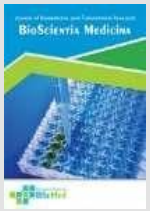
eISSN (Online): 2598-0580



Bioscientia Medicina: Journal of Biomedicine & Translational Research

Journal Homepage: www.bioscmed.com

Surfactant Therapy in Meconium Aspiration Syndrome: A Case Report

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ARTICLE INFO

Keywords:
Meconium aspiration syndrome
Patent ductus arteriosus
Respiratory distress
Surfactant therapy

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All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/bsm.v8i3.950

A B S T R A C T

Background: Meconium aspiration syndrome (MAS) is one of many causes of respiratory distress in newborns. Data regarding MAS in Indonesia is still very limited, but a study revealed MAS is related to a high mortality rate. The latest study revealed surfactant therapy is related to better clinical outcomes in MAS cases. This study aimed to present a case of a baby with meconium aspiration syndrome given bolus surfactant therapy. **Case presentation:** A day-old baby was referred to our emergency department with respiratory distress, delivered by cito caesarean section due to cephalopelvic disproportion with premature rupture of membranes. The baby didn't cry immediately; bluish skin and green amniotic fluid were found. The baby was already intubated from the referring hospital, and the physical examination revealed rales on both lungs with severe work of breath. Chest radiography revealed patchy opacities in the right lung hemisphere, suggesting MAS. Echocardiography revealed a small patent ductus arteriosus, and head ultrasonography revealed mild brain oedema. The baby received bolus bovine surfactant therapy at 16 hours of age, delivered through an endotracheal tube. Clinical improvement was observed, and supplementary oxygen was reduced gradually. The baby was able to maintain good oxygenation without supplemental oxygen by day 12th and was able to breastfeed and drink from the bottle. He was discharged with good condition. **Conclusion:** Surfactant therapy can become a safe and effective treatment modality in MAS. Further study is still needed regarding time, method, and types of surfactants used in MAS management.

1. Introduction

Meconium aspiration syndrome (MAS) is one of the common causes of respiratory distress in newborns. Although not every meconium-stained amniotic fluid (MSAF) delivery will develop into MAS, it remains a major concern for both obstetricians and neonatologists. Meconium aspiration syndrome is still common in most developing countries, compared to other developed countries.[1] Anindita et al. revealed that a total of 22 babies were admitted to the neonatal intensive care unit (NICU) of dr. Soetrasno General Hospital 12 babies (54.5%) are diagnosed with MAS, and most of them require ventilation support.[2] Supportive management, including oxygen supplementation, fluid administration, and mechanical ventilation, becomes the principal therapy in MAS.[3]

Surfactant therapy is a new treatment modality for MAS. Although there haven't been any guidelines regarding this method and timing, mode of deliveries, and types of surfactant used, some studies have revealed surfactant therapy related to good clinical outcomes. In this report, we present a case of a patient with meconium aspiration syndrome given bolus surfactant therapy. We aim to discuss and review the literature to provide better comprehension so that the long-term clinical outcome of MAS patients can be improved.

2. Case Presentation

A day-old male neonate weighing 2,915 grams delivered by cito caesarean section from primigravida and primipara mother due to cephalopelvic disproportion with premature rupture of membranes (PROM) and fetal distress was presented to our emergency department with respiratory distress. The mother had no history of pregnancy problems. The baby didn't cry immediately, a bluish skin colour was observed, and dark green amniotic fluid was found. Baby's skin, nails, and umbilical cord were stained by greenish meconium (Figure 1). The APGAR score for the first minute is 3 and 5 for the fifth minute. Before being admitted to our hospital, the baby was treated and received antibiotic therapy of cefotaxime and amikacin; and continuous positive airway pressure (CPAP) was installed, however, later intubated due to frequent desaturation (SaO_2 70-80%).

Upon arrival, clinical examination revealed poor condition, rales were noticed on both lungs, with grade II systolic murmur at the 2nd intercostal space (ICS), left parasternal line. Blood pressure (BP) was 91/56 mmHg, heart rate (HR) of 141 beats per minute, work of breathing was severe, blood oxygen saturation (SaO_2) of 95% with 100% fraction of inspired oxygen (FiO_2), and temperature of 36,3°C. Laboratory test revealed a leucocyte count of 31,600 /µL (85.9% neutrophils, 5.5% lymphocytes, 7.8% monocytes, 0.3% eosinophils, 0.5% basophils) [reference range 3.000-15.000 /µL], haemoglobin 14.3 g/dL [reference range 9.5-17.0 g/dL], and thrombocytes 309,000/µL [reference range 150.000-440.000/µL]. Blood gas analysis (BGA) revealed respiratory acidosis with pH 7.263 [reference range 7.35-7.45], pO_2 121 mmHg [reference range 80-100 mmHg], pCO_2 55.7 mmHg [35-45 mmHg], HCO_3 25.1 mmol/L [22-26 mmol/L], SO_2 98%, and BEecf -2 [reference range (-2) - (+2)]. Blood culture revealed no bacterial growth. Chest radiography revealed patch opacities in the right lung hemisphere suggesting MAS (Figure 2.). Echocardiography revealed a small patent ductus arteriosus (PDA), and head ultrasonography (USG) revealed mild brain oedema.

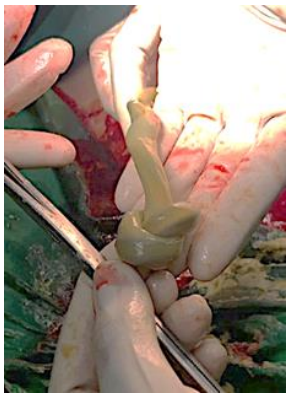

Figure 1. Stained umbilical cord by greenish meconium.

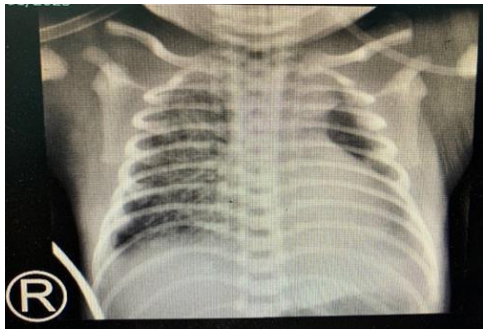

Figure 2. Chest X-ray of opacities in right lung hemisphere.

We continued antimicrobial therapy with cefoperazone, sulbactam and amikacin. Bolus surfactant administration was done at 16 hours of age, and delivered through an endotracheal tube with a dose of 100 mg/kg body weight. Fractional-inspired O_2 was reduced gradually; 17 hours post surfactant therapy FiO_2 was reduced to 40% with the patient's SaO_2 of 94%. Within four days post surfactant therapy, FiO_2 reduced to 30%. The patient was extubated on his 5th day of life and switched to nasal intermittent positive pressure ventilation (NIPPV) with positive inspiration pressure (PIP) of 19 mmHg, positive end-expiratory pressure (PEEP) of 7 mmHg, rate 20 times per minute and FiO_2 30%. The patient was able to maintain good clinical condition with BP 86/54 mmHg, HR 130 beats per minute, RR 55 times per minute, and SaO_2 of 94% with a capillary refill time of less than 3 seconds. On his 9th day, ventilation mode was switched to spontaneous continuous positive airway pressure (CPAP) with PEEP 5 mmHg and FiO_2 30%. The patient was able to maintain good oxygenation without any oxygen support on his 12th day and was able to breastfeed and drink from the bottle without difficulties. The patient was discharged on day 13th in good condition.

During his treatment in our facilities, we also provided several intensive care interventions, i.e.: parenteral and enteral nutrition, inotropic therapy, sedation by morphine administration, symptoms and supportive therapy related to small PDA and mild brain oedema was also provided. EEG was also planned to evaluate any possible effect resulting from previous brain oedema. Written informed consent was also obtained from the patient's parent for publication of this case.

3. Discussion

Respiratory distress is the most common presentation of newborns being admitted to the neonatal intensive care unit. Transient tachypnea of the newborn is the most common cause of respiratory distress in newborns, followed by MAS. The incidence of meconium aspiration itself is low, however, the presence of meconium-stained amniotic fluid occurs in 10-15% of deliveries.[4,5] Passage of meconium is a natural event that happens in a term or post-term fetus, although some theories state that meconium passage is either caused by fetal maturation or fetal stress.[6] Signs suggesting MAS is the presence of meconium-stained amniotic fluid, followed by a non-vigorous baby with signs of respiratory distress, tachypnea, grunting, cyanosis, nasal flaring, retractions, and rales or rhonchi.[1] This report presents a term male neonate delivered by cito caesarean section due to fetal distress and cephalopelvic disproportion from a mother with a history of PROM. Green amniotic fluid, staining in baby's umbilical cord, skin and nails was found, with cyanosis and the baby didn't cry immediately. Obvious signs of fetal respiratory distress were present in this case.

The patient was then resuscitated and received supplemental oxygen via CPAP before referral, but later intubation was done considering the frequent desaturation of the baby (SaO_2 70%-80%). This event is related to the partial or complete obstruction of the airway caused by the meconium plug, leading to air trapping and high resistance to airflow.[1,7] Typical MAS radiologic is diffuse coarse patchy infiltrate, which is present in our case showing diffuse patchy opacities in the patient's right lung hemisphere. Persistent pulmonary hypertension of newborns (PPHN) is one complication of MAS that could worsen hypoxemia. Previous study stated there are 3 possible causes of PPHN: 1. hypertrophy or neo-muscularization of post-acinar capillaries caused by chronic hypoxia in intrauterine; 2. pulmonary vasoconstriction due to hypoxia, hypercarbia, or acidosis; or 3. pulmonary constriction due to lung inflammation.[7] Echocardiogram is needed to evaluate the possibilities of PPHN in MAS, in our case, an echocardiogram was conducted and revealed the presence of a small PDA and there are no findings related to PPHN.

Surfactant therapy is a new treatment modality for MAS cases, which is related to the pathophysiology of MAS itself. Meconium contains various elements, ranging from intestinal secretes, cells, lanugo hair,

bile, blood, pancreatic enzymes, free fatty acids, and some pro-inflammatory mediators.[6] Pancreatic enzymes, bile, and free fatty acids can alter the surfactant functions; while inflammation and oxidative stress could destroy type II pneumocytes, which is important in surfactant production.[8] Meta analysis conducted by El Shaded, et al revealed surfactant therapy had no statistically significant effect on reducing mortality (risk ratio (RR) 0.98, 95% CI 0.41 to 2.39), however, it can reduce the need of extracorporeal membrane oxygenation (ECMO) (RR 0.64, 95% CI 0.46 to 0.91), and the duration of hospital stay (mean difference (MD) -8 days, 95% CI 14 to 03.[9] However Hui, et al revealed usage of surfactant therapy can decrease the duration of mechanical ventilation compared to the control group (weighted mean difference (WMD) -1.12, 95% CI -1.40 to -0.84), although it cannot decrease the duration of oxygen needs and hospital stay, they suggest this method can be effective and safe modalities in treating MAS.[10] Further studies are still needed to evaluate the efficacy and safety of this method, but some reports have shown good clinical improvement by using surfactant therapy in MAS.[9]

The patient received surfactant therapy in his 16th hour of age using bovine surfactant. The patient's condition improved in 7 hours post surfactant therapy, and although it was difficult, we were still able to reduce the oxygen fraction used over time. The ventilation mechanism was changed from pressure control-assist control (PC-AC) into pressure control synchronized intermittent mandatory ventilation (PC-SIMV). We extubated the patient on day 5th and switched to NIPPV. The patient responded well after extubation was done, there were no signs of respiratory distress noticed and the patient was able to maintain good oxygenation (SaO_2 92%-94%). Oxygen supplementation was gradually reduced, ventilation switched from NIPPV to CPAP, high flow nasal oxygen, and low flow oxygen, consecutively; and the patient was able to maintain good clinical condition and oxygen saturation without any oxygen supplementation on his 12th day.

There is still no guideline on how early surfactant therapy should be done, but most of the studies revealed early surfactant therapy is associated with reduced mortality, the need for mechanical ventilation, and hospital length of stay. Meta-analysis conducted by Bahadue and Soll revealed, there is a significant reduction in neonatal mortality and chronic lung disease (CLD) with early surfactant therapy [(RR 0.84, 95% CI 0.74 to 0.95) and (RR 0.69, 95% CI 0.55 to 0.87)].[11] Garib, et al revealed early administration of surfactant is related to early extubation, lower chance of re-intubation, reduced duration of CPAP use, and reduced duration of total oxygen administration and hospital length of stay.[11] In this case we were facing difficulties in weaning the oxygen supplementation, perhaps related to surfactant therapy was done at his 16 hours old age, as the studies recommend delivering early surfactant therapy.

4. Conclusion

Surfactant therapy possesses the chance to become a treatment modality in MAS. Although some studies revealed good clinical outcomes in this treatment, further study is still needed. Thorough examination is mandatory in managing MAS, to evaluate disease severity and any possible complication, related to treatment outcome.

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