

Effect of Transcervical Amnioinfusion in Meconium-Stained Amniotic Fluid and Its Impact on Perinatal Outcome

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ABSTRACT

Background: Meconium-stained amniotic fluid (MSAF) is frequently associated with fetal distress and adverse neonatal outcomes. Transcervical amnioinfusion has been proposed to dilute thick meconium, improve the intrauterine environment, and reduce complications.

Methods: This prospective case-control study included 143 term laboring women with thick meconium-stained liquor, divided into a study group (n=50) who received transcervical amnioinfusion and a control group (n=93) who did not. Amnioinfusion was performed using Ringer's Lactate, infused initially at 1–1.2 L/hr followed by maintenance at 5 mL/min until full cervical dilatation. Maternal and neonatal outcomes were compared between the two groups.

Results: Amnioinfusion significantly improved Apgar scores at 1 and 5 minutes ($p<0.05$). The incidence of meconium at/below the vocal cords was reduced (20% vs 35.48%), and the requirement of advanced neonatal resuscitation methods (intubation/IPPV) was lower in the study group. Cesarean section rate was significantly lower in the amnioinfusion group (20% vs 47.31%; $p<0.001$). Nursery admissions and incidence of Meconium Aspiration Syndrome (MAS) were notably reduced. No maternal complications attributable to the intervention were observed.

Conclusion: Transcervical amnioinfusion is a simple, safe, and cost-effective intrapartum intervention that significantly improves fetal outcomes in cases of thick meconium-stained amniotic fluid by reducing operative deliveries and neonatal respiratory complications.

Key-words: Amnioinfusion, Meconium-stained amniotic fluid, Meconium aspiration syndrome, Perinatal outcome

INTRODUCTION

Meconium passage in utero is a normal physiological process that generally occurs during fetal maturation, particularly in the later weeks of gestation. However, the presence of meconium in the amniotic fluid during labor is regarded as a significant clinical indicator of potential fetal compromise, especially intrapartum hypoxia or stress^[1].

Meconium-stained amniotic fluid (MSAF) is encountered in approximately 7–22% of all term pregnancies, and the incidence increases markedly in post-term gestations due to progressive gastrointestinal maturation and declining placental efficiency^[2]. The appearance of meconium may range from thinly stained greenish fluid to thick particulate meconium, and the clinical implications vary accordingly. Thick meconium is of particular concern because of its association with fetal acidemia and increased risk of adverse neonatal outcomes^[3].

Meconium Aspiration Syndrome (MAS) remains one of the most serious complications associated with MSAF and is a significant contributor to neonatal morbidity and mortality worldwide^[3,4]. MAS results from the aspiration

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of meconium-contaminated amniotic fluid into the fetal respiratory tract, either in utero or during the first breaths postpartum. The aspirated meconium can lead to airway obstruction, surfactant dysfunction, chemical pneumonitis, inflammation, and persistent pulmonary hypertension of the newborn [4]. Infants with MAS may require advanced ventilatory support, surfactant therapy, inhaled nitric oxide, or even extracorporeal membrane oxygenation in severe cases, particularly in resource-limited settings where such therapeutic modalities may not be readily available.

The pathophysiology of meconium passage is closely linked to intrauterine hypoxia. Reduced oxygenation during labor triggers vagal stimulation, increased colonic peristalsis, and relaxation of the anal sphincter, resulting in expulsion of meconium into the amniotic cavity [5]. Thus, thick meconium may serve as a clinical indicator of prolonged fetal distress. Moreover, the viscosity of thick meconium increases the likelihood of aspiration and airway obstruction, necessitating immediate and coordinated obstetric and neonatal interventions [6]. Neonates born through thick MSAF often require close monitoring, prompt resuscitative measures, and early admission to specialized neonatal care units to reduce respiratory complications.

To address these clinical challenges, transcervical amnioinfusion was initially introduced for the management of repetitive variable decelerations caused by umbilical cord compression [7]. Subsequently, it was adapted for use in cases of thick MSAF to improve the intrauterine environment. The technique involves the infusion of isotonic fluid, such as Ringer's Lactate, into the amniotic cavity through an intrauterine catheter. The therapeutic aims of amnioinfusion in MSAF are to dilute thick meconium, reduce particulate density, improve fluid clarity, decrease fetal aspiration risk, and restore normal uterine volume to relieve cord compression [8]. Through these mechanisms, amnioinfusion may effectively reduce both fetal hypoxia and mechanical obstruction of the neonatal airway.

Clinical evidence in favor of amnioinfusion has accumulated over time. Several randomized controlled trials and meta-analyses have demonstrated that intrapartum amnioinfusion can significantly reduce the incidence of MAS, improve Apgar scores, and decrease the need for advanced neonatal resuscitation [9]. Furthermore, a decline in operative delivery rates,

particularly cesarean sections performed due to non-reassuring fetal heart rate patterns, has been reported following the use of amnioinfusion in thick meconium cases [10]. These findings are of critical value in low- and middle-income countries, where the burden of neonatal respiratory morbidity is higher and neonatal intensive care resources are often limited.

In addition, amnioinfusion is a relatively simple, cost-effective, and minimally invasive procedure that can be performed at most obstetric centers without the need for specialized equipment. When administered with appropriate selection criteria and fetal monitoring, its maternal risks are minimal and complications are rare. Thus, the use of transcervical amnioinfusion has gained recognition as a beneficial adjunctive therapy in the intrapartum management of thick MSAF [8].

However, despite its demonstrated advantages, the practice of routine amnioinfusion remains debated in some clinical guidelines due to variable resource availability, training disparities, and differing interpretations of trial outcomes across healthcare settings. Therefore, further evaluation of its effectiveness in improving perinatal outcomes, particularly in real-world clinical environments and diverse patient populations, remains essential [6].

This study was undertaken to assess the impact of transcervical amnioinfusion on perinatal outcomes in pregnancies complicated by thick meconium-stained amniotic fluid, with specific focus on neonatal respiratory adaptation, Apgar scores, incidence of MAS, and mode of delivery.

MATERIALS AND METHODS

Study Design and Setting- This was a prospective case-control study conducted in the Department of Obstetrics and Gynaecology, SCB Medical College and Hospital, Cuttack, Odisha, India, over a period of one year.

Study Population- Pregnant women in active labor with thick meconium-stained amniotic fluid were included in the study.

Sample Size and Grouping- A total of 143 women fulfilling the eligibility criteria were enrolled and divided into two groups:

- **Study Group (Amnioinfusion):** 50 women
- **Control Group (No Amnioinfusion):** 93 women

Inclusion Criteria

- ✓ Full-term singleton pregnancy
- ✓ Cephalic presentation
- ✓ Cervical dilatation between 3–8 cm
- ✓ Presence of thick meconium-stained liquor

Exclusion Criteria

- ✓ Intrauterine fetal demise
- ✓ Known congenital anomalies
- ✓ Chorioamnionitis
- ✓ Cephalopelvic disproportion
- ✓ Fetal distress before procedure

Procedure (Amnioinfusion Technique)- After confirming thick meconium at artificial or spontaneous rupture of membranes, a sterile intrauterine catheter was introduced transcervically.

Ringer Lactate was infused:

- **Initial dose:** 1.0–1.2 L/hour
- **Maintenance:** 5 mL/min

Infusion continued until delivery or complete cervical dilatation. Continuous fetal heart rate monitoring and uterine tone assessment were performed throughout labor.

Outcome Measures

- Mode of delivery
- Apgar scores at 1 and 5 minutes
- Requirement of neonatal resuscitation
- Incidence of meconium below vocal cords
- Nursery/NICU admission
- Occurrence of Meconium Aspiration Syndrome (MAS)
- Maternal complications, if any

Statistical Analysis- Data were analyzed using SPSS version 21.0. Categorical variables were compared using the Chi-square test, and continuous variables using the Student's t-test. A p -value<0.05 was considered statistically significant.

Ethical Considerations- Ethical approval was obtained from the Institutional Ethics Committee. Written informed consent was taken from all participants, and confidentiality of patient information was strictly maintained.

RESULTS

A total of 143 women with thick meconium-stained amniotic fluid were studied. Among these, 50 women received transcervical amnioinfusion (study group), while 93 women were managed expectantly without amnioinfusion (control group). Both groups were comparable in maternal age distribution, parity, and gestational age at admission, indicating homogeneity at baseline.

The distributions of maternal age, parity, gestational age, and liquor volume were similar in both groups (Table 1). There was no statistically significant difference in baseline parameters, indicating that the two groups were comparable for outcome assessment. Labor characteristics also showed no major deviation between groups.

Table 1: Baseline Maternal and Labor Characteristics

Parameter	Amnioinfusion Group (n=50)	Control Group (n=93)
Mean Maternal Age (years)	23.8 ± 3.4	24.1 ± 3.7
Primigravida (%)	58	62
Gestational Age ≥40 Weeks (%)	48	52
Adequate Liquor Volume on PV (%)	88	82.8
Rupture of Membranes Spontaneous (%)	60	57

A significant improvement in liquor consistency was observed in the amnioinfusion group, where 60% of women had clear liquor following infusion and none retained thick meconium (Table 2). The control group continued to show predominantly thick meconium. Correspondingly, the rate of cesarean section was significantly lower in the study group, indicating better intrapartum fetal tolerance. The frequency of spontaneous vaginal delivery was also higher among those who received amnioinfusion.

Table 2: Effect of Amnioinfusion on Liquor Appearance and Mode of Delivery

Parameter	Amnioinfusion Group (n=50)	Control Group (n=93)	p-value
Liquor Became Clear (%)	60	0	<0.001
Liquor Became Thin (%)	24	6.4	<0.001
Liquor Remained Thick (%)	0	72.0	<0.001
Spontaneous Vaginal Delivery (%)	38	20.4	<0.05
Instrumental Delivery (%)	42	32.3	NS
Caesarean Delivery (%)	20	47.3	<0.001

Newborns in the amnioinfusion group demonstrated better Apgar performance at both 1 and 5 minutes compared to the control group (Table 3). The requirement for bag-and-mask ventilation and

endotracheal intubation was substantially lower in the study group. These observations suggest reduced intrapartum hypoxia and improved neonatal respiratory adaptation among infants delivered after amnioinfusion.

Table 3: Neonatal Condition at Birth (Apgar and Immediate Resuscitation)

Variable	Amnioinfusion Group (%)	Control Group (%)	p-value
Apgar Score ≤ 3 at 1 min	12	24.7	<0.05
Apgar Score ≥ 7 at 1 min	42	23.7	<0.01
Apgar Score ≥ 7 at 5 min	72	51.6	<0.01
Bag & Mask / Intubation Required	18	37.6	<0.01

The presence of meconium below the vocal cords was less frequent in the amnioinfusion group, indicating reduced aspiration risk (Table 4). NICU admission rates and duration of NICU stay were also significantly lower in the study group. The incidence of meconium aspiration

syndrome was reduced by half in the amnioinfusion group compared to controls, emphasizing the protective role of intrauterine lavage and dilution of particulate meconium.

Table 4: Neonatal Respiratory Morbidity and NICU Outcome

Outcome	Amnioinfusion Group (%)	Control Group (%)	p-value
Meconium at/below the vocal cords	20	35.5	<0.05
NICU Admission Required	38	60.2	<0.01
Meconium Aspiration Syndrome (MAS)	16	32.2	<0.05
NICU Stay >3 Days	2	9.7	<0.05

DISCUSSION

The presence of thick meconium-stained amniotic fluid during labor is a well-recognized clinical concern due to its association with fetal hypoxia, intrapartum distress, and sub-sequent respiratory complications in the new-

born. In the present study, transcervical amnioinfusion demonstrated significant improvement in both obstetric and neonatal outcomes when compared to conventional management. The intervention effectively diluted thick meconium, reduced the occurrence of fetal compromise,

and improved neonatal adaptation at birth, as reflected by higher Apgar scores and decreased need for neonatal resuscitation.

In the current study, a marked reduction in the cesarean delivery rate was observed in the amnioinfusion group, which supports the hypothesis that improving the intrauterine environment reduces persistent fetal distress. This finding agrees with the observations of Wenstrom and Parsons ^[11], who reported a significant reduction in cesarean sections performed for non-reassuring fetal heart rate patterns following amnioinfusion. Similarly, Sadovsky *et al.* ^[12] demonstrated that intrapartum infusion of crystalloid fluid helps restore uterine cavity volume and reduce cord compression, thereby stabilizing fetal heart rate variability and improving labor progress.

The improvement in Apgar scores in the study group further reinforces the role of amnioinfusion in reducing intrauterine hypoxic stress. Spong *et al.* ^[13] showed that neonates born after amnioinfusion had significantly better Apgar scores and fewer episodes of birth asphyxia compared to controls. This parallels our findings, where Apgar scores at both 1 and 5 minutes were higher in the amnioinfusion group and the proportion of severely depressed neonates was lower.

A significant observation in the present study is the reduction in meconium aspiration syndrome (MAS) among newborns delivered after amnioinfusion. By diluting and washing out particulate meconium from the uterine cavity, the thickness of aspirated material is decreased, resulting in less airway obstruction and reduced lung injury. Macri *et al.* ^[14] and Wing *et al.* ^[15] reported similar benefits, stating that amnioinfusion lessens the likelihood of meconium reaching below the vocal cords, thereby reducing the severity of aspiration. Our data are consistent with their findings, with the study group demonstrating a lower incidence of MAS and a reduced duration of NICU stay.

The procedure was found to be safe, with no maternal complications reported, confirming earlier observations by McEvoy *et al.* ^[16], who found amnioinfusion to be a low-risk intervention when administered under proper monitoring. In the present study, uterine activity remained within physiological limits and no cases of uterine hypertonus or chorioamnionitis were noted.

The benefit of amnioinfusion appears particularly relevant in resource-constrained settings, where

advanced neonatal ventilation and surfactant therapy may not always be readily available. Hofmeyr and Xu ^[17] emphasized that in low- and middle-income health systems, amnioinfusion serves as a cost-effective measure to prevent severe respiratory morbidity. Gupta *et al.* ^[18] and Jaiswal *et al.* ^[19] similarly supported the role of transcervical amnioinfusion as a practical and implementable intervention, especially in maternity units that lack tertiary neonatal support.

The reduced incidence of MAS in the study group also aligns with the results of Patel *et al.* ^[20], who reported improved neonatal outcomes and fewer NICU admissions following amnioinfusion in thick meconium cases. Together, these studies reinforce the findings of the present work and validate amnioinfusion as a rational and beneficial intrapartum strategy.

Overall, the results of the present study, supported by literature, indicate that transcervical amnioinfusion improves fetal condition during labor, reduces operative interventions, and minimizes neonatal respiratory complications. The findings strongly support the use of amnioinfusion in cases of thick meconium-stained liquor where fetal heart rate monitoring suggests potential compromise.

CONCLUSIONS

Transcervical amnioinfusion is a simple, feasible, and safe intrapartum intervention that significantly improves neonatal outcomes in cases of thick meconium-stained amniotic fluid. It reduces the incidence of meconium aspiration, decreases the requirement for advanced neonatal resuscitation, and minimizes NICU admissions. Additionally, it lowers cesarean section rates without introducing maternal morbidity. This technique is particularly valuable in resource-limited settings where advanced fetal monitoring and neonatal ventilation facilities may not be readily available. Based on the findings of this study and supporting literature, amnioinfusion should be considered an important adjunct in the intrapartum management of pregnancies complicated by thick meconium-stained amniotic fluid. Further large-scale multicentric randomized trials are recommended to reinforce these conclusions and establish standardized procedural guidelines.

CONTRIBUTION OF AUTHORS

Research concept- Ankita Pattanaik, Debasis Patro

Study design- Ankita Pattanaik, Debasis Patro

Supervision- Ankita Pattanaik, Debasis Patro

Material preparation- Abhinash Sethi

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Data analysis- Abhinash Sethi, Debasis Patro

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