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Fetal and Maternal Effects of Amnioinfusion Applied during Delivery in Oligohydramniotic Meconium-Stained Pregnancies

Oligohidroamniyotik Mekonyumlu Gebelerde Doğumda Uygulanan Amniyoinfüzyonun Fetal ve Maternal Etkileri

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ABSTRACT

Objectives: This study aimed to investigate the fetal and maternal effects of amnioinfusion applied during delivery in meconium-stained pregnancies.

Methods: Sixty singleton pregnancies with cervical dilation >2 cm, normal fetal heart rate, and amniotic fluid index below 5 cm, at or beyond 37 weeks of gestation were included in this study. Thirty patients were randomly assigned to the amnioinfusion group and the other 30 patients formed the control group.

Results: After amnioinfusion was applied to both groups, maternal fever, fetal tachycardia, fetal heart rate tracings, operation rates, Apgar scores, presence of meconium under vocal cords and oropharynx, and incidence of meconium aspiration syndrome (MAS) were evaluated. Patients requiring operative intervention due to fetal distress were 3% (1/30) in Group 1 and 37% (11/30) in Group 2, which was statistically significant (p=0.002). Apgar scores below 7 at 1 min in Group 1 was 10% (3/30), while it was 40% (12/30) in Group 2, which was statistically significant (p=0.01). In Group 1, no infants had an Apgar score below 7 at 5 min, while in Group 2, 24% (7/30) of infants had an Apgar score below 7, which was statistically significant (p=0.01). Meconium under the oropharynx was found to be 24% (7/30) in Group 1 and 70% (21/30) in Group 2, while the presence of meconium under the vocal cords was 6% (2/30) in Group 1 and 44% (13/30) in Group 2, and both of these differences were statistically significant (p=0.0006, p=0.002). The incidence of MAS observed in Group 1 was 0 and 20% (6/30) in Group 2, which was statistically significant (p=0.02).

Conclusion: Amnioinfusion is one of a series of interventions aimed at reducing mortality and morbidity related to meconium aspiration. Although our clinical study showed positive results, randomized controlled trials, and meta-analyses are needed to clarify whether routine amnioinfusion provides clinical benefits, and prospective randomized controlled studies should be supported.

Keywords: Amnioinfusion; meconium; meconium aspiration syndrome.

ÖZET

Amaç: Bu çalışmada, mekonyumlu gebelerde doğum sırasında uygulanan amniyoinfüzyonun fetal ve maternal etkilerinin araştırılması amaçlandı.

Yöntem: Çalışmaya 37 gebelik haftasından büyük, tekil, baş prezentasyonu, servikal dilatasyonu 2 cm'nin üzerinde, normal kalp atım trasesi, zarları açılmış, koyu mekonyumlu ve amniyotik sıvı indeksi 5 cm'nin altında 60 gebe dahil edildi. Bu kriterlere uygun olan hastalar, rastgele olarak 30'u amniyoinfüzyon grubu, 30'u kontrol grubu olarak ayrıldı. Daha sonra hastalara transabdominal devamlı monitörizasyon ve transvajinal amniyoinfüzyon yapıldı.

Bulgular: Çalışmamızda her iki grup, amniyoinfüzyon yapıldıktan sonra intrapartum olarak maternal ateş, fetal taşikardi ve fetal kalp atım traseleri, uygulanmak zorunda kalınan vakum ekstraksiyon ve sezaryen, APGAR skorları, orofarinks aspirasyonu ve laringoskop ile vokal kord altında mekonyum varlığı ve mekonyum aspirasyon sendromu insidansı yönünden incelendi. Fetal distres nedeniyle operatif girişimde bulunulan hastalar grup 1'de %3 (1/30), grup 2'de %37 (11/30) olarak saptandı ve istatistiksel olarak anlamlı bulundu (p=0,002). Grup 1'de birinci dakika APGAR skorları 7'nin altında olanların oranı %10 (3/30), grup 2'de %40 (12/30) olarak bulundu ve anlamlı olarak saptandı (p=0,01). Grup 1'de beşinci dakika APGAR skoru 7'nin altında olan bebek yoktu, grup 2'de ise %24 (7/30) olarak bulundu ve anlamlı olarak değerlendirildi (p=0,01). Grup 1'de orofarinks altında mekonyum varlığı %24 (7/30), grup 2'de %70 (21/30), vokal kord altında mekonyum varlığı da grup 1'de %6 (2/30), grup 2'de %44 (13/30) olarak bulundu ve bu değerlere göre her iki grup arasında istatistiksel olarak oldukça anlamlı fark olduğu tespit edildi (p=0,0006, p=0,002). Altmış doğum sonunda görülen mekonyum aspirasyon sendromu oranı %10 olarak saptandı. Bu hastaların dağılımı ise grup 1'de 0, grup 2'de %20 (6/30) olarak bulundu ve istatistiksel olarak anlamlı olarak değerlendirildi (p=0,02).

Sonuç: Amniyoinfüzyon mekonyum aspirasyonuna bağlı mortalite ve morbiditeyi azaltmayı amaçlayan bir dizi müdahaleden biridir. Klinik çalışmamız pozitif sonuçlar verse de daha sonra randomize kontrollü çalışmalara ve meta-analizlere göre rutin amniyoinfüzyon uygulamasının klinik fayda sağladığı kesinleştirilemedi, fakat prospektif randomize kontrollü çalışmalar desteklenmelidir.

Anahtar sözcükler: Amniyoinfüzyon; mekonyum; mekonyum aspirasyon sendromu.

The presence of meconium in the amniotic fluid during normal labor may be considered as a sign of fetal distress or distress. Meconium aspiration syndrome (MAS) is defined as respiratory distress that cannot be explained by other causes in newborn babies born with meconium-stained amniotic fluid.[1] The presence of meconium in the amniotic fluid and contact with it by the newborn are closely related to perinatal morbidity and mortality. MAS is caused by mechanical obstruction and chemical inflammation due to aspiration of meconium particles into the lower respiratory tract.[1] It has been reported that MAS is responsible for approximately 10% of all respiratory failure in newborns and its mortality rate is approximately 20% in developing countries.[2] In addition, complications such as neonatal sepsis, seizures, and neurological disorders are seen in newborns exposed to meconium aspiration, and the duration of neonatal intensive care is prolonged.[3] Risk factors investigated for the development of MAS include cesarean delivery, post-term pregnancy, low APGAR score at birth, and abnormal fetal heart rate.[4,5] In recent years, it has been shown that the decrease in the incidence of MAS is due to the decrease in post-term birth and the aggressive management of labor induction and fetal distress in pregnancies over 41 weeks.[6]

Methods to reduce newborn mortality and morbidity in meconium-stained pregnancies have been of interest to researchers for many years. At present, supportive therapies, nasogastric aspiration, nitric oxide, respiratory support, surfactant therapy, antibiotic therapy, steroid therapy, and extracorporeal membrane oxygenation are used for this purpose.[7] The aim of our study is to investigate the fetal and maternal positive effects of amnioinfusion therapy applied during delivery in oligohydramnios meconium-stained pregnancies.

Methods

Our study was planned in accordance with the Declaration of Helsinki. The inclusion criteria for the study were determined as follows: Singleton, cephalic presentation, cervical dilation >2 cm, normal fetal heart rate tracings, ruptured membranes, meconium-stained amniotic fluid, and an amniotic fluid index of <5 cm at 37 weeks gestation or later. Randomly, 30 of the pregnant women were assigned to the amnioinfusion group, while the remaining 30 were assigned to the control group. Meconium staining was defined qualitatively as an opaque, viscous, and lentil soup-like appearance. All pregnant women included in the study underwent ultrasonographic measurement of the amniotic fluid index. Subsequently, continuous transabdominal monitoring and transvaginal amnioinfusion were performed on the patients. For amnioinfusion, 500 cc of physiologic saline warmed up to 37°C was used. If the amniotic fluid index was <5 cm after the first amnioinfusion, a second 500 cc dose of physiologic saline was administered. If the amniotic fluid index was between 5 and 10 cm after the first amnioinfusion, an additional 250 cc of physiologic saline was infused. If necessary, amnioinfusion with physiologic saline was repeated to maintain the amniotic index above 10 cm.

After amnioinfusion, maternal fever, fetal tachycardia, and fetal heart rate tracings were monitored intrapartum. In maternal fever monitoring, values above 37°C were considered significant. Fetal tachycardia was defined as a fetal heart rate >160 beats per minute. The need for operative interventions and APGAR scores was also analyzed in both groups.

To evaluate meconium aspiration, after the baby's head emerged from the perineum and the mouth was cleared, a suction catheter was inserted into the oropharynx to aspi-

rate meconium before the baby's first breath. Subsequently, the presence of meconium was visually checked under the vocal cords of each baby using a laryngoscope. The effect of amnioinfusion on the incidence of MAS was also evaluated.

Statistical Analysis

The Chi-square test was used in the biostatistical analysis of the study to compare the frequency and percentages between groups. Fischer's test was used for binary group measurements where the Chi-square test was suspicious. Student's t-test was used to test whether the given two different groups of numerical data show a significant difference from each other. A significance level of $p<0.05$ was used in the interpretations.

Results

In our study, we followed 60 oligohydramniotic meconium-stained pregnant women during active labor. Thirty cases who received amnioinfusion were defined as Group 1, while 30 cases who received classic obstetric management were defined as Group 2. When groups were compared demographically in terms of age, parity, gestational week, post-term pregnancy, amniotic index, and cervical dilation, no statistically significant difference was found (Table 1) (p>0.05).

The mean amount of fluid infused to increase the amniotic index above 10 cm was 544±110 ml in the Group 1 case, and infusion was applied twice to three patients (10%).

When groups were compared in terms of intrapartum maternal fever after amnioinfusion, no statistically significant difference was found (Table 2) (p=0.2).

Regarding fetal tachycardia monitoring, fetal tachycardia was detected in three cases (10%) in Group 1 and in four cases (13%) in Group 2, and no statistically significant difference was found (p=1). When cases were evaluated for non-reactivity, non-reactivity was detected in 17% (5/30) of Group 1 case and 10% (3/30) of Group 2 cases, and no statistically significant difference was found (p=0.7). In cases where decreased variability was detected during labor, decreased variability was observed in 13% (4/30) of Group 1 case and 17% (5/30) of Group 2 cases, and no significant difference was found (p=0.6). Although no persistent late decelerations were detected in the fetal heart rate tracings of both groups, the significant difference detected in fetal heart rate tracings was usually in the form of variable decelerations that developed due to cord compression. When both groups were evaluated for variable decelerations, variable decelerations were detected in 10% (3/30) of Group 1 case and 37% (11/30) of Group 2 cases. This difference was found to be statistically significant (p=0.03) (Table 3).

In our study, another parameter we examined was the operative interventions performed in both groups. Vacuum extraction and cesarean section were performed as operative interventions in our clinic. These operative interventions were also divided into those performed due to fetal distress and those performed due to other obstetric reasons in our study. According to this, the cesarean section rate due to fe-

Table 1. Demografic specifications

	Infusion group	Control group	Statistical significance
Age	23.1±3.6	22.9±3	p>0.05
Parity	1.23±1.3	1.16±1.3	p>0.05
Nullipar	14 (47)	14 (47	p>0.05
Multipar	16 (53)	16 (53)	p>0.05
Gestasyonel week	40.8±1.1	40.6±1.5	p>0.05
Post-date pregnancy	11 (37)	10 (33)	p>0.05
Amniotic indeks	3.9±1.1	3.7±1.13	p>0.05
Cervical dilatation	3.2±0.9	3.3±0.9	p>0.05

Table 2. Febril morbidity

	Group 1 n=30		Group 2 n=30	
	n	%	n	%
Maternal fever >37°C	6	20	2	7
Maternal fever <37°C	24	80	28	93

Table 3. Fetal tachycardia, reactivity, variability, and variable decelerations

	Group 1 n=30		Group 2 n=30	
	n	%	n	%
Fetal tachycardia(+)	3	10	4	13
Fetal tachycardia (-)	27	90	26	87
Non-reactive	5	17	3	10
Reactive	25	83	27	90
Decreased variability	4	13	5	17
Normal variability	26	87	25	83
Variable deceleration (+)	3	10	11	37
Variable deceleration (-)	27	90	19	63

Table 4. Operative interventions for fetal distress

	Group 1 n=30		Group 2 n=30		Statistical significance
	n	%	n	%	
Cesarean section	1	3	4	13	p>0.05
Vacuum extraction	0	0	7	24	p=0.01
Total	1	3	11	37	p=0.002

Table 5. Operative interventions for other reasons

	Group 1 n=30		Group 2 n=30	
	n	%	n	%
Cesarean section	3	10	2	7
Vacuum extraction	5	17	1	3
Total	8	27	3	10

Table 6. Apgar scores

	Group 1 n=30		Group 2 n=30	
	n	%	n	%
Apgar score <7 at 1st min	3	10	12	40
Apgar score >7 at 1st min	27	90	18	60
Apgar score <7 at 5th min	0	0	7	24
Apgar score >7 at 5th min	30	100	23	76

tal distress was found to be 3% (1/30) in Group 1 and 13% (4/30) in Group 2, and was not found to be statistically significant. Vacuum extractions performed due to fetal distress were found to be 0% in Group 1 and 24% (7/30) in Group 2, and a statistically significant difference was observed (p=0.01). Overall, the percentage of pregnant women who underwent operative interventions due to fetal distress was found to be 3% (1/30) in Group 1 and 37% (11/30) in Group 2, and a statistically significant difference was detected between the groups (Table 4) (p=0.002).

When operative interventions performed due to other obstetric reasons not related to fetal distress were examined, the cesarean section rate was found to be 10% (3/30) in Group 1 and 7% (2/30) in Group 2; the vacuum extraction rate was found to be 17% (5/30) in Group 1 and 3% (1/30) in Group 2 and no significant difference was observed (p>0.05). Operative interventions performed for reasons other than fetal distress were found to be 27% (8/30) in Group 1 and 10% (3/30) in Group 2, and no significant difference was detected (Table 5) (p>0.05).

Table 7. Presence of meconium below the vocal cords and oropharynx

	Group 1 n=30		Group 2 n=30	
	n	%	n	%
Meconium at oropharynx (+)	7	6	21	70
Meconium at oropharynx (-)	23	76	9	30
Meconium below vocal cords (+)	2	6	13	44
Meconium below vocal cords (-)	28	94	17	56

Table 8. Meconium aspiration syndrome

	Group 1 n=30		Group 2 n=30	
	n	%	n	%
Meconium aspiration syndrome (+)	0	0	6	20
Meconium aspiration syndrome (-)	30	100	24	80

An APGAR score of 7 was considered a critical value. When the first and 5th min APGAR scores were compared, in Group 1, the proportion of those with 1st min APGAR scores below 7 was 10% (3/30), while in Group 2, it was 40% (12/30) and a statistically significant difference was detected between the groups (p=0.01). When the 5th min APGAR scores of the monitored infants were examined, it was found that the number of infants with 5th min APGAR scores below 7 was 0 in Group 1 and 24% (7/30) in Group 2 and a significant difference was observed between the groups (Table 6) (p=0.01).

The confirmation of meconium aspiration was evaluated by aspiration and visual laryngoscopic analysis. The presence of meconium detected under the oropharynx was 24% (7/30) in Group 1 and 70% (21/30) in Group 2. Meconium presence was observed below the vocal cords in 6% (2/30) of Group 1 case and 44% (13/30) of Group 2 cases. Statistical analysis showed a significant difference between the groups (Table 7) (p=0.0006, p=0.002).

When evaluating the effect of amnioinfusion on the incidence of MAS, none of the newborns from the 60 included pregnancies were diagnosed with severe MAS. Only six neonates who did not receive amnioinfusion were diagnosed with mild MAS, as evidenced by tachypnea, intercostal retractions, and cyanosis. The incidence of MAS after 60 deliveries was found to be 10%. The distribution of these cases was 0% in Group 1 and 20% (6/30) in Group 2, and a statistically significant difference was observed (Table 8) (p=0.02).

Discussion

Our study shows the positive effects of amnioinfusion in oligohydramnios pregnancies and newborns by reducing fetal distress, decreasing operative interventions, improving fetal prognosis, and reducing severe MAS. Our results are consistent with studies in the literature reporting that amnioinfusion reduces cesarean section rates associated with fetal distress.[8-10] However, it has been reported that the risk of cesarean section does not change despite a decrease in MAS with amnioinfusion.[11] Moodley et al.[12] showed that although cesarean section rates did not change, umbilical artery pH was significantly higher. Our results are similar to studies showing that amnioinfusion significantly reduces cesarean section rates.[8,13,14] In addition, our study is consistent with Sadovsky et al.'s[15] finding that there were fewer variable decelerations in cases where amnioinfusion was performed compared to those where it was not. In Wenstrom and Porsons' study, 35 patients who underwent amnioinfusion were compared to 44 patients who did not, and it was found that amnioinfusion was associated with increasing in APGAR scores, decreasing in the rate of meconium seen below the vocal cords, and decreasing in the rate of operative interventions.[16] Another study that supports our results found that the fetal distress rate and cesarean section rate for fetal distress were significantly reduced in the amnioinfusion group compared to the control group. In addition, MAS was less common in the amnioinfusion group.[17] In addition to studies associating amnioinfusion with a significant decrease in neonatal acidemia in meconium-stained cases, studies showing no association between amnioinfusion and the incidence of neonatal poor outcomes and postpartum complications also exist.[18,19] One of the most important points in amnioinfusion treatment is the evaluation of complications. While our study results showed no significant difference in maternal complications, we believe that we do not have evidence at the level of certainty to form a conclusive opinion on whether amnioinfusion significantly increases the risk of complications, which is consistent with studies in the literature reporting that amnioinfusion does not significantly increase the risk of complications.[20]

In a study by Rathor et al.,[21] which compared pregnant women who received amnioinfusion with those who did not, there was no difference in the risk of cesarean section between the two groups (amnioinfusion 9.5% vs. control 12.3%; RR 0.84, 95% CI 0.53–1.32). However, MAS was significantly less common in the amnioinfusion group (3.1% vs. 12.8%; RR 0.24, 95% CI 0.12–0.48), and there was a lower incidence of perinatal death (1.2% vs. 3.6%; RR 0.34, 95% CI 0.11–1.06). In a similar study, MAS was observed in 6% of the amnioinfusion group and 20% of the control group. While two newborns in the control group died due to MAS, there were no reported cases of maternal mortality or major maternal complications.[22] In a multicenter study by Fraser et al.,[23] there was no significant difference in perinatal death risk between the two groups, and both groups had cases of moderate or severe MAS. The cesarean section rate was 31.8% in the amnioinfusion group and 29% in the control group, with no significant difference noted. However, the risk of MAS was reported to be lower in the amnioinfusion group.[23] In a meconium examination under the vocal cords, the amnioinfusion group had a statistically significant advantage ($p<0.004$), and MAS was significantly reduced in the infusion group.[24,25] In addition, studies have shown that newborns in the amnioinfusion group experience less respiratory distress than those in the control group.[26] Although most of these findings are consistent with the results of this study, a meta-analysis by Hofmeyr et al.[18] found significant heterogeneity in some of the findings, and only two studies (138 women) reported almost complete elimination of the effect of meconium (RR 0.03, 95% confidence interva (CI) 0.01–0.15) with amnioinfusion. This meta-analysis emphasizes the importance of standard peripartum monitoring and concludes that amnioinfusion does not provide statistically significant improvement in perinatal outcomes. While the absence of severe MAS in any of the 60 newborns in this study calls into question the positive efficacy of amnioinfusion, the statistically significant high incidence of meconium presence in the oropharynx and below the vocal cords in the group without amnioinfusion and the higher incidence of mild MAS in this group is noteworthy, and further investigation is necessary.

Within the limitations of our study, which included being a single-center study, the association between MAS was described qualitatively rather than quantitatively, and the definition of meconium was made qualitatively without support from microbiological samples.

Amnioinfusion is one of the interventions aimed at reducing mortality and morbidity associated with meconium aspiration. While our clinical study yielded positive results, subsequent randomized controlled trials, and meta-analyses have not conclusively shown that routine amnioinfusion provides clinical benefits. The fetal and maternal effects of administering amnioinfusion during delivery to oligohydramnios meconium-stained pregnancies should be supported by detailed prospective randomized controlled studies.

Disclosures

Ethics Committee Approval: It was completed as a specialization thesis study with the permission of SSK Göztepe Training and Research Hospital Education and Planning Commission.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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