J Afric Neonatal 2023;4: 126 – 129

ORIGINAL

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Minimally invasive surfactant therapy using an adapted 5 Fr feeding tube at a tertiary centre in a low resource setting

Received: 20th June 2023
Accepted: 24th October 2023

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Abstract: Minimally invasive surfactant therapy (MIST) is increasingly being preferred to the traditional techniques of surfactant replacement therapy (SRT) because the respiratory care of preterm infants has evolved over the past few years to be less invasive. The overall goal is less requirement for mechanical ventilation, reduction in bronchopulmonary dysplasia and ultimately reduced mortality following respiratory distress syndrome. The specially designed catheters, introducers and forceps for surfactant administration will incur additional costs for SRT in a low resource setting where the exorbitantly-priced surfactant is solely borne by the parents. To facilitate ease of administration and adoption of SRT, this article describes the innovation using low-cost consumables (French size 5 feeding tube and 0.5mm soft dental stainless steel wire as stylet) at a tertiary public hospital in a low resource setting.

Keywords: MIST, surfactant, feeding tube, 0.5mm aluminum dental wire, stylet

Résumé: La thérapie moins invasive de surfactant est de plus en plus préférée aux techniques traditionnelles d'administration du surfactant, car les soins respiratoires des prématurés ont évolué au cours des dernières années pour devenir moins invasifs. L'objectif global est de réduire le recours à la ventilation mécanique, la dysplasie bronchopulmonaire, et enfin la mortalité consécutive au syndrome de détresse respiratoire. Les cathéters, introducteurs et pinces spécialement conçus pour l'administration de surfactant entraîneront des coûts supplémentaires dans un contexte de faibles ressources où le surfactant, dont le prix est exorbitant, est entièrement à la charge des parents. Pour faciliter l'administration et l'adoption de la thérapie de remplacement du surfactant, cet article décrit une innovation utilisant des consommables peu coûteux (sonde d'alimentation française de taille 5 et fil dentaire souple en acier inoxydable de 0,5 mm comme stylet) dans un hôpital public tertiaire disposant de peu de ressources.

Mot clés : Thérapie moins invasive de surfactant, surfactant, tube d'alimentation, fil dentaire en aluminium de 0,5mm, stylet

Introduction

Surfactant replacement therapy (SRT) is a proven management option for respiratory distress syndrome, a common occurrence among preterm infants.[1] However, the mode of administration has transited from more invasive to less invasive techniques, which have been proven to be equally effective by high-quality trials.[2] Minimally or less invasive surfactant administration (LISA) is advocated for globally because it has proven to improve survival of these infants, encourage anticipatory management in the form of rescue surfactant, reduce the need for mechanical ventilation and the risk of bronchopulmonary dysplasia.[3]

Consensus of SRT varies slightly from one region to the other and different modes for MIST and LISA have been generated by different experts. The general principle is

to administer SRT to a spontaneously breathing neonate on non-invasive ventilation such as continuous positive airway pressure (CPAP). Administration is achieved with the use of semi-rigid fine bore catheter introduced with or without the Magill forceps under direct laryngoscopy, with or without medications.[1]

The recent introduction of SRT to Nigeria was accompanied by the desire to ensure that this expensive therapy was judiciously administered with readily available low-cost consumables, without loss of the medication to the gastrointestinal tract. In order to align with this position in our hospital Federal Medical Centre, Abeokuta, it was necessary to design this innovation with the use of the French size 5 feeding tube and 0.5mm aluminium dental wire stylet under direct laryngoscopy and CPAP.

Methods

Pre-procedural preparation

The procedure is performed in the NICU by two trained personnel and a staff nurse for documentation and assistance if necessary. Prior to the procedure, the infant is placed on a radiant warmer, the interface is changed to a snuggly fitting nasal cannula for delivering NIPPV and the infant is placed in sniffing position. Heart rate and SpO2 are monitored throughout the procedure. The surfactant is taken out of the refrigerator 30 minutes before the procedure to get it to room temperature. It is gently withdrawn into a 5cc syringe, taking care not to create bubbles in the mixture while withdrawing it. There is no need for administration of a sedative prior to the procedure.

Equipment for the procedure

Intermittent positive pressure ventilation equipment (Bag and Mask), appropriately sized neonatal laryngoscopes and blades, 0.5mm aluminum dental wire (14cm long), French size 5 feeding tube (shortened to 12cm), marker (gentian violet suggested) and sterile gloves (Figure 1).

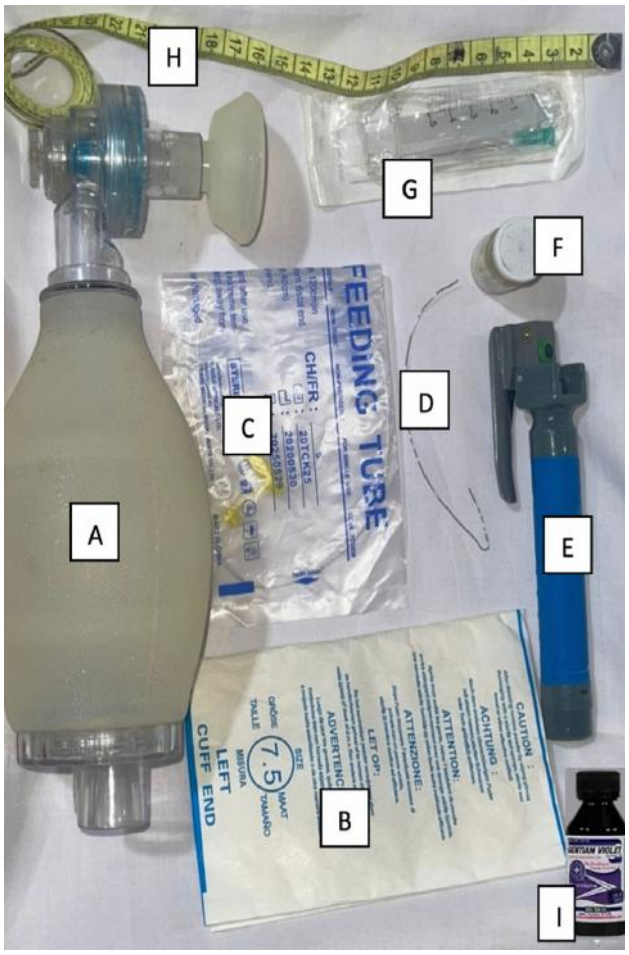
Procedure

The 0.5mm aluminium dental wire is inserted as a stylet about 12 cm deep into the infant feeding tube (5Fr): the proximal 2cm is bent over and hooked onto the lip of the tube to retain it in place. The excess distal tube length is cut off about 0.3cm from the tip of the stylet to produce a semi-rigid catheter which is fashioned slightly curved. Under direct laryngoscopy, secretions are suctioned, and the tube is inserted 1.5-2cm (this is ascertained with a marker) which is preferably sterile gentian violet through the vocal cords. The laryngoscope is removed gently while the tube is held to the upper lip. The adapted stylet is then gently removed to avoid unintentional tube displacement. The surfactant is instilled gently into the airway through the tube over five minutes while observing for reflux and monitoring oxygen saturation and vital signs. About 0.3ml of air is then instilled through the tube to ensure complete delivery of surfactant.

Mode of dissemination of the technique

This technique can be disseminated through physical demonstration with the use of a mannequin at academic fora and societal meetings, and a pre-recorded video which can be assessed on YouTubelink provided after the references.

Fig 1



Legend

A: Bag and mask
B: Sterile glove
C: French size 5 feeding tube
D: 0.5mm soft dental stainless steel wire
E: Haryngoscope with blade
F: Surfactant
G: hypodermic needle and syringe
H: Tape measure
I: Marker

Discussion

The availability of equipment for the administration of surfactants would further promote the spread and adoption of LISA. Tube flexibility has been reported to contribute to the difficulty experienced with the intratracheal insertion of a feeding tube for LISA.[4] To this effect, the 16-gauge angiocath made from fluorinated ethylene propylene polymer was developed in the USA, allowing for adequate stiffness to overcome the challenge of flexibility while maintaining elasticity and softness.[5] Also, other LISA-specific catheters include LISAcath® and Surfcath®.[6]

In France, Szczapa *et al*.[7] reported 86% use of LISA cath while 7% used nasogastric tube in the performance of LISA procedure by neonatologists and neonatal residents. A higher proportion of physicians in the USA (46%) use feeding tubes for LISA.[8] In Germany on the other hand, mainly thin (3.5--5.0 French) and soft catheters (including gastric tubes, suction catheters, and umbilical arterial or bladder catheters) are used for LISA with the assistance of the Magill forceps as reported in the COLOGNE and SONSURE methods.[9,10] While these methods use soft catheters as the present procedure, Magill forceps are designed to minimize trauma during airway device insertion but expertise is essential in ensuring that the forceps are used correctly to avoid any unintended tissue damage or bleeding. The delicate nature of neonatal respiratory mucosa and vocal cords makes them highly susceptible to damage. Magill forceps, characterized by their bulkiness and less user-friendly design, pose an increased risk of inadvertently pinching the delicate respiratory mucosa. This can, at times, potentially lead to prolonged manipulation during this procedure. Also, inexperienced practitioners may inadvertently cause injury or discomfort to the patient if they are not skilled in handling these forceps, especially in micropreemies with their relatively small mouths.
In resource-constraint settings none of these specialized catheters is readily available thereby clogging the establishment of routine accessibility of preterm infants to this life-saving procedure, hence this demonstration of an adaptable mode of LISA technique.

The cost disparity between the more expensive tubes, which average around $20, and the tube recommended in the current study, priced at less than one dollar, is striking. This significant price gap highlights the potential economic benefits of adopting the recommended tube, particularly in healthcare systems where cost-effectiveness is a priority. While the pricier options may find favor in certain settings, the affordability of the recommended tube makes it a cost-efficient alternative for a wide range of healthcare facilities, promising not only effective patient care but also prudent resource allocation.

Conclusion

Adapted thin tubes allow infants to breathe physiologically while on non-invasive ventilation during LISA. LISA-specific catheters are not readily available in resource-constraint settings. Hence, it is imperative that readily available, accessible, and cheaper alternatives are sought as demonstrated with the French size 5 feeding tube and 0.5mm aluminum dental wire stylet.

What is already known about this topic

- Minimally or less invasive surfactant administration (LISA) is advocated for globally because it has proven to improve survival of preterm infants
- Specially designed catheters, introducers and forceps for surfactant administration are commonplace in high-income countries
- Implementing the procedure of LISA in resource-constraint settings is limited by the cost of catheters, introducers, and forceps

What this study adds

- Introduces an adaptation of LISA which can be used in resource-constraint settings
- Provides details on the technical know-how of the procedure using materials which are readily available and at minimal cost
- The knowledge of the use of non-invasive respiratory support (CPAP) with administration of the adapted method of LISA.

Acknowledgments

Nursing staff of the Neonatal Unit, Federal Medical Centre, Abeokuta, Ogun State, Nigeria.

Conflict of interest: None
Funding: None

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YouTube link to video demonstration of procedure: https://youtu.be/X0eg5NWUHmY