section rates were nearly doubled in cases (40 %) compared to controls (21.5 %). Similar findings were noted in studies by Saunders[17] et al. Naveen S[18] et al. Priti Singh et al. Mundhra et al. and Sundaram et al. This may be due to aggressive management of labours complicated by meconium especially in areas where there are no facilities for fetal scalp sampling.

25 % babies among cases were depressed at birth compared to 4.5 % controls. Neonatal depression with meconium stained amniotic fluid was also noted in studies by Patil[19] et al. (19 %), Vidya et al. (27 %) and Sundaram et al. (18 %). This may be attributed to umbilical vasoconstriction caused by meconium leading to placental insufficiency. Severe birth asphyxia was found in 6 babies with grade 3 meconium who required mechanical ventilation. Incidence of meconium aspiration syndrome (MAS) in the study was 6 % and all of them belonged to grade 3 meconium. Incidence of MAS was 5 % in a study by Vidya et al. and 3.95 % in a study by Priti Singh et al. Neonatal intensive care unit admission was more in babies with meconium stained amniotic fluid, similar findings were there in a study by Goud[20] et al. No perinatal mortality was found in the case or control group.

CONCLUSIONS

In our study primiparity, advanced gestational age, gestational hypertension, gestational diabetes mellitus, hypothyroidism, maternal infection, oligoamnios, fetal growth restriction, prolonged labour and induced labour were found to be the significant risk factors for passage of meconium. Babies with meconium stained amniotic fluid also had low Apgar scores at birth and required increased NICU admission. Meconium aspiration syndrome is an important cause of respiratory distress and birth asphyxia in the new-born and incidence of meconium aspiration syndrome was more in grade 3 meconium group. Even though there is a reduction in under five mortality rate, neonatal mortality rate in India is still high. The neonatal morbidity associated with meconium stained amniotic fluid and meconium aspiration syndrome can be reduced by identifying the maternal risk factors and appropriate management of the same. Regular blood pressure monitoring and screening for gestational diabetes mellitus and hypothyroidism, early diagnosis of fetal growth restriction and oligoamnios, treatment of maternal infections like urinary tract infection, vaginitis and lower respiratory tract infections, detection of prolonged labour with the use of partogram etc. are some of the preventive measures we can adopt to reduce the incidence of meconium stained amniotic fluid.

Limitations

Since the study was conducted in a single centre, the results may not be representative of community or other institutions. In meconium deliveries, there is a high rate of operative delivery leading to maternal morbidity and mortality. Our suggestions for future research are to determine as to whether implementation of fetal scalp sampling methods will reduce the rates of maternal morbidity without compromising the fetal outcome.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
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