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Infants born with meconium-stained amniotic fluid: Clinical profile

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Abstract
MSAF is observed in 4-22% of all newborn, increasing to 23-52% in post-term newborns. Only 3-12% of newborns delivered with MSAF acquire meconium aspiration syndrome. During birth 20% found to be non-vigorous, 30-35% require intubation and respiratory support, and 5-12% die. Clinical: Demographic data include maternal age, parity, pregnancy-related illnesses like gestational hypertension and gestational diabetes mellitus. Sonographic data was looked into for fetal growth restriction, amniotic fluid volume, fetal Doppler indices, and biophysical profile. Gestational week, type of labor, whether artificial rupture of membrane showed meconium, the grade of meconium, duration of the second stage, and mode of delivery was recorded. Newborn resuscitation (if any), assessment of gestational age, and anthropometry was captured. All newborns were of Term gestation with median gestational age among cases is 39 weeks with IQR of 1 weeks, among controls is 39 weeks with IQR of 2 weeks. The median birth weight among cases is 3010 gm with (IQR 390 gm) and among controls is 2950 (IQR 635 gm). The median length among cases is 49 cm with IQR of 2 cm and among controls is 48 cm with IQR of 1 cm. The median Head circumference among cases is 34 cm with IQR of 1 cm and among controls is 33 cm with IQR of 0.8cm. 5(12.5%) among cases and 1(5%) among controls were SGA. 31(77.5%) among cases and 19(95%) among controls were AGA.4(10%) among cases were LGA.

Keywords: Infants, meconium-stained amniotic fluid, clinical profile

Introduction
Meconium is the blackish green, sterile, odorless substance present in fetal small intestine. It consists of water, desquamated epithelial cells, pancreatic and intestinal enzymes, bile, hair particles, glycoproteins. Meconium usually is seen in fetal intestine between two to three months of intrauterine life. It moves to large intestine by 16 weeks. Fetal intestinal contents, rich in enzymes appear in Amniotic fluid by 14-22 weeks. After 22 weeks, development of anal sphincter tone is noted, which coincides with the decline in gastrointestinal enzymes within the amniotic fluid. By the process of swallowing, meconium is cleared regularly. A possibility of MSAF is seen if there is reduced clearance or increased production of meconium as seen in case of feto-maternal stress factors like hypoxia and infection [1, 2].

Though meconium begins to develop in the gut at 12 weeks of gestation, the first emission is usually by 24 hours. Early discharge of meconium into amniotic fluid, results in "stained fluid". Hypoxia and acidosis leading to stress in fetus causes meconium staining of amniotic fluid. Fetal stress causes a parasympathetic stimulation of Vagus. Enhanced peristaltic movements and loosening of anal sphincter, culminates to intrauterine passage of meconium. Placental compromise, hypertension and pre-eclampsia in mother, low liquor, compression of cord during labor, drug addictions in mother are risk factors for MSAF. Gasps during intrauterine period or first breath after delivery leads to aspiration of meconium stained liquor [3].

Meconium is classified into thin and thick based on its consistency. Thin is green tinged and liquid in consistency. Thick is granular and brown or black color. Five times increased risk of mortality is seen if thick meconium is present during labor. Thin meconium is usually passed during maturation. If there is passage of meconium seen after passage of liquor during labor, the risk of perinatal morbidities is midway between passage of thick and thin [4].

Meconium usually not seen in amniotic fluid before 34 weeks of intrauterine life. Risk of MAS increases in term and post term neonates significantly [5].

MSAF is observed in 4-22% of all newborn, increasing to 23-52% in post-term newborns. Only 3-12% of newborns delivered with MSAF acquire meconium aspiration syndrome.

During birth 20% found to be non-vigorous, 30-35% require intubation and respiratory support, and 5-12% die. Despite suitable management measures, about 10% have air leaks. 10% of infant respiratory failure is due to meconium aspiration syndrome. Pulmonary artery hypertension seen in 15-20% of newborns with the MAS [6].

Methodology

Type of study	:	Observational
Study design	:	Cross-sectional, analytical
Study unit	:	Neonatal Intensive Care Unit, Department of Pediatrics,

Sampling Method: Convenience Sampling

Inclusion criteria
Singleton, term newborns born through MSAF

Exclusion criteria
1. Preterm (gestational age <37 completed weeks)
2. Multiple gestation
3. Neonatal respiratory distress due to hemodynamically significant structural heart disease, structural malformations like diaphragmatic hernia
4. Major congenital malformations influencing the neonatal outcome

Control group
Inclusion criteria
Term, Singleton
Appropriate for gestational age born with clear amniotic fluid
Matched for maternal age and parity

Exclusion criteria
1. Meconium-stained amniotic fluid
2. Maternal chorioamnionitis
3. Fetal distress
4. Premature rupture of membranes
5. Preterm (gestational age <37 completed weeks)
6. Multiple gestation
7. Small and large for gestational age
8. Neonatal respiratory distress due to hemodynamically significant structural heart disease, structural malformations like diaphragmatic hernia
9. Major congenital malformations influencing the neonatal outcome

Sample size
All newborns born through MSAF were included. We expect to enroll a minimum of 60 newborns, of whom 8-10 (20-25%) may develop MAS.
Twenty normal newborns were recruited as control group for cord blood estimation of Interleukin-6

Data collection
Clinical: Demographic data include maternal age, parity, pregnancy-related illnesses like gestational hypertension and gestational diabetes mellitus. Sonographic data was looked into for fetal growth restriction, amniotic fluid volume, fetal Doppler indices, and biophysical profile. Gestational week, type of labor, whether artificial rupture of membrane showed meconium, the grade of meconium, duration of the second stage, and mode of delivery was recorded. Newborn resuscitation (if any), assessment of gestational age, and anthropometry was captured. The newborn was observed for 24 hours for the development of respiratory distress and progression using the Downe respiratory score. The neonatal course of infants who develop MAS was recorded for the outcome.
Lab: Three milliliter of cord blood was collected in a plain vacutainer in all newborns with MSAF. Measurement of IL-6 was done by Electro-chemiluminescence Immunoassay. The value is expressed in picogram/ml. Other inflammatory markers like Leukocyte count, neutrophil to lymphocyte ratio, CRP, and procalcitonin was documented if done as part of standard care. Cord arterial blood gas was noted. When done as part of routine care, we noted the findings in the chest radiographs and echocardiogram.

Results

In our study, a total we have enrolled 40 newborns, born through MSAF were included (Study group). We also included recruited 20 newborns for comparison of cord blood IL-6 levels (Control group).
Of the 40 newborns born through MSAF, 22(55%) developed respiratory distress (MAS group) suggestive of MAS.

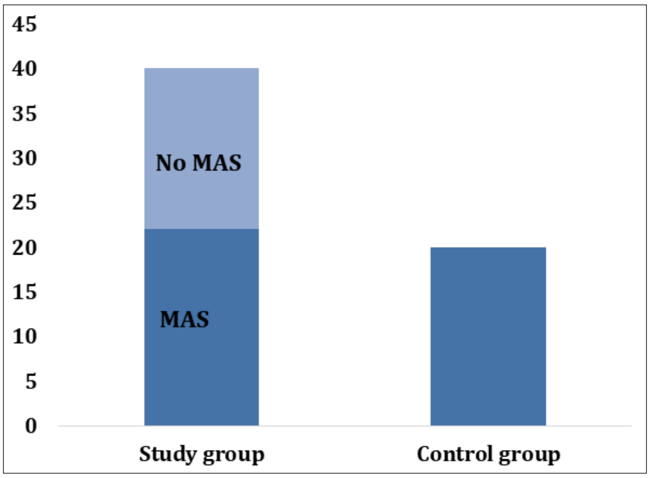

Fig 1: MSAF

The median maternal age within study group was 28 years (IQR 7), and among controls 29.5 years (IQR 6). Primigravida accounted for 24 (60%), 13(70%) were multigravida in study and control groups respectively. Five mothers (12.5%) within study group and 3(15%) in control group had diabetes. Two (5%) had gestational hypertension in study group. Fetal growth restriction was found in 1(2.5%) of study group. Doppler abnormalities was found in 1(2.5%) of control group. Fetal distress was found in 3(7.5%) of study group. There was no cases of Maternal chorioamnionitis, PROM, BPP abnormalities in our study group. Table 1 shows that Maternal demography with respect to Age, pregnancy related illness, sonogram, mode of delivery.

Table 1: Maternal demography in symptomatic and asymptomatic newborns.

Maternal data	Asymptomatic n(%)	Symptomatic n(%)	P Value
Primigravida	10(55)	14(63.6)	0.604
Multigravida	8(44.4)	8(36.4)	
Diabetes	-	5(22.7)	0.031
Hypertension	2(11.1)	-	0.109
FGR	1(5.6)	-	0.263
Fetal distress	2(11.1)	1(4.5)	0.433
Doppler abnormalities	-	1(4.5)	0.360
Labor	10(55.6)	7(31.8)	0.131
Spontaneous Induced	8(44.4)	15(68.2)	
Mode of delivery			
• Vaginal	9(50)	8(36.4)	0.409
• Assisted	-	3(13.6)	
• LSCS	9(50)	11(50)	
1. Elective	7(77.8)	6(54.5)	0.279
2. Emergency	2(22.2)	5(45.5)	

Caesarean sections were comparable. Common indication among study group was meconium-stained liquor and control group is Previous caesarean section.

Grade 2 meconium was found in 3(7.5%) of cases. Grade 3 meconium in 37(85%) of cases.

Control group was matched for age of mother and parity. The babies in study group were larger compared to study group.

All newborns were of Term gestation with median gestational age among cases is 39 weeks with IQR of 1 weeks, among controls is 39 weeks with IQR of 2 weeks. The median birth weight among cases is 3010 gm with (IQR 390 gm) and among controls is 2950 (IQR 635 gm). The median length among cases is 49 cm with IQR of 2 cm and among controls is 48 cm with IQR of 1 cm. The median Head circumference among cases is 34 cm with IQR of 1 cm and among controls is 33 cm with IQR of 0.8cm. 5(12.5%) among cases and 1(5%) among controls were SGA. 31(77.5%) among cases and 19(95%) among controls were AGA. 4(10%) among cases were LGA.

Table 2: Newborn demography

Newborn Data	Median (IQR) MAS (*n*=22)	Median (IQR) No MAS (*n*=18)	P Value
Gestational age	39(1)	39(2)	0.416
Birth weight	3070(750)	2950 (670)	0.015
Length	49(2)	48(1)	0.031
Head circumference	34(1)	33(0.8)	0.025

The maternal demography was comparable with respect to age, pregnancy related illness, sonogram and type of delivery in newborns with MAS and no MAS.

The gestational age of newborns with and without MAS were comparable. However the newborns progressing to MAS were significantly larger (Weight, Height, Head circumference) in comparison to those who did not.

Discussion

Aspirated meconium contents disrupt regular breathing through a variety of processes. Reduced oxygenation and reduced compliance of lungs are two frequent pulmonary function abnormalities in MAS. Mismatch in ventilation perfusion, pulmonary shunts exacerbate hypoxic state [7].

Very little knowledge is cellular and biochemical abnormalities caused by meconium in fluid-filled fetal lungs. Meconium hinders resorption of fluid in lungs, which may interfere with the lung capacity to adapt correctly to extrauterine life.

Meconium can either cause partial or full blockade of airway, resulting in hyperinflation or alveolar atelectasis. Meconium plugs causes obstruction of the airways resulting in significant resistance for movement of air and causes trapping of air. Partial obstruction causes ball valve effect leading to hyperinflation. Complete obstruction leads to "patchy" patches of atelectasis. Pulmonary interstitial emphysema, pneumothorax, and pneumomediastinum can be result of air leaks [8].

Meconium is a neutrophil chemoattractant. Inflammatory cells are identified in the alveoli, and parenchymal lung tissue within a few hours. Meconium contains interleukins, tumor necrosis factors (TNF). It causes inflammation by stimulating oxidation mechanism in macrophages and neutrophils, which damages parenchymal tissue of lung resulting in pneumonitis and edema in lung tissue [9].

Meconium in the inhibits endogenous surfactant activity and reduce the synthesis of surfactant molecules. Meconium, by the combined effect of cholesterol and bile acid, decreases pulmonary surfactant. Meconium alters the structure of surfactant molecule, speeds up the large molecule breakdown into small which are less active. Some meconium components which are either fat-soluble or water-soluble decrease lung function [10].

Conclusion

The median maternal age within study group was 28 years (IQR 7), and among controls 29.5 years (IQR 6). Primigravida accounted for 24 (60%), 13(70%) were multigravida in study and control groups respectively. Five mothers (12.5%) within study group and 3(15%) in control group had diabetes. Two (5%) had gestational hypertension in study group. Fetal growth restriction was found in 1(2.5%) of study group. Doppler abnormalities was found in 1(2.5%) of control group. Fetal distress was found in 3(7.5%) of study group.

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Author's Contribution

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Conflict of Interest
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