original article

Have the 2015 Neonatal Resuscitation Program Guidelines changed the management and outcome of infants born through meconium-stained amniotic fluid?

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BACKGROUND: In 2015, the Neonatal Resuscitation Program (NRP) guidelines were updated to recommend that nonvigorous infants delivered through meconium-stained amniotic fluid (MSAF) do not require routine intubation and tracheal suction.

OBJECTIVE: Explore the implications of 2015 NRP guidelines on delivery room management and outcome of infants born through MSAF.

DESIGN: Retrospective cohort study.

SETTINGS: King Abdul-Aziz University Hospital (KAUH).

PATIENTS AND METHODS: All term (≥37 weeks) infants born in KAUH through MSAF between January 1, 2016, and December 31, 2017, were included. Patients were divided into two groups according to the date of birth: period 1 (January 1, 2016, to December 31, 2016), before the implementation of the new NRP guidelines; period 2 (January 1, 2017, to December 31, 2017), after the implementation.

MAIN OUTCOME MEASURES: Outcomes of infants born through MSAF.

SAMPLE SIZE: 420 infants.

RESULTS: A majority of infants (n=261) were born in period 1 and 159 after in period 2. No differences were found in the booking status of mothers, cesarean section rate, and number of deliveries attended by physicians between the 2 cohorts. Infants in both cohorts were of similar gestational age, birth weight, and gender. A nonsignificant lower rate of intubation at birth (2.3% vs 0.6%), admission to neonatal intensive care unit (3.8% vs 3.1%), and meconium aspiration syndrome (1.5% vs 0.6%) were found in period 2 compared with period 1. Only 1 infant died in period 1.

CONCLUSION: After the implementation of 2015 NRP guidelines, fewer infants were intubated at birth for MSAF. No difference was observed in the rate of associated morbidities and mortality.

LIMITATIONS: A single-center retrospective study of misclassification bias because some of the medical staff started practicing the new guidelines before the official implementation.

CONFLICT OF INTEREST: None.

Meconium is the first stool of neonates and is normally retained in the infant's bowel until they are born. However, in certain conditions, the fetus passes the meconium into the amniotic fluid before birth or during labor and delivery.[1] Around 7%–22% of term and 22%–44% of post-term (>42 weeks) deliveries are complicated by meconium passage before delivery, resulting in meconium-stained amniotic fluid (MSAF).[2,3] Passage of meconium in the amniotic fluid can be a sign of gestational maturation or can be due to pathological causes that take place at the time of pregnancy or delivery. Intrapartum hypoxia secondary to placental insufficiency, cord compression, maternal hypertension or diabetes, oligohydramnios, pre-eclampsia, maternal drug abuse, and smoking can lead to meconium contamination of the amniotic fluid.[4]

MSAF can result in meconium aspiration syndrome (MAS) in 2%–10% of cases[5] and is associated with an increased risk of mortality and respiratory morbidities.[6] The risk of MAS was found to be higher with advanced gestational age (1.1% at 37 weeks and 24% at >42 weeks).[7] In the same study, 81.5% of infants with MAS were discharged home, 9% were transferred to higher levels of neonatal intensive care, 1.2% died, and 1.4% were treated with extracorporeal membrane oxygenation (ECMO).[7]

A nonrandomized clinical trial (RCT) in 1976 suggested that the standard of care of infants born through MSAF should include suctioning of the oropharynx and nasopharynx before delivery of their shoulders, followed by endotracheal suctioning regardless of the consistency of meconium and clinical condition of infant at birth.[8] Subsequent large multicenter RCTs led to changes in neonatal resuscitation[9-11] and tracheal suctioning of infants born through MSAF. The American Academy of Pediatrics and the International Liaison Committee on Resuscitation adopted this change and modified their guidelines to recommend postnatal endotracheal suctioning only for depressed infants.[11,12] Finally, because of insufficient published evidence, the 2015 Neonatal Resuscitation Program (NRP) recommended that even nonvigorous infants delivered through MSAF did not routinely require intubation and tracheal suction.[13] The aforementioned recommendation of change in practice placed a greater value on avoiding the harm of intubation and delaying the establishment of breathing over the undetermined benefits of routine tracheal intubation and suction.

The aim of this study was to investigate the implication of 2015 NRP guidelines on delivery room management and outcome of infants born through MSAF compared with those born before the implementation of 2015 guidelines.

PATIENTS AND METHODS

This was a retrospective cohort study conducted at King Abdul-Aziz University Hospital (KAUH), Jeddah, Saudi Arabia, which is one of the largest tertiary referral and teaching centers in the Western region of Saudi Arabia with a capacity of 800 beds. The Institutional Review Board of KAUH approved the study.

Population and setting

All live term infants born in KAUH through MSAF between January 1, 2016, and December 31, 2017, were included in this study. Term infants are those delivered at ≥37 weeks of gestation determined by either the first day of last menstruation or early antenatal ultrasound. Neonates born with multiple congenital anomalies were excluded. 3The NRP guidelines were officially applied in the study center in January 2017. The population was divided into two categories: period 1 including all infants born through MSAF from January 1, 2016, to December 31, 2016, and period 2 including all infants born through MSAF from January 1, 2017, to December 31, 2017.

The delivery room electronic records of all infants and their mothers were checked. A nonvigorous infant was defined by the presence of at least one of the following signs: decreased muscle tone, not breathing or crying, and/or heart rate <100/min (NRP 2010). MAS was defined as respiratory distress in an infant born with MSAF and having specific radiological changes that could not be otherwise explained.[14] Fetal distress was defined as category III fetal heart rate tracings, which involved either (1) sinusoidal pattern or (2) absent baseline fetal heart rate variability and any one of the following signs: recurrent late decelerations, recurrent variable decelerations, or bradycardia.[14] Hypoxic–ischemic encephalopathy is differentiated by laboratory and clinical proofs of acute or subacute brain injury caused by asphyxia.[15,16] At the study center, the medical record documentation of the delivery room was handwritten on preformatted flow sheets that were filled after delivery and before transferring the infant to the newborn nursery or neonatal intensive care unit (NICU). The information from the same copies was entered into an electronic delivery room database. Infants who were afterward admitted to the NICU had a detailed chart review.

Statistical analysis

Categorical variables were described using frequencies and associated percentages. However, normally distributed continuous variables were described using mean with its associated standard deviation. If continuous variables did not follow a normal distribution, they were expressed as median with interquartile range. The groups were compared using the *t* test and chi-square test for continuous data and categorical data, respectively. When the assumptions for the chi-square test did not hold, the Fisher exact test was used. For all statistical tests, a *P* value less than .05 was deemed significant (IBM SPSS Statistics version 21.0).

RESULTS

A total of 420 infants with MSAF at birth were included in this study, of which 261 were born before the implementation of new NRP guidelines and 159 after. The rate of MSAF before the implementation of NRP guidelines was 6.5%, while that after the implementation was 3.6%. No differences in the booking status of the mother (84% vs 85%, *P*=.890), cesarean section rate (10.3% vs 14.5%, *P*=.217), and the number of deliveries attended by physicians (51.7% vs 46.5%, *P*=.316) were found between the two cohorts (**Table 1**). Infants of both cohorts were of similar gestational age, birth weight, and gender (**Table 1**). Although the rates of intubation at birth (2.3% vs 0.6%), admission to NICU (3.8% vs 3.1%), and MAS (1.5% vs 0.6%) were lower in period 2 (after the implementation of NRP guidelines), they did not reach statistical significance (**Table 2**). Only one infant died in the period before the implementation of NRP guidelines (**Table 2**).

DISCUSSION

In this retrospective observational study of 420 infants born through MSAF, 261 were born before the implementation of new NRP guidelines and 159 after implementation, no significant difference in neonatal morbidity and mortality was observed between the 2 periods. Moreover, the two periods had comparable maternal and infant characteristics, ensuring that the effect of the application of guidelines was not confounded by other known factors. The clinical importance of the meconium contamination of amniotic fluid is attributed to the fetal and maternal disorders causing it and the complications associated with it, contributing to increased neonatal mortality and morbidity.[14]

The NICU admission rate, neonatal complications, and mortality in the two groups were examined to determine whether the application of new NRP guidelines significantly altered the patient outcomes. Neonates managed according to the new guidelines had lower rates of intubation at birth (0.6% vs 2.3%), admission to NICU (3.1% vs 3.8%), and MAS (0.6% vs 1.5%). However, these differences did not reach statistical significance. Only 1 of the 5 infants born nonvigorous at birth after the implementation of NRP guidelines was intubated after failing initial resuscitation steps. The same infant was diagnosed with hypoxic–ischemic encephalopathy. The rate of MSAF was low in the present cohort (3.6%–6.5%) compared with previous studies reporting a rate of 5%–12%[15,16] and 29%–32%.[17,18] These differences might be explained by variation in the studied population and study design (a single-center or a multicenter study) among different studies.

The new guidelines recommend that even nonvigorous infants delivered through MSAF do not routinely require intubation and tracheal suction. This recommendation is based on studies that reported the lack

Table 1. Characteristics of deliveries of infants born through meconium meconium-stained amniotic fluid.

Variables	Before 2017 (N=261)	After 2017 (N=159)	*P* value
Booked (n, %)	219 (84)	134 (85)	.890
Cesarean section (n, %)	27 (10.3)	23 (14.5)	.217
Attended by physicians (n, %)	135 (51.7)	74 (46.5)	.316
Male (n, %)	134 (51.3)	82 (51.6)	.99
Gestational age, weeks (mean, SD)	39.5 (1.3)	39.7 (1.13)	.240
Gestation age ≥41 weeks	48 (18.4)	39 (24.5)	.138
Birth weight, grams (mean, SD)	3122 (442)	3230 (450)	.288
Apgar score at 1 min (median, IQR)	9 (9, 9)	9 (8, 9)	.489
Apgar score at 5 m (median, IQR)	10 (10, 10)	10 (10, 10)	.193
Non-vigorous at birth (n, %)	17 (6.5)	5 (3.1)	.176
Intubation at birth (n, %)	6 (2.3)	1 (0.6)	.261

Table 2. Outcome of infants born through meconium meconium-stained amniotic fluid.

Variables	Before 2017 (N=261)	After 2017 (N=159)	*P* value
NICU admission	10 (3.8)	5 (3.1)	.793
Meconium aspiration syndrome (n, %)	4 (1.5)	1 (0.6)	.654
Pulmonary air leak (n, %)	0	0	NA
Received nitric oxide (n, %)	1 (0.4)	0 (0)	.99
Non-invasive ventilation (n, %)	8 (3.0)	4 (2.5)	.646
Hypoxic-–ischemic encephalopathy (n, %)	3 (1.1)	2 (1.3)	1.000
In-hospital mortality (n, %)	1 (0.4)	0 (0)	1.000

NICU, Neonatal intensive care unit.

of the beneficial effect of intervention in infants born through MSAF. Moreover, endotracheal intubation for suctioning can result in bradycardia, bleeding, apnea, hoarseness, upper airway injury, and stridor.[19] In addition, intubation can defer the initiation of positive pressure ventilation, which can be critical to resolve asphyxia and stabilize the neonate.[15] The results from the present study supported this recommendation because of no significant difference in the incidence of meconium aspiration–related complications and patient outcomes between the neonates who underwent suctioning or those who did not undergo suctioning. Noteworthy, the incidence of meconium aspiration–related complications in the present study was higher in the endotracheal suctioning cohort, although it did not reach statistical significance.

The results of the present study were also consistent with previous studies reporting a nonsignificant difference in the rate of MAS with or without suctioning.[15,17,18,20,21] An increased rate of assisted ventilation was observed in patients who underwent suctioning of the trachea, although it did not reach statistical significance. In partial agreement with the present findings, Yoder[22] reported that the need for ventilation or oxygen support was significantly greater among infants born through MSAF and who underwent suctioning. Vain et al[23] found no significant difference between infants with MSAF who were suctioned and those who were not suctioned with regard to the need for mechanical ventilation, duration of ventilation, oxygen treatment, and hospital care. In contrast, Chettri et al[17] and Nangia et al[18] found an increased rate of invasive and noninvasive ventilation, respectively, in nonsuctioned neonates.

The absence of beneficial effects of endotracheal suctioning on the outcome of such patients may be attributed to many factors. One of the suggested reasons is that meconium passage and aspiration occur in utero, and by the time suctioning is applied, meconium has already reached the distal lung.[24] Other mechanisms include surfactant inhibition,[25] chemical pneumonitis,[26] persistent pulmonary hypertension of newborn, and secondary infection.[27]

A limitation of the study is that it was single center and thus not generalizable. There were no missing data, but data on some variables that may have been confounders was not available, including instrumental delivery, duration of the second stage, other comorbidities in the mother or the fetus, and the level of skills of the delviery attendants. Moreover, some medical staff did not start practicing intubation for infants born through MSAF before the official implementation of NRP guidelines in the study center, leading to the dilution of the effect of guidelines on the associated morbidities.

In conclusion, fewer infants were intubated at birth for MSAF after the implementation of 2015 NRP guidelines. No difference was observed in the rate of associated morbidities and mortality. These results supported the implementation of the new guidelines. However, further large-scale, randomized, clinical multicenter studies are recommended to inaugurate the standard of care for infants born through MSAF.

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