



ORIGINAL RESEARCH PAPER

Paediatrics

THE OUTCOME OF SURFACTANT THERAPY IN MECONIUM ASPIRATION SYNDROME- A PROSPECTIVE OBSERVATIONAL STUDY IN A TERTIARY CARE HOSPITAL OF BHUBANESWAR

KEY WORDS:

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ABSTRACT

Meconium aspiration syndrome (MAS) remains an important cause of neonatal respiratory distress and contributes significantly to neonatal morbidity and mortality, particularly in term and post-term infants. The aspirated meconium causes airway obstruction, chemical pneumonitis, pulmonary hypertension, and inactivation of endogenous surfactant, resulting in severe respiratory failure. This prospective observational study was conducted in the neonatal intensive care unit of a tertiary care hospital in Bhubaneswar over a period of six months to evaluate the effectiveness of surfactant therapy in neonates with MAS. A total of 60 term neonates (≥ 37 weeks gestation) born through meconium-stained amniotic fluid who developed respiratory distress requiring respiratory support were enrolled. Surfactant therapy was administered to neonates requiring invasive mechanical ventilation with an oxygen index greater than 10–12. The primary outcomes assessed were mortality and duration of mechanical ventilation. Of the 60 neonates studied, 36 were inborn and 24 were outborn. Forty-eight neonates (80%) were successfully weaned off mechanical ventilation within 48 hours and survived, while 12 neonates (20%) could not be weaned and died. Mortality among neonates who received surfactant therapy was significantly lower (7%) compared to those who did not receive surfactant (42%), with the difference being statistically significant ($p \approx 0.0014$). The findings of this study indicate that early administration of surfactant in neonates with meconium aspiration syndrome improves respiratory outcomes, facilitates earlier weaning from ventilatory support, and significantly reduces mortality.

INTRODUCTION

Meconium aspiration syndrome (MAS) is a serious neonatal respiratory condition that occurs when a newborn aspirates meconium-stained amniotic fluid either in utero or during delivery, leading to significant respiratory distress soon after birth. MAS complicates approximately 3–12% of deliveries with meconium-stained amniotic fluid, and nearly one-third to one-half of affected neonates require continuous positive airway pressure or mechanical ventilation due to severe hypoxemia and respiratory failure [1,2]. The pathophysiology of MAS is multifactorial and includes airway obstruction, chemical pneumonitis, surfactant dysfunction, and persistent pulmonary hypertension, all of which contribute to impaired gas exchange and increased morbidity and mortality [3].

A key mechanism in the progression of MAS is the inactivation of endogenous pulmonary surfactant by meconium. The enzymatic, fatty acid, and sterol components of meconium disrupt surfactant phospholipids and inhibit surfactant proteins, resulting in increased alveolar surface tension, reduced lung compliance, and secondary surfactant deficiency [4,5]. This surfactant dysfunction exacerbates ventilation-perfusion mismatch and leads to worsening hypoxemia, often necessitating invasive respiratory support and, in severe cases, extracorporeal membrane oxygenation (ECMO) [6].

Surfactant replacement therapy has emerged as an important therapeutic strategy in the management of moderate to severe MAS. Several studies have demonstrated that exogenous surfactant administration improves oxygenation, enhances lung compliance, reduces the duration of mechanical ventilation, and decreases the need for ECMO in affected neonates [7,8]. Despite this evidence, variability exists in the timing, indications, and outcomes of surfactant use in MAS, particularly in resource-limited settings. Therefore, this prospective observational study was undertaken to evaluate the effect of surfactant therapy on mortality and respiratory outcomes in neonates with meconium aspiration syndrome admitted to a tertiary care

neonatal intensive care unit.

AIMS AND OBJECTIVES

The aim of this study was to evaluate the effectiveness of surfactant therapy in neonates diagnosed with meconium aspiration syndrome admitted to a tertiary care neonatal intensive care unit. The primary objective was to assess clinical outcomes in terms of mortality among neonates receiving surfactant therapy compared with those who did not receive surfactant. The secondary objectives included evaluating the impact of surfactant administration on respiratory morbidity, particularly the duration of mechanical ventilation and the ability to achieve early weaning from ventilatory support, as well as overall improvement in respiratory status during the course of hospital stay.

METHODS AND METHODOLOGY

This prospective observational study was conducted over a period of six months in the Neonatal Intensive Care Unit of Hi-Tech Medical College and Hospital, Bhubaneswar. A total of 60 neonates were enrolled during the study period. Term neonates (≥ 37 weeks gestation) born through meconium-stained amniotic fluid who developed respiratory distress immediately after birth and were diagnosed with meconium aspiration syndrome were included in the study within 12 hours of birth. Neonates requiring respiratory support with an oxygen index between ≥ 8 and ≤ 25 were considered eligible. Neonates with congenital anomalies, inborn errors of metabolism, preterm birth, respiratory distress syndrome due to primary surfactant deficiency, or those who were chronically ventilated were excluded. Detailed clinical evaluation including perinatal history, demographic details such as sex, gestational age, birth weight, and mode of delivery was recorded for all enrolled neonates. Diagnostic evaluation included chest X-ray, arterial blood gas analysis, pulse oximetry, blood culture, and echocardiography when indicated. Initial respiratory management included continuous positive airway pressure or non-invasive ventilation, and neonates who failed non-invasive support were escalated to invasive mechanical ventilation. Surfactant

therapy was administered to intubated neonates with an oxygen index greater than 10–12, and those intubated in the emergency room due to severe respiratory distress received surfactant immediately after admission to the NICU. Clinical outcomes including mortality, duration of mechanical ventilation, duration of oxygen supplementation, pneumothorax, intraventricular hemorrhage, and chronic lung disease were monitored throughout the hospital stay, with mortality as the primary outcome and duration of ventilatory support as secondary outcomes. Statistical significance was assessed, with a p-value of less than 0.05 considered significant.

RESULTS

As shown in Figure 1; Among the 60 neonates enrolled in the study with meconium aspiration syndrome, the majority were inborn. Out of the total study population, 24 neonates (40%) were outborn and referred to the tertiary care center within the first 24 hours of life, while 36 neonates (60%) were inborn and delivered at the study institution.

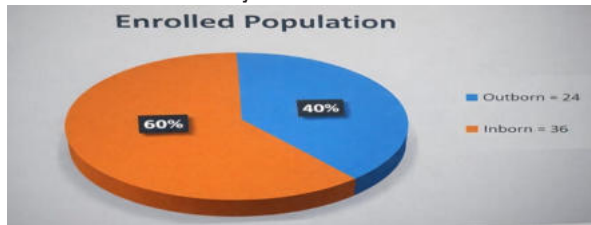


Figure 1

In Table 1 Out of the 60 neonates with meconium aspiration syndrome included in the study, 39 neonates received surfactant therapy while 21 did not receive surfactant. Among those who received surfactant, 36 neonates survived and 3 neonates died, resulting in a survival rate of 92.3% and a mortality rate of 7.7%. In contrast, among neonates who did not receive surfactant therapy, only 12 survived while 9 died, corresponding to a survival rate of 57.1% and a mortality rate of 42.9%. Overall, 48 neonates (80%) survived and were discharged, whereas 12 neonates (20%) succumbed to the illness. Survival was significantly higher and mortality markedly lower in neonates who received surfactant therapy compared to those who did not, demonstrating a strong association between surfactant administration and improved survival outcomes in meconium aspiration syndrome.

Table 1

	SURFACTANT (YES)	SURFACTANT (NO)	TOTAL
SURVIVED	36	12	48
DIED	3	9	12
TOTAL	39	21	60

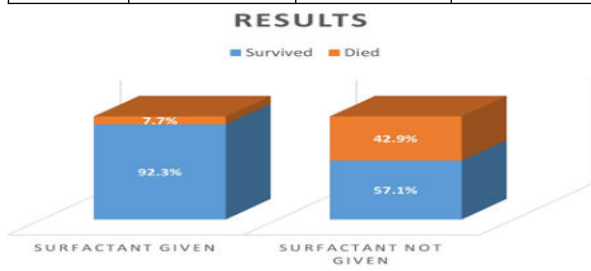


Figure 2

The Figure 2 shows outcome of neonates with meconium aspiration syndrome differed significantly based on surfactant administration. Among neonates who received surfactant therapy, 92.3% survived while 7.7% died. In contrast, among neonates who did not receive surfactant therapy, only 57.1% survived, whereas 42.9% succumbed to the illness. The survival rate was markedly higher and the

mortality rate substantially lower in the surfactant-treated group compared to the non-surfactant group. These findings demonstrate a strong association between surfactant administration and improved survival outcomes in neonates with meconium aspiration syndrome.

Figure 3 illustrates that mechanical ventilation weaning outcomes within the first 48 hours were favorable in the majority of neonates with meconium aspiration syndrome. Out of the 60 neonates included in the study, 48 neonates (80%) were successfully weaned off mechanical ventilation within 48 hours, while 12 neonates (20%) remained ventilator-dependent beyond 48 hours. The high proportion of early successful weaning reflects improved respiratory recovery in most neonates and indicates effective response to respiratory management, including surfactant therapy, during the acute phase of illness.

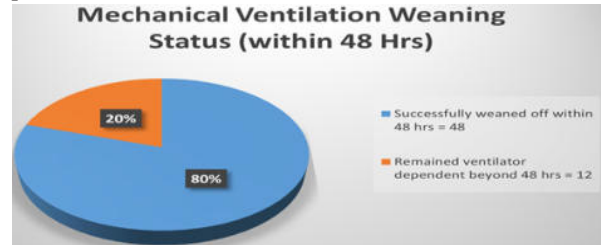


Figure 3

In Figure 4 and Figure 5 it shows that among inborn neonates with meconium aspiration syndrome, 18 received surfactant therapy and 18 did not. Overall, 30 inborn neonates were discharged, while 6 died, indicating favorable outcomes with early in-hospital management. Among outborn neonates, 21 received surfactant therapy and 3 did not. Eighteen outborn neonates were discharged and 6 died. Despite delayed referral, most outborn neonates achieved favorable outcomes following surfactant administration. Overall, surfactant therapy was associated with improved survival and discharge rates in both inborn and outborn neonates.

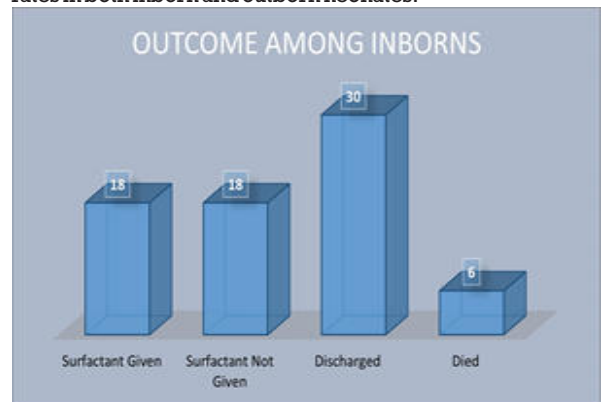


Figure 4

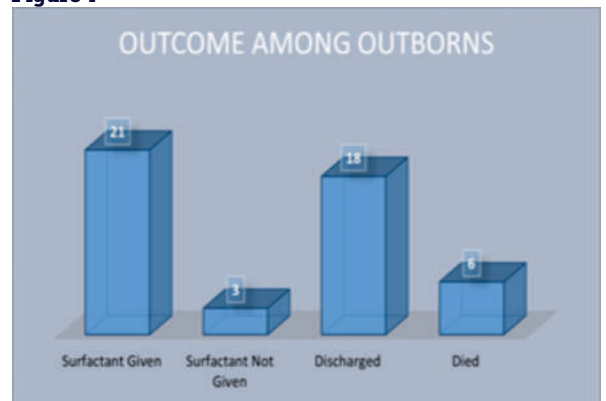


Figure 5

In a whole a total of 60 neonates with meconium aspiration syndrome were included in the study, of whom 36 (60%) were outborn and 24 (40%) were inborn. Surfactant therapy was administered to 39 neonates, while 21 did not receive surfactant. Overall, 48 neonates (80%) survived and were discharged, whereas 12 neonates (20%) died. Survival was significantly higher among neonates who received surfactant therapy, with a survival rate of 92.3% and a mortality rate of 7.7%, compared to a survival rate of 57.1% and mortality rate of 42.9% among those who did not receive surfactant. Mechanical ventilation weaning within 48 hours was achieved in 48 neonates (80%), while 12 neonates (20%) remained ventilator-dependent beyond 48 hours and subsequently died. Among inborn neonates, 30 were discharged and 6 died, whereas among outborn neonates, 18 were discharged and 6 died. Despite a higher severity of illness at presentation among outborn neonates, surfactant therapy was associated with improved survival and favorable outcomes in both inborn and outborn groups.

LIMITATIONS

The present study has certain limitations. The sample size was relatively small, which may limit the generalizability of the findings and reduce statistical power. As a single-center, prospective observational study, the results may be influenced by institutional practices and may not be representative of other settings. Inclusion of both inborn and outborn neonates introduced heterogeneity in the study population, with outborn neonates likely experiencing delays in referral and initiation of definitive treatment, potentially affecting outcomes. Additionally, the absence of randomization and a control group limits the ability to establish a causal relationship between surfactant therapy and improved outcomes. Long-term respiratory outcomes were not assessed, restricting conclusions to short-term clinical outcomes only.

CONCLUSIONS

Meconium aspiration syndrome remains an important cause of neonatal respiratory morbidity and mortality, particularly among term and post-term neonates requiring intensive respiratory support. The findings of this prospective observational study demonstrate that surfactant therapy plays a significant and beneficial role in the management of moderate to severe meconium aspiration syndrome. Neonates who received surfactant therapy showed markedly improved survival, earlier weaning from mechanical ventilation, and better overall respiratory recovery compared to those who did not receive surfactant. The substantial reduction in mortality observed in the surfactant-treated group highlights the importance of addressing secondary surfactant inactivation, a key pathophysiological mechanism in meconium aspiration syndrome. Favorable outcomes were observed in both inborn and outborn neonates, indicating that surfactant therapy is effective even in referred cases presenting with more severe illness. Early recognition of disease severity, timely escalation of respiratory support, and prompt surfactant administration based on oxygen index appear to be crucial determinants of improved outcomes. These findings support the inclusion of surfactant therapy as an integral component of management protocols for severe meconium aspiration syndrome, while emphasizing the need for larger multicentric studies with long-term follow-up to further validate these results and establish standardized treatment guidelines.

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