Preliminary Evaluation of a New Technique of Minimally Invasive Surfactant Therapy

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STUDY QUESTION

Can surfactant be effectively delivered by minimal invasive surfactant (MIST) technique via a vascular catheter (angiocath) to 25-34 weeks preterm infants with respiratory distress syndrome (RDS)?

METHODS

This is a non-randomized feasibility study.

Population

All 25–34 weeks preterm infants admitted to tertiary neonatal intensive care unit with respiratory distress supported with CPAP, and needed surfactant.

Inclusion

All preterm infants below 34 weeks on CPAP and need surfactant.

Exclusion

Preterm infants that intubated at birth.
Preterm infants with congenital malformation.

Intervention

All 25–28-week infants at any CPAP pressure and fractional inspired O_2 concentration (FiO_2), and of 29–34-week infants at CPAP pressure ≥7 cm H_2O and FiO_2 ≥0.35 are enrolled to receive surfactant via MIST. This technique (MIST) means without premedication, a 16-G vascular catheter was inserted through the vocal cords under direct vision. Porcine surfactant (~100 mg/kg) was then instilled, followed by reinstitution of CPAP.

Technique

In stable infants (heart rate >120 bpm and oxygen saturation (SpO_2) >85%) under a radiant warmer or in a humidicrib without premedication was used.

A 16G vascular catheter 130 mm in length (16G Angiocath, BD, Sandy, UT, USA) prepared by marking a point indicating the desired depth of insertion beyond the vocal cords with a marker pen at 1 cm for 25–26 weeks infants and 1.5 cm for 27–34 weeks and 2 cm for 29–34 weeks. Porcine surfactant (Curosurf, ChiesiFarmaceutici, Parma, Italy) at a dose of 100 mg/kg (1.25 ml/kg) was drawn up in a 3-ml syringe, and an additional 0.5 ml of air was drawn up into the syringe taking account of the dead volume of the instillation catheter.

CPAP face mask or prongs were removed and direct laryngoscopy was performed using a standard laryngoscope

and Miller oo blade. The instillation catheter was inserted through the vocal cords to the desired depth and manually held in position at the lips. If catheterization of the trachea was not possible within 20–30 s, face mask CPAP was briefly reinstituted followed by a further catheterization attempt. After tracheal catheterization, the surfactant syringe was then connected to the catheter hub, and the dose of exogenous surfactant administered in one bolus (25–28 weeks) or two boluses 10 seconds apart (29–34 weeks). The tracheal catheter was immediately withdrawn, and CPAP reinstituted by mask, with positive pressure inflations as necessary if the infant was apnoeic or bradycardic. Once restabilized, the infant was established on CPAP using Hudson binasal prongs (Hudson Respiratory Care, Temecula, CA, USA). A video of the procedure is available as an online supplement to this article.

RESULTS

Two catheterization attempts required in 8 (32%). All infants were able to return to Hudson prong CPAP after the procedure. The 25–28-week infants were treated relatively early, on average at 1.4 hour, whereas the 29–34-week infants were treated at a mean of 9.4 hour.

Coughing or gagging was noted in 32% of infants, equal in both groups.

Bradycardia was similar in the two groups (44%), with recovery of heart rate above 100 bpm in all cases within 10s. Positive pressure inflations were given to 44% of infants, for a longer duration in smaller babies. Oxygen saturation increased after MIST, with a more immediate response in 29–34-week group, FiO_2 could be reduced and remained well below the baseline value at 4 hour (pre-MIST: 0.39±0.092 (mean±SD); 4 hour: 0.26±0.093; P<0.01).

CPAP was also reduced after MIST, with values at 4 hour being less than at baseline overall and for the 25–28-week group when analyzed separately. Seventeen blood gas samples were available, with a lower PCO_2 and higher pH noted at 2 hours after the procedure (PCO_2 pre-MIST: 54±8.0 mmHg; 2 hours: 49±8.1 mmHg; P=0.014; pH pre-MIST: 7.29±0.046; 2 hours: 7.32±0.036; P<0.01).

Severity of HMD was mild in 1 (4%), moderate in 18 (72%) and severe in 6 (24%). In five cases there appeared to be some asymmetry of lung aeration after surfactant administration by MIST. Of 25–28 weeks group, three intubated in the first 72 hours of life, three infants were intubated at a later time with suspected sepsis.

Five infants of 25–28-week group had a PDA treated with indomethacin, two had intraventricular hemorrhage (IVH) and three out of 10 survivors (30%) had chronic lung disease, 1infant in the 25–28-week group died of respiratory complications.

There were no significant differences between the MIST-treated infants and historical controls group of 25–28-week (27±0.96) infants of 1070±220 g birth managed initially with CPAP in the period 2006–2008 for any outcome, but there was a trend toward a lower rate of intubation after MIST in the first 72 hours (OR 0.26, 95% CI 0.058, 1.2).

Outcomes for infants treated with MIST were very favorable, with no infant requiring intubation, having a pneumothorax or developing chronic lung disease. OR for these outcomes were not calculable given the null values in MIST-treated infants.

CONCLUSIONS

Surfactant can be successfully administered to preterm infants without premedication using a narrow-bore vascular catheter passed into the trachea under direct vision.

This technique of surfactant delivery produces a clear therapeutic benefit with reductions in FiO_2 and CPAP pressure, and further evaluation of this method, ultimately including clinical trials, appears warranted.

COMMENTARY

Many preterm infants with respiratory distress are now managed from the outset on CPAP, and thus fewer infants with HMD receive surfactant at an optimal time. While there appear to be a benefit its from intubation with an endotracheal tube solely for surfactant administration, a simpler and less invasive technique to administer surfactant would be advantageous. It seems a good idea to administer the surfactant without possibility of damaging the lung through bagging, as there is no ETT to do so. As the study gives surfactant in spontaneously breathing infants, this is lead to an even dispersion of surfactant through both lungs.

As the effect of surfactant on RDS are well documented in many trials with solid evidence and is the routine in neonatal care thus comparisons of surfactant group versus CPAP group regardless of the mechanisms of administration will definitely favor the infants that receive surfactant. It might be good idea to compare surfactant administration by this technique (MIST) versus standard surfactant administration using ETT, which eliminate the confounding of effect of surfactant, as the two groups will receive it. The study used porcine surfactant (Curosurf, ChiesiFarmaceutici, Parma, Italy) at a dose of 100 mg/kg (1.25 ml/kg) was drawn up in a 3-ml syringe. Considering

that many units use other surfactant which utilize larger volume such as Survanta (100 mg in 4 ml) or BLES (100 mg in 5 ml), the study did not show the maximum volume that can be administer through this method. Considering the intubation time (presumably 30s) and the time of administration of surfactant by MIST (about 45s) this increases the total time of having the blade of laryngoscope inside the preterm's larynx above the critical safe time (30s) in most infants.

The researchers disconnect CPAP during intubation and while instilling surfactant, which might lead to lung atelectasis. There were no comments on the training of staff to perform intubation by this techniques and its possible difficulties.

Abstracted from

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