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The incidence and clinical features of meconium aspiration syndrome: a two-year neonatal intensive care experience

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ABSTRACT

Objectives: The aim of this present study was to review the clinical characteristics, risk factors, frequency of meconium aspiration syndrome (MAS), development and maternal demographic characteristics of the newborns born with meconium stained amniotic fluid (MSAF) in our neonatal intensive care unit.

Methods: The files of the patients hospitalized in our neonatal intensive care unit between July 31, 2015 and July 31, 2017 and who were diagnosed with MAS or MBAS were examined retrospectively.

Results: A total of 1410 patients were included during this period. Of these patients, 98 were term infants and 3 (34 weeks) were preterm infants. One hundred and one infants (7.1%) had MSAF and/or MAS. Of the patients, 63 were boys, 38 were girls. MAS developed in 61 patients (60.3%) who were hospitalized due to MBAS. No difference was detected between two groups in terms of the systemic diseases, age, pregnancy number, gestation week, delivery type, length of hospital stay of mother and birth weight of infant. The fifth minute Apgar score and need for resuscitation were found to be statistically significant in patients with MAS. We did not have any mortality.

Conclusion: MAS frequency decreases in parallel with the developments in neonatal care but it is still a major cause of mortality and morbidity. We believe that chance of mortality and morbidity will decrease thanks to the close follow-up and early treatment in infants born with MSAF who are likely to develop MAS.

Keywords: Meconium aspiration syndrome, meconium stained amniotic fluid, newborn

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Diagnosis of meconium aspiration syndrome (MAS) is made by the presence of respiratory distress and other characteristic radiologic findings in babies born with meconium-stained amniotic fluid (MSAF) [1, 2,]. In the healthy newborn, the first meconium outflow is between 24th and 48th hours and it is rarely seen between 20 and 34 weeks of pregnancy [1, 2]. Due to increase in pregnancy age, especially after the 42nd week of pregnancy, the meconium passage is frequent. In this week, motilin hormone responsible for vagal stimulation and intestinal peristalsis is at the highest level [3]. Prenatal meconium outflow is controversial, but fetal stress and vagal stimulation are possible factors. In addition, risk factors such as placental insufficiency, preeclampsia, eclampsia, diabetes mellitus, cardiovascular disease, smoking, oligohydramnios, intrauterine growth retardation in the mother cause meconium outflow [4].

Meconium causes harm in lungs with various mechanisms and that was defined as MAS by the presence of respiratory distress and other characteristic radiologic findings in babies born with MSAF [2, 5].

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The clinical picture may vary from mild respiratory distress to severe respiratory failure. Hypoxic encephalopathy, air leaks, persistent pulmonary hypertension (PPH) and infections can also be added to the clinical picture [6, 7]. In this study, it was aimed to review the clinical characteristics, risk factors, frequency of MAS development and maternal demographic characteristics of babies born with MSAF in intensive care unit along with the information of the literature.

METHODS

We retrospectively reviewed the files of patients admitted to our neonatal intensive care unit between July 31, 2015 and July 31, 2017 and who were diagnosed with MAS or MSAF. Babies who are born dead have a major congenital anomaly and congenital heart disease were not included in the study although they were born with meconium. Concerning included patients, birth weight, gestational week, sex, first and fifth minute Apgar scores, need for resuscitation in birth-room, type of meconium, ventilatory support, duration of hospitalization, hemogram biochemistry, results of C-reactive protein (CRP), features regarding mother and birth and MAS related complications were evaluated. MAS diagnosis was made after seeing meconium presence in the amniotic fluid, respiratory failure together with increased oxygen demand in the first postnatal 4 hours and/or radiographic changes such as reticulogranular on chest x-ray [8-10]. The level of vitamin D was investigated, if the patients have hypocalcaemia. Asphyxia diagnosis in patients was made by pH ≤ 7.0 in umbilical cord arterial blood sample, and 0-3 Apgar score after thefifth minute and neurological findings belonging to neonatal period (seizure, hypothyroidism, coma and hypoxic-ischemic encephalopathy, multiorgan failure) [11].

Statistical Analysis

Statistical Analyses Independent samplest test or Mann-Whitney U test was used depending on the distribution of data in the group comparisons with respect to continuous variables, and Chi-Square or Fisher's Exact test was used to examine the relations between categorical variables. Statistical analyses were performed with the SPSS v.22 packet program and $p < 0.05$ was considered significant.

RESULTS

Between July 31, 2015 and July 31, 2017, a total of 1410 patients were interned in our neonatal intensive care unit. Of these, one hundred of one (7.1%) were infants with MSAF and/or MAS. 63 of the patients were male, 38 were female, 98 were term, and 3 (34 weeks) were preterm infants. The mean birth weight was 3391 ± 534 gr (1500 gr-4405 gr), the mean pregnancy week was 37.9 ± 7.9, and the average length of hospitalization was 7 ± 3.4 days. CRP was

Table 1. Demographic characteristics of patients

Birth weight (mean ± SD) (min-max), gr	3391 ± 534 (1500 - 4405)
Gestational week (mean ± SD)	37.9 ± 7.9
Gender (Male/Female)	63/38
Type of delivery (Cesarean /NSD)	64/37
Average length of hospitalization (mean ± SD), day	7 ± 3.4
MAS/ MSAF (n)	61/40
Ventilator support, n (%)	11 (10.8)
Need for resuscitation at birth, n (%)	15 (14.8)
Dark meconium, n (%)	6 (5.9)
The cord entanglement, n (%)	2 (1.9)
Elevation in liver enzyme, n (%)	16 (15.8)
Thrombocytopenia, n (%)	3 (2.9)
D vitamin deficiency, n (%)	8 (7.9)
CRP positivity, n (%)	54 (53.4)

NSD = Normal spontaneous delivery, MAS = Meconium aspiration syndrome, MSAF = Meconium-stained amniotic fluid, CRP = C-reactive protein, SD = standard deviation

Table 2. Demographic characteristics of mothers

The age of mothers, year (mean ± SD)	28.7 ± 5.1
The number of pregnancies (mean ± SD)	2 ±1.9
Systemic disease, n (%)	16 (15.8)
Urinary tract infection, n (%)	16 (15.8)
PROM, n (%)	11 (10.8)
Smoke, n (%)	9 (8.9)
Influenza infection, n (%)	2 (1.9)
Placental abruption, n (%)	1 (0.9)

PROM = Premature rupture of membrane, SD = standard deviation

positive in 54 (53.4%) of the patients. Demographic characteristics of the patients are shown in Table 1. Of the patients admitted due to MSAF, 61 (60.3%) developed MAS.

The mean age of mothers was 28.7 ± 5.1 years and the number of pregnancies was 2 ± 1.9. Systemic disease 16 (15.8%), urinary tract infection 16 (15.8%), premature rupture of membrane (PROM) 11 (10.8%) were the most common causes when the mothers were evaluated for risk factors (Table 2). In our study, ventilator support was given to 11 (10.8%) patients with MAS and general respiratory support was given to 50 (49.5%) patients by means of hood.

The rate of < 7 Apgar score in the fifth minute was significantly higher in patients with MAS than in patients with MBAS ($p < 0.047$). Similarly, when comparing ventilator requirement and need for resuscitation at birth, there was a statistically significant difference between the patients with MAS and the patients with MSAF ($p < 0.006$, $p < 0.007$; respectively) (Table 3). There were no differences between the two groups in terms of maternal systemic diseases, age, number and week of pregnancy, type of delivery, weight of birth and duration of hospitalization. We did not have any mortality.

DISCUSSION

In 8-15% of births, amnion fluid is contaminated with meconium, and MAS develops in 5-10% of these infants [12]. Meconium causes harm in lungs with various mechanisms such as mechanical obstruction in the early period, chemical pneumonia, surfactant inactivation, vasoconstriction in pulmonary veins and inflammation in the late period [13, 14].

The incidence of MAS is 16.5% in term infants and 27.1% in post-term infants, and is among the most

Table 3. Demographic characteristics of MAS and MSAF patients

	MAS (n = 61)	**MSAF (n = 40)**	***p* value**
Male, n (%)	40 (65.6)	23 (57.5)	0.413
Female, n (%)	21 (34.4)	17 (42.5)	
Cesarean, n (%)	37 (60.7)	27 (67.5)	0.485
Normal spontaneous delivery, n (%)	24 (39.3)	13 (32.5)	
APGAR 5 < 7, n (%)	6 (9.8)	0 (0.0)	**< 0.047**
APGAR1 < 7, n (%)	8 (13.1)	3 (7.5)	0.519
Urinary tract infection, n (%)	7 (11.5)	9(22.5)	0.138
Systemic disease, n (%)	7 (11.5)	7 (17.5)	0.391
PROM, n (%)	8 (13.1)	4 (10.0)	0.759
Asphyxia, n (%)	3 (4.9)	0 (0.0)	0.275
Ventilator support, n (%)	11 (18.0)	0 (0.0)	**< 0.006**
Need for resuscitation at birth, n (%)	14 (23.0)	1 (2.5)	**< 0.007**
Birth weight (mean ± SD) (min-max)	3391.80 ± 577.96 (1500-4300)	3392.13 ± 467.13 (1600-4405)	0.998
Gestational week (mean ± SD) (min-max)	38.77 ± 1.38 (34-40)	38,73 ± 1,62 (30-40)	0.880
Mother age (mean ± SD) (min-max)	28.17 ± 5.19 (19-42)	29.60 ± 4.96 (20-42)	0.172
Number of pregnancies, median (min-max)	1 (1-6)	1 (1-5)	0.896

MAS = Meconium aspiration syndrome, MSAF = Meconium stained amniotic fluid, PROM = Premature rupture of membrane, SD = standard deviation

frequent causes of hospitalization for neonatal intensive care unit for this group newborns [15]. Fetal distress, post-term pregnancy, low Apgar score, cesarean birth, advanced maternal age, maternal hypertension and cardiovascular disease are among risk factors for MAS [16, 17].

In the study made among the 394 term newborns who developed MAS with MSAF in the literature, the MAS development rate was determined to be 4.8%. In this study, low Apgar score in the fifth minute was found to be a significant risk factor [18]. In the study by Espinheira *et al*. [19], they found that staining of amnion mine with medium or thick meconium and low Apgar score in the first minute facilitated MAS formation. Şen *et al*. [20] found the MAS development frequency to be 18% in the series of 106 cases made. Low Apgar score in the first minute was reported as a risk factor for MAS. In the same study, mortality in 23 patients with low Apgar scores and complications (hypoxia, hypoxic-ischemic encephalopathy, pulmonary hypertension and mechanical ventilator support) in 52 patients were found to be more frequent. In our study, we found MAS development frequency to be 60.3%. The rate of MSAF was similar in the literature but the rate of MAS development in these babies was found to be high. The reason for this is that every baby born with meconium is not admitted to the neonatal intensive care unit and the newborn born with MBAS is followed by the mother if there is no problem. We found the 5th-minute lowness of the Apgar score, increased cesarean rate (63.3%), maternal systemic illness, UTİ, PROM, cigarette use to be risk factors. Among our patients, there were no advanced maternal age and no post-term pregnancy. Male clinical gender, oligohydramnios, and nulliparity have also been reported among the risk factors in some clinical trials [21, 22]. However, these risk factors were not identified in our study.

In patients with MAS, correct response, fast diagnosis, well-planned treatment has reduced mortality and morbidity. Adequate oxygenation-ventilation in mild and moderate MAS, restoring of metabolic abnormalities, evaluation of patients according to their clinic in terms of antibiotic treatment are main treatment approaches. In severe MAS, mechanical ventilation support, high-frequency ventilation, surfactant therapy and nitric oxide may be required [2, 12, 23, 24]. In 218 MSAF and/or MAS case studies of Özdemir *et al*. [25], 86 patients needed general respiratory support and 20 patients underwent mechanical ventilator treatment. In our study, ventilator support was given to 11 (10.8%) patients with MAS and general respiratory support with hood were given to 50 patients. We did not have any patient who needs high-frequency ventilation, surfactant therapy and nitric oxide therapy.

In cases with meconium and fetal distress in amniotic fluid, perinatal mortality was reported as 3-22.2% and neonatal mortality as 7-50% in studies reported in the literature [12, 24]. In 106 cases study of Şen *et al*. [20], mortality rate was found to be 21.7% and 34.7% of deceased patients were detected to have hypertension.

Deterioration in hypoxia-induced liver function tests, sepsis, necrotizing enterocolitis, sepsis, pulmonary hypertension, air leak syndromes are other problems affecting mortality and morbidity [26, 27].

We did not have patients with pulmonary hypertension. After obtaining the cultures of CRP positive patients, appropriate antibiotic therapy was applied. Our patients with elevated liver enzymes were also recovered with close follow-up supportive care. We did not have any mortality. The treatment of infants born to our hospital according to the guidelines of the Turkish Neonatology Association 2016 birth room management guide is among the reasons for the low mortality and morbidity.

CONCLUSION

In conclusion, although MAS frequency decreases in parallel with the developments in neonatal care, it is still a major cause of mortality and morbidity. We believe that chance of mortality and morbidity will decrease thanks to the close follow-up and early treatment in infants born with MSAF who are likely to develop MAS.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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