A Sticky Situation: Meconium Aspiration in the Emergency Department

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CE Earn Up to 7.5 Hours. See page 111.

Contribution to Emergency Nursing Practice

- The current literature on meconium aspiration syndrome indicates that there is insufficient evidence to support the need for routine tracheal intubation for nonvigorous neonates born in meconium-stained fluid in contrast to no intubation for suctioning.
- This article contributes information on management of the nonvigorous infant born with meconium aspiration syndrome.
- Key implications for emergency nursing practice found in this article are signs and symptoms of meconium aspiration, the updated American Heart Association guidelines for management of a nonvigorous infant born in meconium-stained fluid, and equipment to prepare for a precipitous delivery and possible intubation.

Case Study

A 30-year-old African-American woman, G1P0 at 41 weeks' gestation, presents to the emergency department with a chief complaint of abdominal pain. She tells the triage nurse that her water broke about 1 hour before arrival and that she has been feeling increased pressure. She relates that this is her first pregnancy, and she has not received prenatal care. She denies history of alcohol or drug use. Her vitals are temperature: 100°F, blood pressure of 150/86, heart rate of 110 beats per minute, respiratory rate of 24 breaths per minute, and oxygen saturation of 99% on room air. She rates her abdominal pain as 10/10 and sharp. She tells the triage nurse that she thinks the baby is coming now. The triage nurse finds the baby's head crowning with a thick greenish sticky substance noted the women's underwear and on top of the baby's hair. The woman is immediately rushed to a treatment room, the ED physician is notified, and the neonatal intensive care unit (NICU) team is called. When the newborn is delivered, she is gray in color, unable to take a breath of her own, and has a pulse of 60.

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Background

Meconium stained amniotic fluid (MSAF) can occur at any gestational age but is most pronounced in post-term infants.[1] Approximately 10% to 16% of full-term infants are born in MSAF. Of the infants born in MSAF, meconium aspiration syndrome (MAS) is diagnosed in 0.10% at 37 weeks, peaking at 0.31% at 41 weeks' gestation.[1] The number of US infants diagnosed with MAS experienced a major decline in the 1990s due to a reduction in births of greater than 41 weeks' gestation and increased diagnosis of abnormal fetal heart tracings.[2] MAS is still considered a serious challenge in newly industrialized and developing countries and makes up 10% of respiratory failure occurrences with a mortality rate of 39%.[2]

Etiology

There are many common antepartum, intrapartum, and neonatal risk factors associated with the development of MAS (Table 1). Of note, drugs of abuse, including cocaine[3] and methamphetamine,[4] increase the risk of meconium passage, and those dependent on opiates have a 6 times greater risk for pregnancy complications including MAS.[5]

TABLE 1
Risk factors for meconium aspiration syndrome

Risk Factors	Examples
Ethnicity	African-American,[1] African,[1] Pacific Islander,[1] Indigenous Australian[1]
Maternal Factors	Nulliparity,[1] intrapartum fever,[1] hypertension,[7] preeclampsia,[7] placental insufficiency,[7] oligohydraminos,[7] >41 weeks' gestation,[1] mean low pH of the umbilical cord,[1] maternal infection,[7] maternal drug use[7](methamphetamines,[4] opiates,[5] cocaine[3]), tobacco[5]
Fetal Factors	Irregular fetal heart rate,[1] low Apgar score,[1] fetal hypoxia,[7] low birth weight[1]

Pathophysiology

Although many of the complications from meconium aspiration occur after the neonate leaves the emergency department, the underlying mechanisms leading to these complications begin at birth. Minimizing these complications will have impact on the course of treatment and, potentially, the long-term health of the child.

Meconium may be relatively watery but typically has a thick, sticky, dark green appearance and is composed of cellular debris, lanugo, ingested vernix caseosa, gastrointestinal secretions, bile, bile acids, pancreatic juice, mucus, and blood.[2,6] Meconium can be found in the fetal gastrointestinal tract as soon as 14 to 16 weeks' gestation and is normally passed within 24 hours of birth. Passage of meconium may be induced by peristalsis and rectal sphincter relaxation caused by vagal stimulation from the brain or compression of the spinal cord.[7] Importantly, fetal hypoxia can cause colonic stimulation, which enables meconium passage.[2] As opposed to normal fetal breaths, which are shallow, fetal distress caused by ischemia or hypoxia may stimulate deep gasping, leading to meconium amniotic fluid aspiration.[2,8]

The pathophysiology of MAS involves acute airway obstruction, inactivation, or dysfunction of surfactant, leading to alveolar collapse, chemical pneumonitis causing inflammatory changes, and vasoconstrictive-mediator release resulting in reduced ability to exchange gases, and persistent pulmonary hypertension of the newborn (PPHN). This latter complication can be fatal and is often made worse with pulmonary air leaks including pneumothorax, pneumomediastinum, pulmonary interstitial emphysema, PPHN, and respiratory failure.[2]

Diagnosis

The clinical criteria for MAS are respiratory distress demonstrated in a neonate born in MSAF; oxygen needed to maintain an oxygen saturation of 92% or greater; the need for oxygen within the first 2 hours of life, continuing for a minimum of 12 hours; and absence of heart, airway, or lung congenital malformations.[2,6] MAS can range in severity from mild respiratory distress to respiratory failure.[8] Neonates with meconium aspiration also have increased chance of complications such as seizures, neurological dysfunction, sepsis, and a longer stay in the NICU.[9]

MAS diagnosis is based on findings of respiratory distress (Table 2) in an infant born in MSAF without any other respiratory distress cause.[2] Chest x-ray findings of MAS include diffuse patchy infiltrates and lung overexpansion.[2] Some of these areas may imply consolidation or atelectasis, and different areas may show air trapping.[10] X-ray findings may not always be congruent with the clinical picture.[2]

Emergent Treatment

Precipitous delivery requires the rapid assembly of the team. In addition to nurses and physicians, respiratory therapists, and, if available, a neonatal team should be requested. The American Heart Association (AHA) has updated their recommendations for management of a neonate born with MSAF. There is insufficient evidence to support the need for routine tracheal intubation for nonvigorous neonates born in MSAF in contrast to no intubation for suctioning.[11] However, 2 team members (eg, physician and respiratory

TABLE 2
Clinical presentation of meconium aspiration syndrome[3]

System	Symptoms
Respiratory	Increased work of breathing: tachypnea, nasal flaring, grunting, retractions
Skin	Cyanosis
Breath Sounds	Rhonchi and crackles

therapist) who have experience intubating should be present because of the potential need for resuscitation.[11] Without proven benefit for suctioning, the ED staff should focus on providing ventilation in the first minute in the ineffectively or nonbreathing infant. For newborns 35 weeks or older, begin with 21% oxygen (room air) for positive-pressure ventilation. For neonates younger than 35 weeks' gestation, begin with 21% to 30% oxygen. To meet the oxygen saturation goal measured by pulse oximetry, free-flow oxygenation is started at 30%. Titration of oxygen concentration is achieved using the blender. If the newborn is experiencing respiratory distress, or if the oxygen saturation goal cannot be achieved despite 100% oxygenation, consider continuous positive airway pressure (CPAP).[11] Intubation and suctioning of the airway is recommended for an obstructed airway.[11]

A nonvigorous infant is characterized by the Neonatal Resuscitation Program as meeting 1 or more of the following criteria: decreased muscle tone, respiratory depression, or heart rate under 100 beats per minute.[12] If the infant is nonvigorous, resuscitation should be done under a radiant warmer. This will lessen the loss of heat and allow the infant to be easily accessible during resuscitation.[13] After the initial steps of resuscitation, positive pressure ventilation (PPV) should be given if the infant's heart rate is below 100 per minute or is nonbreathing.[11] If an infant born through MSAF is vigorous with normal respiratory function and muscle tone, the infant may be placed skin-to-skin with a stable mother. If needed, a bulb syringe may be used to clear meconium from the nose and mouth.[11]

Ongoing Emergency Department Management

If available, a neonatologist should be consulted regarding the type of unit to which the newborn should be admitted. Generally, neonates born through MSAF who exhibit respiratory distress need to be admitted to a NICU.[3] If the hospital does not have a NICU, a safe transfer should be arranged for the neonate to the higher level of care.

Care for the neonate until admission or transfer is predominately supportive; its goals are to correct acidosis and hypoxemia and maintain temperature and blood pressure. An unstable neonate should receive ICU level nursing care: a one to one assignment. An estimated one third of infants with MAS need intubation and ventilation; however, in less critical incidences of MAS, oxygen therapy may be the only treatment needed.[14] Oxygen is a strong pulmonary vasodilator, and oxygen saturations should be kept between 90% and 95%.[7] Reduced handling, maintaining a quiet environment, analgesia, and sedation help guard against pain and stress-induced hypoxia and right-to-left shunting in ventilated MAS patients.[3] Metabolic irregularities, such as hypocalcemia, hypoglycemia, and polycythemia, will need to be corrected.[3] Dextrose infusions are given to prevent or treat hypoglycemia and can be administered through umbilical access or an intravenous line; fluid should be administered at rates of 60 to 70 mL/kg/day.[7]

Protecting the neonate from loss of body heat is an important goal.[15] The goal for the neonatal axillary temperature should be approximately 36.5°C (97.7°F).[11] For the stable neonate who has been given to his or her mother, both infant and mother need to be covered with a blanket.

There remains disagreement about whether to treat infants with MAS with broad-spectrum antibiotics. There is no definitive evidence that prophylactic antibiotics decrease the development of sepsis in neonates who are born through MSAF.[7,10] Further, antibiotics are not immediately necessary and may be started in the NICU for those infants with suspected or proven infections.[7]

Implications for Emergency Nursing

Because of the unknown condition of the fetus before delivery and the potential need for resuscitation, women presenting with impending precipitous deliveries should be triaged as an Emergency Severity Index (ESI) level 1.[16] Staff should obtain all appropriate equipment for delivery and potential resuscitation (Tables 3, 4, 5, and 6).

TABLE 3
Precipitous delivery kit[22]

Item	Sizes
(2) Receiving blankets	
(2) Cord clamps	
(1) Bulb syringe	
(1) Measuring tape	
(1) Temperature probe	
(3) Name bands	
(1) Infant mask	1
(1) Laryngoscope with neonate blade and holder	
(2) French suction catheters	8, 10
(1) Sterile gloves	
(1) Scissors	

TABLE 4
Intubation equipment[21]

Item	Sizes
(1) Laryngoscope	
(3) Blades	Size 1 (full term infant), size 0 for premature infant, size 00 for extremely premature infant
(4) Endotracheal tube	2.5, 3, 3.5, 4
(1) Stylet	
(1) Carbon dioxide detector	
(4) Set up for suction and suction catheters	Suction catheters: 5F, 6F, 8F, 10F (suctioning pharynx)
(1) Waterproof tape	
(1) Oral airway	0, 00, 000
(2) Positive pressure tubing and device	Preterm, term infant masks
(1) Oxygen source	
(1) Compressed air source	
(1) Oxygen blender	
(1) Pulse oximeter	
(1) Stethoscope	
(1) Meconium aspirator	

In addition to the management of the infant throughout the emergency encounter, the ED nurse should prepare and attach identification (ID) bands to the mother and newborn while the neonate is still with the mother. The ID band should display the mother's medical record number, infant's gender, date and time of birth, and other information required by hospital protocol.[13]

Although the priority is to medically stabilize the infant, ED nurses need to keep the parents informed.

TABLE 5
Medications at bedside for resuscitation[21]

Item	Concentration or Amount
Epinephrine	1:10,000 (0.1 mg/mL)
Isotonic Intravenous Bags: Normal saline, Lactated Ringers	Lactated ringer size: 100-mL bag
Dextrose 10%	
Normal Saline flushes	

TABLE 6
Umbilical artery catheterization equipment[21]

Item	Sizes
(2) Umbilical catheters	3.5F, 5F
(6) 3-way stop cock syringes	1, 3, 5, 10, 20, 50 mL
(3) Needles	18, 21, 25 gauges
Sterile gloves	
(1) Betadine	
(1) Scalpel	
(1) Umbilical tape	

Parents require honest and understandable explanations involving the plan of care to relieve fear.[17] Patients and families may have a deficit of knowledge regarding what questions to ask. Communication from the health care team should include the possible benefits and risks of treatments, be informative, and allow parents to have input into the plan of care.[18,19] A modified family-centered care (FCC) model is encouraged to provide the best outcomes for the neonates and their families. The FCC includes sharing of information, dignity and respect, participation, and collaboration.[19] Practicing this model may lessen parental stress through increased participation in taking care of their infants. Challenges to providing patient and FCC may include time constraints, absence of a previous relationship between the ED staff and the patient/family, and the emergent reason for the emergency department visit.[18,19] Even infants in the most guarded conditions need care provided by their parents. If skin-to-skin contact is not possible, encourage encircled holding, which is where parent(s) arrange their arms around the infant, providing intimacy while allowing the neonate to stay in the warmer.[20]

If the neonate needs to be transported to a different hospital, the ED nurse must be aware that transport affects the parents' ability to build a relationship with their infants and can lead to parental worry and anxiety. ED nurses should work with the transport team to make sure the parents are informed about the plan of care (eg, reuniting with the infant, provision of breast milk) and give the parents the opportunity to ask questions and see and touch their infants before they are transported.[19]

Finally, because of the relative infrequency of complicated deliveries occurring in the emergency department, ongoing education of the nursing staff is of upmost importance. There should be an annual review of equipment necessary for delivery, including the infant warmer, location

and calculation of drugs to be used in a neonatal arrest, and umbilical tray locations.

Case Study Conclusion

PPV was applied initially with 21% oxygen but without adequate chest rise, despite repositioning of the mask. The neonate was intubated with a size-3 endotracheal tube by the physician, and suction was applied to the tube with results of a small amount of thick green fluid. The infant was reintubated with subsequent adequate chest rise. Vital signs and pulse oximetry stabilized. The plan for the baby was discussed with the mother. The baby was to be transferred to the connected children's hospital's NICU. The mother was informed that she would be brought to see her baby in the NICU within a couple of hours. Following discussion, which revealed that the mother was planning to breastfeed, a breast pump was provided upon arrival in women's services. The mother was discharged on day 3, and baby was discharged home to her mother on day 8 following birth.

Conclusion

This high-risk, low-volume, complicated delivery is more common among women who are of certain ethnicities such as African-American or Pacific Islander, who are of 41 weeks' gestation, have histories of hypertension, and/or use illicit drugs or alcohol. Recognizing these risk factors can help the nurse to quickly identify these women. In the event of an ED delivery, the emergency team needs to be prepared and up to date on managing not only the delivery but also the complications associated with meconium aspiration. In addition to skilled care, timely collaboration with other team members, including NICU and the transport team, are vital to providing emergent care for the neonate and minimizing future complications. Not only the physical skills of managing the delivery but incorporating FCC will have a lasting aspect on the new family.

REFERENCES

1. Choi W, Jeong H, Choi SJ, et al. Risk factors differentiating mild/moderate from severe meconium aspiration syndrome in meconium-stained neonates. *Obstet Gynecol Sci*. 2015;58(1):24-31. https://doi.org/10.5468/ogs.2015.58.1.24.
2. Swarnam K, Soraisham AS, Sivanandan S. Advances in the management of meconium aspiration syndrome. *Int J Pediatr*. 2012. https://doi.org/10.1155/2012/359571.
3. Goel A, Nangia S. Meconium aspiration syndrome: challenges and solutions. *Res Rep Neonatol*. 2017;7:19-28. https://doi.org/10.2147/RRN.S78106.
4. Carter RC, Wainwright H, Molteno CD, et al. Alcohol, methamphetamine, and marijuana exposure have distinct effects on the human placenta. *Alcohol Clin Exp Res*. 2016;40(4):753-764. https://doi.org/10.1111/acer.13022.
5. Minozzi S, Amato L, Bellisario C, et al. Maintenance agonist treatments for opiate dependent pregnant women. *Cochrane Database Syst Rev*. 2013;12:1.
6. Lindenskov H, Castelheim A, Saugstad OD, Mollnes TE. Meconium aspiration syndrome: possible pathological mechanisms and future potential therapies. *Neonatology*. 2015;107:225-230. https://doi.org/10.1159/000369373.
7. Geis A, Clark DA, Windle ML, et al. Meconium aspiration syndrome treatment & management. Medscape. http://emedicine.medscape.com/article/974110-treatment. Accessed July 3, 2017.
8. Nangia S, Thukral A, Chawla D. Tracheal suction at birth in non-vigorous neonates born through meconium-stained amniotic fluid protocol intervention. *Cochrane Database Syst Rev*. 2017. https://doi.org/10.1002/14651858.CD012671.
9. Chettri S, Bhat BV, Adhisivam B. Current concepts in the management of meconium aspiration syndrome. *Indian J Pediatr*. 2016;83(10):1125-1130. https://doi.org/10.1007/s12098-016-2128-9.
10. Mokra D, Mokry J. *Meconium Aspiration Syndrome: From Pathomechanisms to Treatment*. New York, NY: Nova Science Publishers; 2010.
11. Weiner GM. *Textbook of Neonatal Resuscitation*. 7th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2016.
12. Sawyer TL, Rosenkrantz T. Intubation and tracheal suctioning for meconium aspiration. Medscape. https://emedicine.medscape.com/article/1413467-overview?pa=FCsmxCtZfJrWs6mIXXOt%2BLxXWrJR638jJ8B%2FXLunsPIGgmAm6Z%2BTxzbJFTcCyzRtNFsYxDuz%2Fz2hge3aAwEFsw%3D%3D. Accessed May 10, 2018.
13. American Academy of Pediatrics Committee on Fetus and Newborn. Care of the newborn. In: *Guidelines for Perinatal Care*. 7th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2012. https://ebookcentral.proquest.com/lib/csla/reader.action?docID=1074106&query=. Accessed August 20, 2017.
14. Dargaville PA. Respiratory support in meconium aspiration syndrome: a practical guide. *Int J Pediatr*. 2012. https://doi.org/10.1155/2012/965159.
15. Hockenberry MJ, Wilson D. Health promotion of the newborn and family. In: *Wong's Nursing Care of Infants and Children*. 9th ed. St. Louis, MO: Elsevier Mosby; 2010:250. https://ebookcentral.proquest.com/lib/csla/reader.action?docID=1074106&query=. Accessed October 7, 2017.
16. Holbery N, Newcombe P. Children in the emergency department. In: *Emergency Nursing at a Glance*. 1st ed. Oxford, UK: John Wiley & Sons, Ltd; 2016:179. https://ebookcentral.proquest.com/lib/csla/reader.action?docID=4386002. Accessed November 26, 2017.
17. Robinson L, Everson FP. Preparing for precipitous vaginal deliveries in the emergency department. *J Emerg Nurs*. 2009;35:258.
18. Gilboy N, Tanabe T, Travers D. *Emergency Severity Index (ESI): A Triage Tool for Emergency Department Care. Version 4 Implementation Handbook 2012 Edition*. Rockville, MD: Agency for Healthcare Research and Quality; 2012.

19. Dudley N, Ackerman A, Brown KM, Snow SK. Patient-and-family-centered care of children in the emergency department. *Pediatrics*. 2015;135(1):e255-e272.

20. Mullaney DM, Edwards WH, Degrazia M. Family-centered care during acute neonatal transport. *Adv Neonatal Care*. 2014;14(suppl 5):S16-S23. https://doi.org/10.1097/ANC.0000000000000119.

21. Griffith T, Celenza J. Supporting the role of the mother and family in the nicu. In: *The Delivery Room and Beyond*. New York, NY: Springer; 2014:98, 100. https://ebookcentral.proquest.com/lib/csla/reader.action?docID=1675083&query=. Accessed November 26, 2017.

22. Bowen A, Bowen W, Haines CJ. Emergent delivery and neonatal resuscitation. *Pediatr Emerg Med Rep*. 2009;20(1):1-10.