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SHORT REPORT

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Surfactant lavage for extracorporeal membrane oxygenation-requiring meconium aspiration syndrome —a cheap alternative

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A full-term newborn girl presenting with typical very severe meconium aspiration syndrome (MAS) fulfilling the criteria for extracorporeal membrane oxygenation (ECMO) was successfully treated by surfactant lavage. We wish to draw attention to this alternative treatment option.

The patient's 32-year-old G1P0 mother was admitted to the labour ward at 41 weeks gestation for induction of labour. Pregnancy was uneventful and fetal anatomy and biometry were normal on ultrasound. A thick meconium-stained amniotic fluid was noted when membranes ruptured. Fetal tachycardia necessitated a caesarean section 2 h later. A baby girl was delivered who was cyanotic, hypotonic and non reactive. The heart rate was over 100/min (APGAR 2 at 1 min, 6 at 5 min and 7 at 10 min). Birth weight was 3170 g (P10–P50), length 50 cm (P50) and cranial circumference 35.5 cm (P50–P90). Arterial and venous umbilical cord blood gases were pH 7.07, BE -9 and pH 7.17, BE -7.8 respectively. In the absence of spontaneous breathing, she was immediately intubated and the endotracheal (ET) cannula withdrawn again under continuous suctioning. Copious amounts of meconium were withdrawn and as the heart rate remained above 100/min, a second ET aspiration was performed through an ET tube but no more meconium was removed. As the baby established spontaneous breathing thereafter, nasal CPAP (PEEP 8 cm H_2O) was initiated at FiO_2 1.0 and rapidly reduced to 0.6. Umbilical catheters were inserted and 10% glucose was started concomitantly with antibiotics before the baby was transferred to the neonatal intensive care unit.

At 3 h of life, respiratory and cardiovascular conditions worsened. Hypotension was treated with volume expansion (0.9% NaCl, 10 ml/kg i.v.) and a continuous dopamine infusion (10 μg/kg per min) as well as addition of dobutamine to stabilise blood pressure. Respiratory distress worsened considerably with oxygen requirements increasing to FiO_2 1.0 to achieve a saturation of 85%–90%. A chest X-ray film showed typical signs of severe MAS with a patchy pulmonary parenchyma and zones of hyperinflation and atelectasis. Arterial blood gases with paO_2 of 40.7 mmHg and pCO_2 of 68 mmHg, BE -4.3 (OI 19.6) [6] required re-intubation after induction with morphine (0.1 mg/kg), midazolam (0.05 mg/kg) and pancuronium (0.1 mg/kg). Ventilation was started on high frequency oscillation by first intention (MAP 23 cm H_2O; Delta P 45 cm H_2O; FiO_2 1.0, Sensormedics). The baby further deteriorated and pulmonary hypertension was suspected on differentials of more than 10% between pre- and post-ductal oxygen saturations and confirmed on heart scan with a right to left shunt over the ductus arteriosus.

At 9 h of life, FiO_2 was still 0.8, MAP 23.5 cm H_2O and Delta P 52 cm H_2O to achieve a paO_2 of 25.6 mmHg and BE -2.3 (OI 73.4) (Fig. 1). Inhaled nitric oxide (NO) was started at 5 ppm and rapidly raised to 20 ppm. Intravenous morphine and repeated single doses of pancuronium were given to optimise sedation. Good but transitory improvement was noted after starting NO. Despite deep sedation, pH >7.3 and NO, respiratory distress worsened again and severe pulmonary hypertension persisted.

At 26 h of life, the clinical condition showed no improvement (FiO_2 1.0, MAP 19.5 cm H_2O, Delta P 55 cm H_2O to achieve a paO_2 of 36.4 mmHg, BE -3.3, OI 53.6). The chest X-ray film revealed a further increase in hyperinflation.

MAS with OI >40 despite full conventional therapy over several hours, is generally considered an indication for ECMO [1]. However, ECMO in newborns is still associated with a high morbidity and was unavailable in Switzerland at that time. Furthermore, as the baby was too unstable for transport to the closest European ECMO centre, we opted for a broncho-alveolar lavage with

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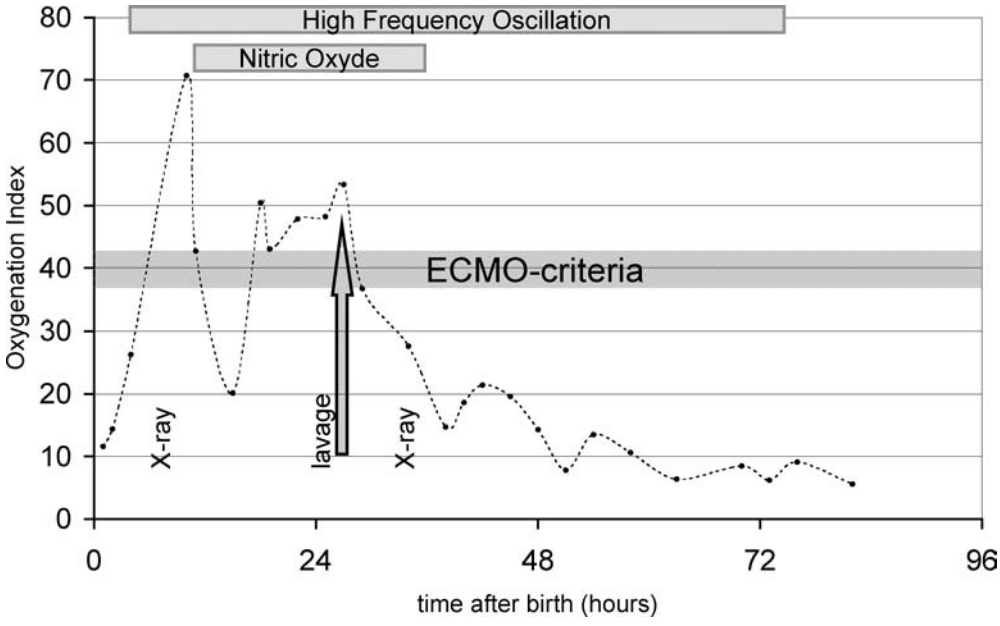

Fig. 1 The course of OI from birth to extubation

diluted exogenous surfactant based on a small published trial [3] using a protocol with a total volume of 15 ml/kg (Curosurf 5 mg/ml diluted with 0.9% NaCl). We injected 24×2 ml aliquots of diluted surfactant through the side-port of a 3.5 ET tube (Abbott) and re-aspirated through the ET tube as soon as ventilation parameters restabilised. Short desaturations and transiently reduced ventilation required a brief adaptation of ventilator settings, but no haemodynamic or pulmonary complications resulted from the procedure. Almost immediately after the procedure, the baby started to improve (OI 36.9 after 3 h; OI 7.8 after 24 h). Hyperinflation and atelectasis had disappeared on the chest X-ray film 3 h later (Fig. 2) and it was possible to wean and stop NO 16 h after the procedure. The baby was extubated at 4 days of life (50 h after the procedure); oxygen was stopped on day 7 and nasal CPAP on day 9. Brain scans remained normal as well as oto-acoustic emissions. The baby was discharged home at 15 days of life.

Two randomised controlled trials have demonstrated a reduction in the severity of the respiratory disease and in the number of infants requiring ECMO after surfactant replacement for severe MAS [2, 4]; however, mortality remained unchanged. In cases with high mortality, as indicated by ECMO criteria, broncho-alveolar lavage may be superior to replacement therapy and present a valuable alternative, particularly in situations and countries where ECMO is not readily available for newborns as well as in critical situations when the baby is not stable enough for transport to an ECMO centre. Little is known about surfactant lavage but it is cheap and may prove as effective as ECMO for the treatment of severe MAS [5] when conventional therapy including high frequency oscillation and NO fail. The efficacy of the treatment has been reported in several case reports and in a small, randomised controlled trial [7] but for establishment of the technique, randomisation versus the standard ECMO technique is required. Nevertheless,

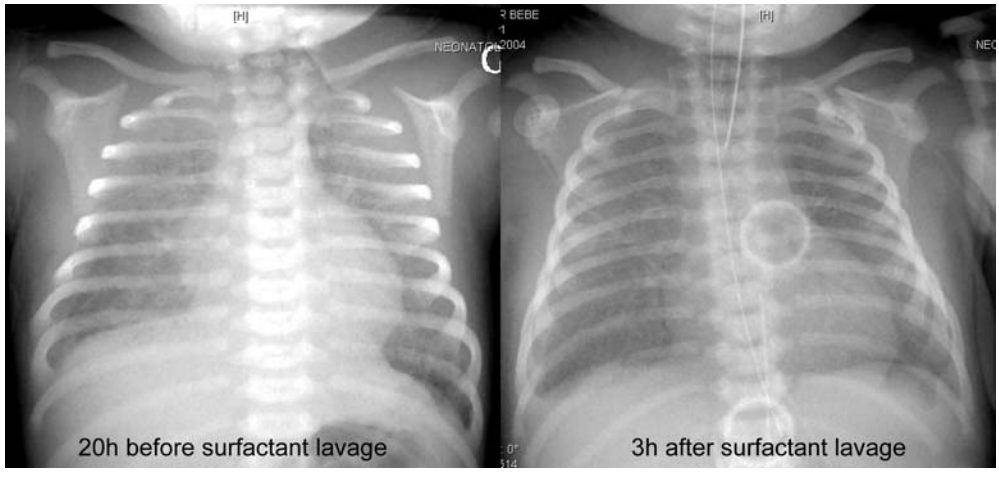

Fig. 2 Chest X-ray films 20 h before and 3 h after surfactant lavage

this approach is worth considering when ECMO is unavailable for the treatment of severe MAS.

References

1. Cook LN (2004) Update on extracorporeal membrane oxygenation. Paediatr Respir Rev 5[Suppl A]: S329–S337
2. Findlay RD, Taeusch HW, Walther FJ (1996) Surfactant replacement therapy for meconium aspiration syndrome. Pediatrics 97: 48–52
3. Lam BC, Yeung CY (1999) Surfactant lavage for meconium aspiration syndrome: a pilot study. Pediatrics 103: 1014–1018
4. Lotze A, Mitchell BR, Short BL (1998) Multicenter study of surfactant (Beractant) use in the treatment of term infants with severe respiratory failure. J Pediatr 132: 40–47
5. Möller JC, Kohl M, Reiss I, Wiebke D, Nitsche EM, Göpel W, Gortner L (1999) Saline lavage with substitution of bovine surfactant in term neonates with meconium aspiration syndrome (MAS) transferred for extracorporeal membrane oxygenation (ECMO): a pilot study. Crit Care 3:19–22
6. Ortiz RM, Cilley RE, Bartlett RH (1987) Extracorporeal membrane oxygenation in pediatric respiratory failure. Pediatr Clin North Am 34: 39–46
7. Wiswell TE, Knight GR, Finer NN (2002) A multicenter, randomized, controlled trial comparing Surfaxin (lucinactant) lavage with standard care for treatment of meconium aspiration syndrome. Pediatrics 109: 1081–1087