Title: International survey showed that supraglottic airway devices were not often used for surfactant administration.

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Author's contribution

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Abstract

Background and Aim: Surfactant can be administered by an endotracheal tube or by a catheter through the vocal cords, but both techniques need laryngoscopy skills and can be associated with complications. Supraglottic airway devices have also been used for surfactant administration, and we conducted an international survey to understand how much this is done in current practice.

Methods: This online survey was conducted from September 2023 to June 2024. Questions broadly addressed unit structure, practices around surfactant and the role of supraglottic airway device in their unit.

Results: There were total of 75 responses, 73% from United Kingdom. Most of the responses were from intensive care (55%). 53 units reported use of supraglottic airway device only in cases of unsuccessful intubation. Only 12 units report use of supraglottic airway device for surfactant administration. 22 units reported that they are likely to use this device in the near future and 5 of the special care units reported that this technique would be useful for units with limited intubation skills.

Conclusions: There is limited uptake of using supraglottic airway device for surfactant administration. Lack of training, guidelines, and evidence are the most common reasons limiting this practice.

Summary:

• In randomised trials, a supraglottic airway device has been successfully used for surfactant administration in infants ≥1250 g.
• We conducted a survey to understand the uptake of this practice and found that the use was limited to 12 out of 75 centres, with lack of training, insufficient evidence, and no available guidelines being the reasons most often reported.
• The technique could be more useful in settings with limited intubation skills.

Key Words: Supraglottic airway device, surfactant, intubation.

Abbreviations: InSurE: Intubate-surfactant-Extubate; LISA: Less invasive surfactant administration; MIST: Minimally invasive surfactant treatment; RDS: Respiratory distress syndrome; RCT: Randomised control trial; SGAD: Supraglottic airway device.

Background:

Preterm births account for 15 million births per year worldwide and this number is increasing(1). A proportion of these preterm infants need surfactant as a treatment for respiratory distress syndrome(2). Recent European data has shown that 50% of preterm babies born between 22 and 32 weeks received surfactant (3). Surfactant is traditionally administered by endotracheal intubation with or without mechanical ventilation. Each of these elements could be associated with complications(4-7). Endotracheal intubation is an invasive procedure that is difficult to perform. It is well recognized that neonatal intubation success rates are suboptimal, and complications commonly occur. Success rates are lowest for inexperienced clinicians or those that intubate infrequently. Opportunities to perform intubation are decreasing due to changes in neonatal management, and this is further reducing for trainees to learn the skill(8, 9). Mechanical ventilation, even for brief periods, has been shown to cause lung damage(7, 10, 11). To reduce these poor outcomes, international committees recommend use of non-invasive respiratory support with early selective use of surfactant in preterm infants with respiratory distress syndrome (RDS)(3,

12). In order to avoid the harmful effects associated with mechanical ventilation, alternative methods of surfactant administration such as less invasive surfactant administration (LISA), Intubation-surfactant-extubation (INSURE) and use of supraglottic airway device (SGAD) have been proposed(5). Each of those techniques has its own advantages and disadvantages(5). INSURE still requires the clinician to be able to intubate. LISA requires the use of laryngoscope, and a skill in visualising the cords and inserting the catheter. Surfactant administration through SGAD is different in that it does not require the clinician to be able to intubate. SGAD insertion has been shown to be easily learned in a simulated environment and have high insertion success rates and low rates of complications(13, 14). However, the use of SGAD within neonatal care is variable and some clinicians will not have used them previously. This international survey was conducted to understand the current practices with use of supraglottic airway device, and factors limiting its use for surfactant administration.

Methods:

We conducted a prospective international online survey from September 2023 to June 2024. The survey was sent to all the neonatal units of all levels of care across the United Kingdom and through key contacts in other countries (Australia-New Zealand, Canada, Europe, and United States). We used JISC online survey, formerly Bristol Online survey accessed through University of Durham, United Kingdom. We collected contact email addresses and telephone details for all the neonatal units by contacting neonatal networks, and by contacting previous groups conducting similar surveys. All the survey questions were sent online with reminder emails every 2-4 weeks. Further, neonatal units were contacted by telephone if no response was obtained by email communications.

The survey comprised of three sections: unit structure and current practice on surfactant, use of SGAD use for resuscitation and use of SGAD for surfactant administration. Details of the survey questions are provided in Appendix 1. Survey questions were combination of multiple choice with options to provide free text answers if appropriate. Survey questions focused on use of SGAD for surfactant administration: training, equipment used, method of surfactant administration through supraglottic device, guidelines, premedication used, weight threshold, and reasons for not using supraglottic device. We described special care/local neonatal unit (level-1 and 2) and intensive care/referral hospitals (level 3) as per

UK standards(15). As there are no comparative data, no statistical analysis was performed. As the survey was conducted among healthcare professionals and no personal identifiable data was collected, ethical approval was not required in United Kingdom.

Results:

After removing duplicates, we had a total of 75 responses. Majority of the responses were from UK with 55 responses followed by European countries (n=12), Canada (n= 2), USA (n= 2), Australia and New Zealand (n= 2), , Japan (n= 1), and Chile (n= 1). We have contacted approximately 150 neonatal units in UK, with 37% response rate. There were 41 responses (55%) from teaching/University hospitals (level 3), 9 (12%) from referral centres, 3 (4%) from community hospitals, and 22 (29%) from special care/local neonatal units. Over the survey period of 10months, total of 3 survey reminders were sent to key contacts. Neonatal units reported delivery rate of 5000-10000 (n=25), 3000-5000 (n=24) and 1000-3000 (n=24) deliveries per year. Neonatal units reported admission rate of >500 (n=27), 300-500 (n=26) and <300 (n=20) admissions each year.

Forty-nine (65%) units stabilised extremely preterm infants <28 weeks' gestational age (GA) at delivery with endotracheal intubation. Eighteen units (24%) selectively intubated some infants, often with limitations based on GA or birth weight and stabilised the remaining babies on non-invasive ventilation. Six units provided only non-invasive ventilation at delivery and did not intubate. Table 1 provides the details of each unit with regards to their methods of surfactant administration and role of SGAD in their unit.

The most common reasons reported for not using SGAD to give surfactant included: i) not part of their guidelines, ii) limited evidence, or iii) successfully using LISA technique. Those units reported using SGAD, had i-gel (i-gel® Intersurgical) as the common type of SGAD (n=17). Eleven units reported use of T-piece circuit with duckbill port which provides separate port for suctioning or surfactant administration (Fisher and Paykel, New Zealand) and carbon dioxide calorimetric detector along with SGAD during surfactant administration. Those units that have used SGAD for surfactant administration reported to use a thin catheter to deliver surfactant. All of the units that are using SGAD for surfactant administration reported that they provide peak end expiratory pressure (PEEP) through SGAD during and after surfactant administration. Thirteen units reported that they have guidelines on the use of supraglottic airway surfactant administration. Twelve units reported

use of sucrose and/or swaddling during the use of SGAD for surfactant administration, 8 units reported use of atropine, and 5 units reported use of other pharmacological agents (fentanyl=3, propofol=1, ketamine=1). All units reported use of one or more agents during the procedure. Eleven units reported that they would use SGAD in infants with birth weight of ≥1500grams and 9 units would use in infants with birth weight of ≥1200grams.

Irrespective of the device used, FiO_2 cut off of >30% was the commonly used threshold for surfactant administration in preterm infants <32 weeks (n=32) and also in preterm infants >32 weeks (n=24). Almost all the units reported that they use other criteria such as clinical parameters, chest X-ray changes, and blood gas for surfactant administration. Ten units reported that they would use prophylactic surfactant in certain gestational age, and 8 units report the use of lung ultrasound in their decision making for surfactant administration.

For the survey question "If you do not currently use supraglottic airway for surfactant administration, which statement best reflects your opinion on the future use of this technique in your unit?", the responses included: 22 units responded that they are likely to introduce this approach in future, 22 units reported that they are unsure and 16 units reported that they are unlikely to introduce this approach in future. The units reported the following limiting factors for use of supraglottic airway for surfactant administration in their units (each unit have selected more than one answer): lack of guidelines (n=35), lack of training (n=27) and lack of evidence (n=22). Five of the special care/local neonatal units reported that use of SGAD for surfactant administration would be useful for their units if sufficient training and guidelines were provided.

Discussion:

From our international survey it is evident there are considerable variations in practice of using SGAD for surfactant administration and it is evident that the uptake for this procedure is limited. The reasons for this are most likely due to lack of strong evidence, guidelines and training. A recent large European survey from 37 countries (response from 397 neonatal units) found that none of the units reported use of any type of SGAD for surfactant administration(3). INSURE and LISA were the two most commonly used surfactant administration techniques in this survey.

Over the last decade there is some uptake of using SGAD for surfactant delivery(4). Ease of use of the device, not needing to use a laryngoscope and premedications are few of the reasons for this recent uptake of this practice(4). One major limitation of this device is that it is only licensed to use for infants from 2 kilograms onward(16). This possibly does not help the most vulnerable population of preterm infants who are highly likely to receive intubation for surfactant delivery (9) and likely to have more intubation related complications(17). Smaller size (size 0, size 0.5) SGAD called Air-Q ® 3 laryngeal airways are now available in the market, though lacking clinical studies (Fannin).

Another issue with SGAD, is the uncertainty of how effectively surfactant is delivered into lungs. However, this also applies to other techniques of surfactant administration, such as LISA. The most common method to confirm a correct position of SGAD is by detection of carbon dioxide during expiration, either by a colorimetric device or by a conventional end-tidal CO2 monitor and may enhance likelihood of effective surfactant delivery(18). A recent Cochrane review reported no significant difference in surfactant reflux, gastric aspirate of surfactant and need for repeat doses of surfactant between the SGAD surfactant group compared with surfactant delivery through ET but based on limited data(19). Ultimately, if there is a positive clinical response by the infant, and in particular if mechanical ventilation is avoided, this would indicate sufficient delivery of surfactant for benefit, so clinical trial outcomes will be the most important indicator of efficacy.

Needing to have the skill to intubate is necessary to perform LISA and INSURE. A large database of National Emergency Airway Registry for Neonates reported first pass successful intubation rate was 49%(17) and first pass success rate for paediatric trainees was only 23% (20). In a UK survey, 81% of the trainees reported only 1-3 opportunities to perform neonatal intubations over 6 months period(21). 44% of the respondents reported that their intubations were successful, with only 25% of the respondent's reporting success in first pass intubations. On a five-point Likert scale (scale for self-reporting on how each individual would strongly agree/disagree), 63% of the trainees reported that they are not at all confident in intubating preterm infants. Performing LISA is even more challenging, as there is minimal or no use of sedating premedications, and most studies were done from high performing neonatal intensive care units. In comparison, first attempt success rate of placing SGAD in all groups of resuscitators was 95%(18). Expecting the same skill levels of

intubation/performing LISA across all type of neonatal units may not be appropriate. SGAD could offer an alternative, and safer option for surfactant delivery in certain populations. Though most guidelines recommend use of minimally invasive techniques like LISA for surfactant administration, this is specially applicable for preterm infants <32weeks and in highly trained neonatal units (12, 22) and there are limited data on moderate and late preterm infants(18). Whether there is a role of SGAD surfactant administration in this population remains to be studied. In our survey, some special care/local neonatal units reported that the introduction of SGAD surfactant for moderate or late preterm infants would be beneficial, as this is the most common patient group in these units. 30-40% of late preterm and early term infants require admission to neonatal units with respiratory disease as one of the most common reasons for admission(23).

A recent Cochrane review on this topic included 8 trials with 510 newborns. These trials compared SGAD surfactant with InSurE (no of studies=5), usual method of ETT surfactant (no of studies=1), and group with no surfactant administration (no of studies=2) (19). In this review there is no study comparing SGAD surfactant versus LISA. SGAD surfactant may reduce the need for mechanical ventilation with number needed to treat of 7 (low certainty of evidence). In these trials, the comparison group received some form of sedation or analgesia. The review concluded that SGAD surfactant did not have any effect on composite outcome of death or BPD at 36 weeks, with low to very low certainty evidence, with no studies reporting long term outcomes and insufficient data in preterm infants <1500grams. There is no difference in adverse events such as pulmonary air leak between the groups.

There are no studies comparing different type of SGAD for surfactant delivery. For positive pressure ventilation, i-gel was found to be most effective for pressure transmission with lowest leak for PPV in manikin studies, and faster insertion time than classical laryngeal mask airway in infants during anaesthesia(18). I-gel was the most commonly used SGAD in our survey. Currently, there are no studies comparing different premedications for surfactant administration using SGAD(24). In our survey, most units commonly reported use of sucrose, swaddling and atropine as premedications, which is similar to published studies(18).From our survey, many units reported lack of training as one of the reasons for not using SGAD. Compared to endotracheal intubation or face mask, training to use SGAD appears to be easier, even with inexperienced operators(18).

Our survey had several limitations. The majority of responses were from the UK. We obtained only fewer number of responses from other countries, and hence, the results may not be generalisable to neonatal units in other countries. Most countries other than UK needed local ethical approval for responding to survey, which is one of the main reasons for poor responses. Due to our limitation with time, we did not apply individual countries ethical approval. Also, surveys were completed by individual physicians and the response could be influenced by their own bias and experiences.

Though the practice of using SGAD for surfactant delivery is varied, a few questions need to be answered with certainty with regards to population, short term and long-term benefits. SGAD for surfactant administration is promising especially with less skilled operators. Current and future studies could potentially answer the above questions, which could lead to more widespread adoption of this technique. Currently a large international multi-center non-inferiority trial is ongoing in Australia, New Zealand and United Kingdom (Surfactant Administration by Supraglottic Airway for Preterm Infants with Respiratory Distress Syndrome: The SURFSUP 1 Trial, Australia New Zealand Clinical Trials Registry 12620001184965). This trial is recruiting babies with birth weight 1250 g or above (n=1000) and less than 37 weeks' gestation with diagnosis of RDS to receive surfactant either using SGAD or MIST (LISA) technique, with primary composite outcome of rate of mechanical ventilation and/or repeat surfactant treatment. The results will substantially add to the evidence for this technique.

Conclusions:

Currently the use of SGAD for surfactant administration is limited and variable. Most units reported lack of training and/or guidelines are one of the main reasons for not introducing this technique. A proportion of units are planning to introduce this technique in the future, and special care units reported that this technique would be useful for their units. SGAD could have a useful role in non-intensive care settings, where intubation skills are limited. SGAD could also play a useful role in intensive care settings if efficacy in small preterm infants is shown now that SGAD devices are available for infants < 2 kg.

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Table 1: Surfactant administration methods and role of SGAD in each neonatal unit

	All units n=75(%)	UK units n=55 (%)
Routinely provided Surfactant by one or more method (ETT/ INSURE/LISA/MIST)	67 (89%)	47 (85%)
Routinely used LISA/MIST for surfactant administration	58 (77%)	43 (78%)
SGAD training for airway support	58 (77%)	45 (82%)
Use of SGAD for resuscitation in the event of mask ventilation is unsuccessful/prolonged or if intubation is unsuccessful.	53 (71%)	49 (89%)
Units that reported not using SGAD for any resuscitation	14 (19%)	7 (13%)
Provided training for using SGAD for surfactant administration	12 (16%)	9 (16%)
Using SGAD for surfactant administration occasionally	8 (11%)	8 (14.5%)
Using SGAD for surfactant administration as a part of research	4 (5%)	2 (3.6%)
For each of the question more than one response was selected by the unit.		