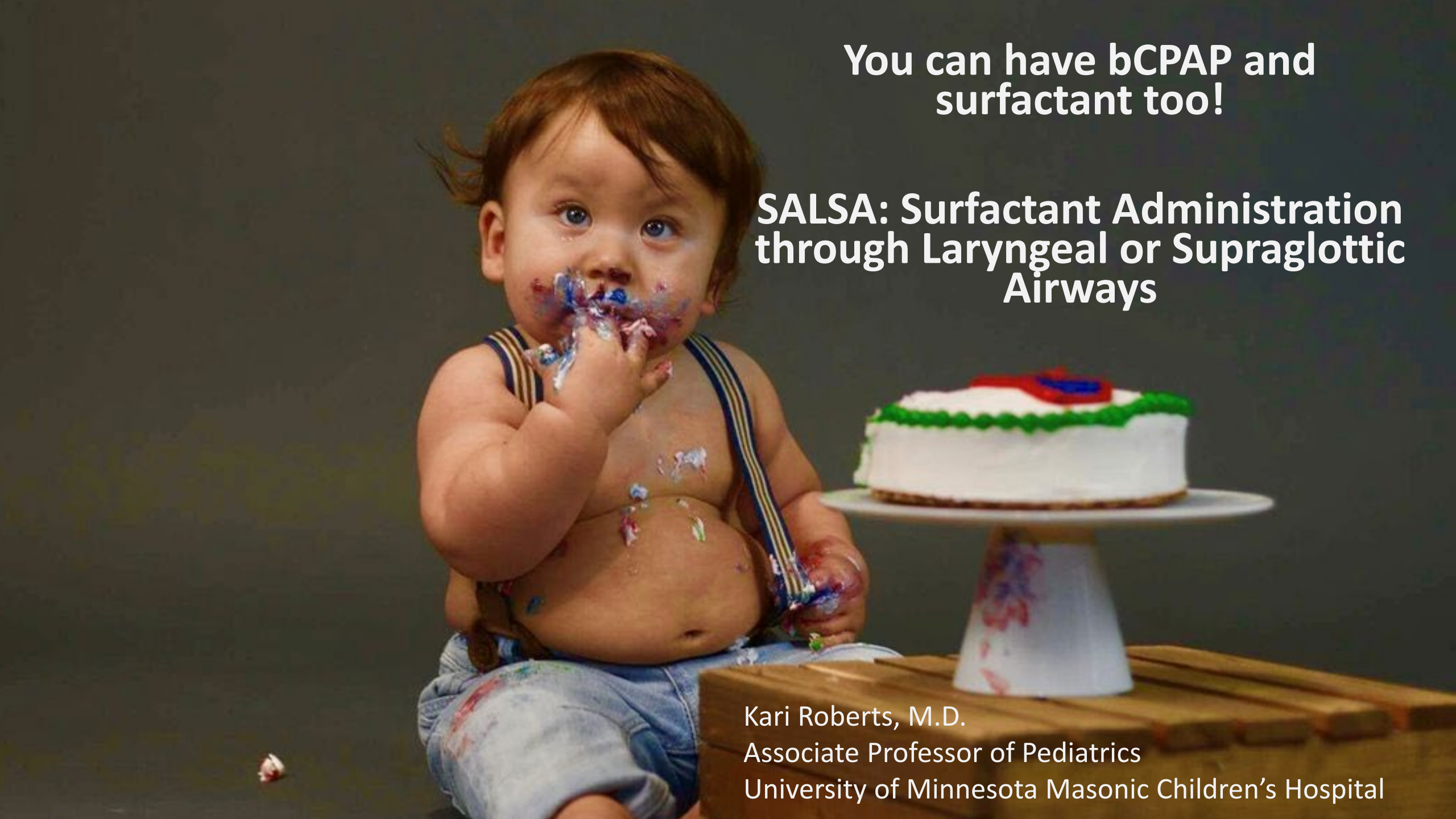


You can have bCPAP and surfactant too!

SALSA: Surfactant Administration through Laryngeal or Supraglottic Airways

Kari Roberts, M.D.
Associate Professor of Pediatrics
University of Minnesota Masonic Children's Hospital

DISCLOSURE STATEMENT

Speaker: Kari Roberts, M.D.

I have the following financial relationships with the manufacturer(s) of any commercial product(s) and/or provider(s) of commercial services discussed in this CME activity:

I am a consultant for ONY Biotech. I am involved in device development but do not receive financial benefit from sales of the product. I am involved in the clinical trial of this product.

I do intend to discuss an unapproved/investigative use of a commercial product/device in my presentation.

- Laryngeal Mask Airway which is FDA approved for ventilation but not medication administration
- Surfactant administered through devices other than an endotracheal tube

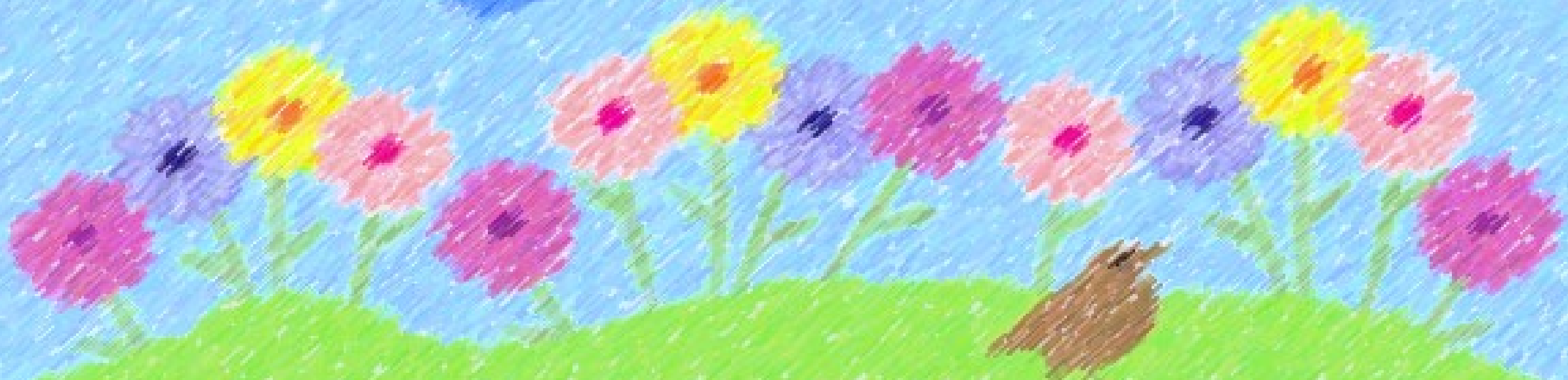
Learning Objectives:

Saturday:

Describe and compare methods for less-invasive surfactant instillation

Sunday:

Demonstrate how to administer surfactant via an LMA



Laryngeal Mask Airway (LMA)

Developed in 1981

Use in NICU increasing

- Difficult airways
- Transport
- Surgeries

Primarily for infants > 2 kg

- Does fit in infants >1250 g

Case reports of use in smaller infants:

- Smallest: 800g infant for ventilation and epinephrine administration

Laryngeal Mask Airway (LMA)

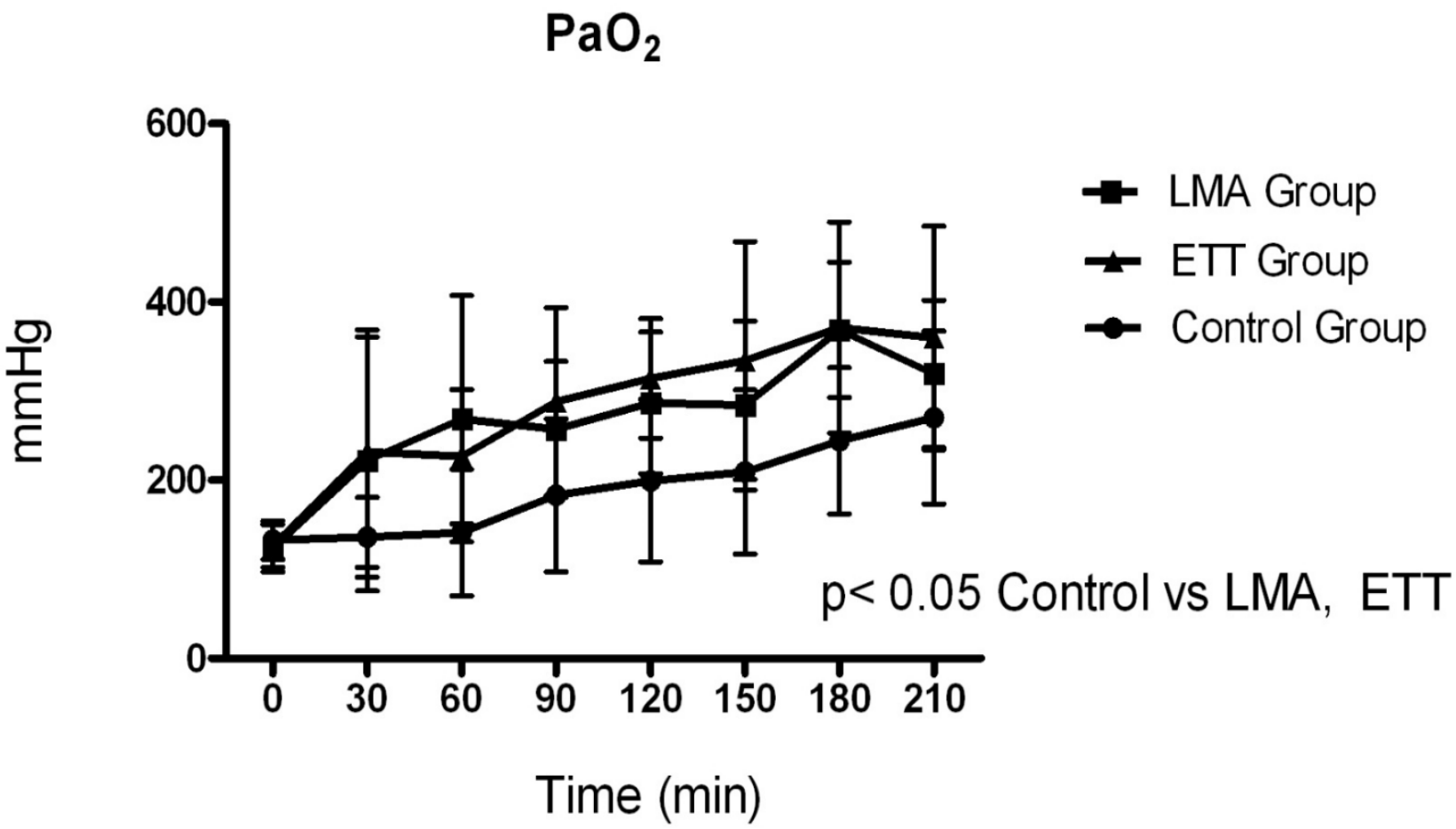
- Animal Trial (n=2)
- Randomized Controlled Trials (n=8)

Animal Trial: Roberts

Randomized, controlled trial
n= 24 piglets (1-2 days old)
Lung injury induced, nCPAP
Groups:

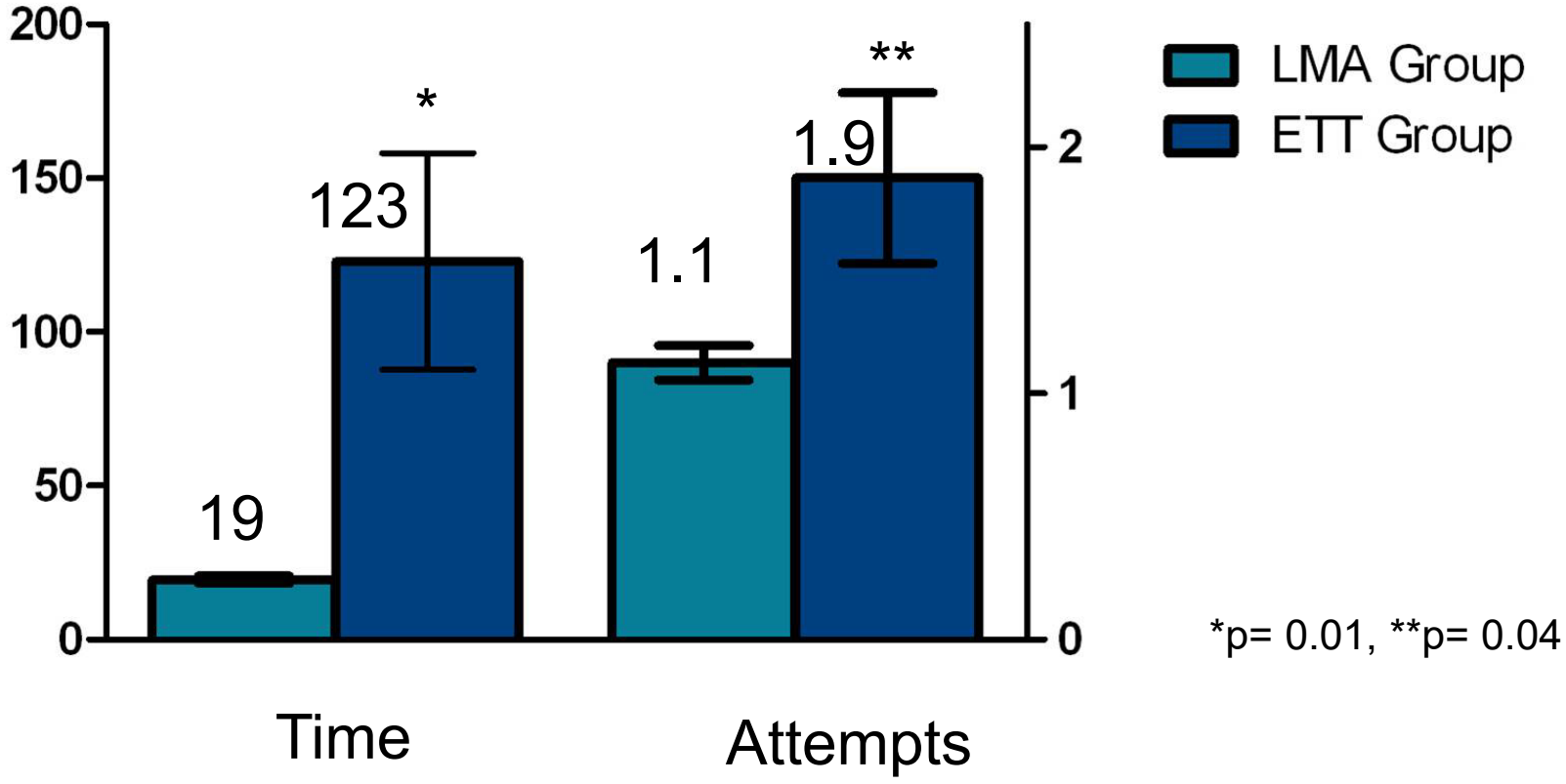
1. LMA placed, *no* surfactant (control group)
2. LMA placed, surfactant (LMA group)
3. ETT placed, surfactant (ETT group)

back on nCPAP



Improvement in oxygenation: LMA= ETT

Roberts et al. Laryngeal Mask Airway for Surfactant Administration in a Newborn Animal Model. Pediatric Research 2010; 68: 414-418.



*p= 0.01, **p= 0.04

LMA 6x faster to place

LMA 2x fewer number of attempts

Roberts et al. Laryngeal Mask Airway for Surfactant Administration in a Newborn Animal Model. Pediatric Research 2010; 68: 414-418.

Animal Trial: Bernardo

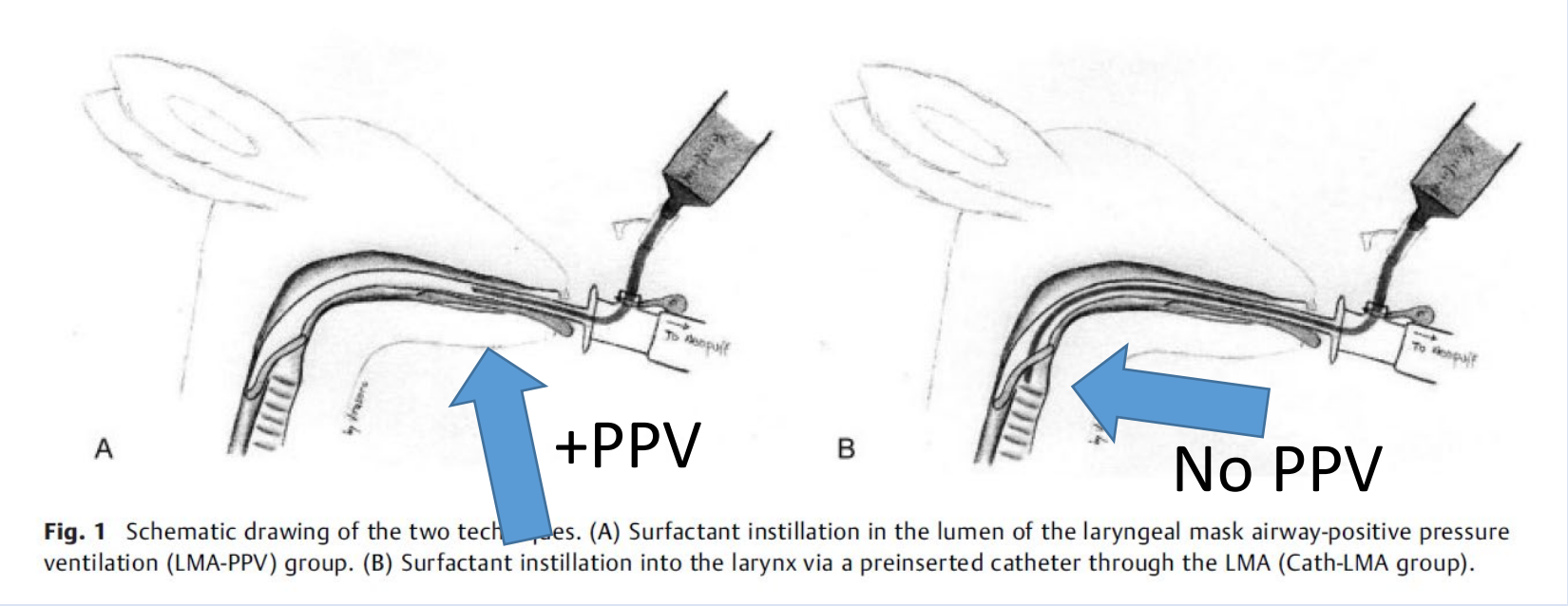


Fig. 1 Schematic drawing of the two tech[illegible]es. (A) Surfactant instillation in the lumen of the laryngeal mask airway-positive pressure ventilation (LMA-PPV) group. (B) Surfactant instillation into the larynx via a preinserted catheter through the LMA (Cath-LMA group).

Equally effective with and without PPV

Bernardo et al. Surfactant administration through laryngeal mask airway: a randomized controlled study in rabbits. American journal of perinatology. 2018;35(07):669-675.

Trial	Intervention vs. control	Gestation range	Entry criteria	Premedication	Findings
Randomized Controlled Trials					
Attridge 2013	LMA (n=13) vs CPAP alone (n=13)	BW ≥1.2 kg	Age <72 hr FiO_2 30-60%	None	FiO_2 at 1 hr 25% vs 37%, p=.002; FiO_2 at 12 hrs 27% vs 40%, p=.04; Required MV 8% vs 23%, p=.59
Sadeghnia 2014	LMA (n=35) vs INSURE (n=35)	BW ≥2 kg	Age < 48 hrs FiO_2 ≥ 30%	None	a/A PO_2 after surfactant dose 0.48 vs 0.43, p=.014
Pinheiro 2016	LMA (n=30) vs INSURE (n=31)	29-36 wks	Age < 48 hrs FiO_2 30-60%	LMA: Atropine INSURE: Atropine and Morphine	Failure requiring MV 30% vs 77%, p<.001; Early failure 3% vs 67%, p<.001; Late failure 10% vs 27%, p=.181; FiO_2 decrease and adverse events similar between groups
Barbosa 2017	LMA (n=26) vs INSURE (n=22)	28-35 wks BW > 1 kg	FiO_2 ≥40%	LMA: Lidocaine gel on mask INSURE: Remifentanil and Midazolam	FiO_2 ≤30% at 3 hrs post surfactant 77% vs 77%, p.977; 54% of LMA group did not require MV; lower Silverman- Anderson score at 3 and 6 hrs after surfactant 2 vs 0, p=.0001 and 0.5 vs 0, p=.017; similar second dose of surfactant
Roberts 2017	LMA (n=50) vs CPAP alone (n=53)	28-35 wks BW ≥1250g	Age ≤ 36 hrs FiO_2 30-40%	LMA: Atropine and 24% sucrose solution	MV in first 7 days 38% vs 64%, p=.006; Duration of MV, CPAP and supplemental oxygen at 7 days of age similar between groups
Gharehbaghi 2018	LMA (n=25) vs INSURE (n=25)	33-37 wks BW > 1800g	RDS clinical, radiologic	INSURE: Fentanyl	Similar MV and decrease in FiO2
Amini 2019	LMA (n=30) vs INSURE (n=30)	< 37 wks BW ≥1200g	Age ≤ 2 hrs FiO_2 30-40%	INSURE: Morphine	Similar MV (23 vs. 20%, *p*=0.75), requirement for second dose surfactant, BPD, pneumothorax and IVH similar
Gallop 2022	LMA (n=51) vs INSURE (n=42)	28- 26 wks BW > 800g Lowest LMA 1050g	Age ≤ 48 hrs FiO_2 30-60%	LMA: Atropine INSURE: Atropine, remifentanil	Similar MV in first 48 hrs (LMA 20% vs INSURE 29%,p=.311). Early failures (within 1 hour; LMA 2% vs INSURE 12.5%, p=.044). Similar decrease FiO2, doses, time on resp support, adverse events pneumothorax, BPD

Human Trial: Roberts

Randomized, controlled trial

Feb 2011- April 2015

n=103

Eligibility Criteria:

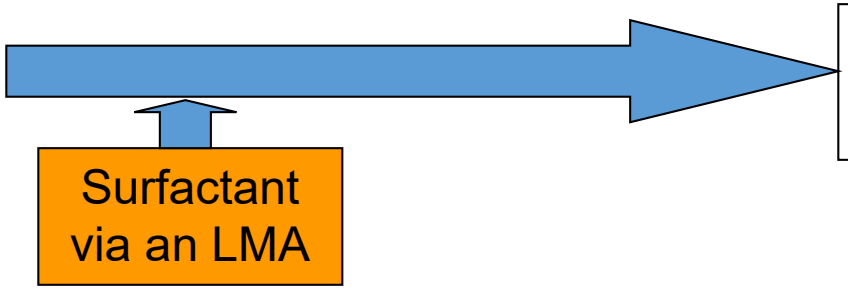
- 28 – 36 weeks
- Weight ≥ 1250g
- Age ≤ 36 hours old
- On nCPAP with FiO_2 **30-40%**
- CXR and clinical presentation of RDS

Control Group:

CPAP 

Intubated in the first 7 days of life?

Study Group:

CPAP 

Surfactant via an LMA

Intubated in the first 7 days of life?

Subject Characteristics

n= 103	Control Group (n= 53)	LMA Group (n= 50)
Birth Weight, mean ±SD (range), g	1995 ± 483 (1254-3305)	1968 ± 506 (1250-3180)
Gestational age, mean ±SD (range), wks	32 6/7 ± 1 6/7 (28 5/7-35 6/7)	32 5/7 ± 1 6/7 (29 3/7- 35 6/7)
FiO_2 at enrollment, %	35 ±5 %	34 ±6%
Blood gas at enrollment	7.28/54/44/24	7.29/53/44/24

Primary Outcome

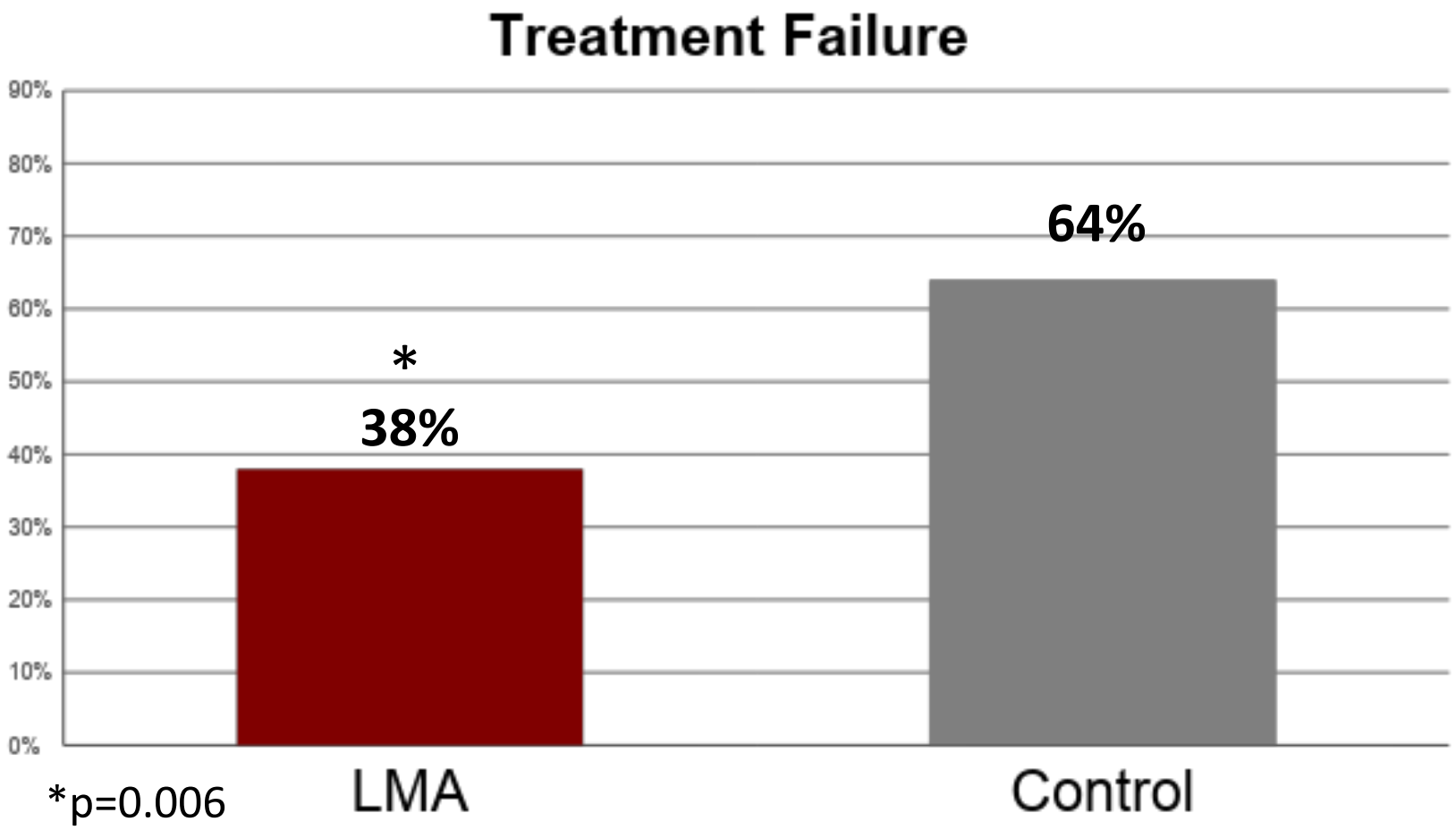
Need for intubation in first 7 days of life

Need ***TWO*** of the following:

- FiO_2 > 40% for > 30 min
- $PaCO_2$> 65 mmHg
- pH < 7.22

OR need ***ONE*** of the following:

- Recurrent or severe apnea
- Hemodynamic instability requiring pressors
- Intubation deemed necessary by clinical provider



*p=0.006

Secondary Outcomes

Did not differ between groups:

- Duration nCPAP
- Duration of oxygen requirement
- Incidence of pulmonary airleaks
- Chronic Lung Disease
- Severe IVH
- PVL

Conclusion

The LMA can be used successfully to administer surfactant and prevent the need for intubation and mechanical ventilation.

64% vs 38%, p=0.006

26% fewer intubations

Procedure

- Well tolerated
- Required less time and fewer attempts as compared to ETT placement



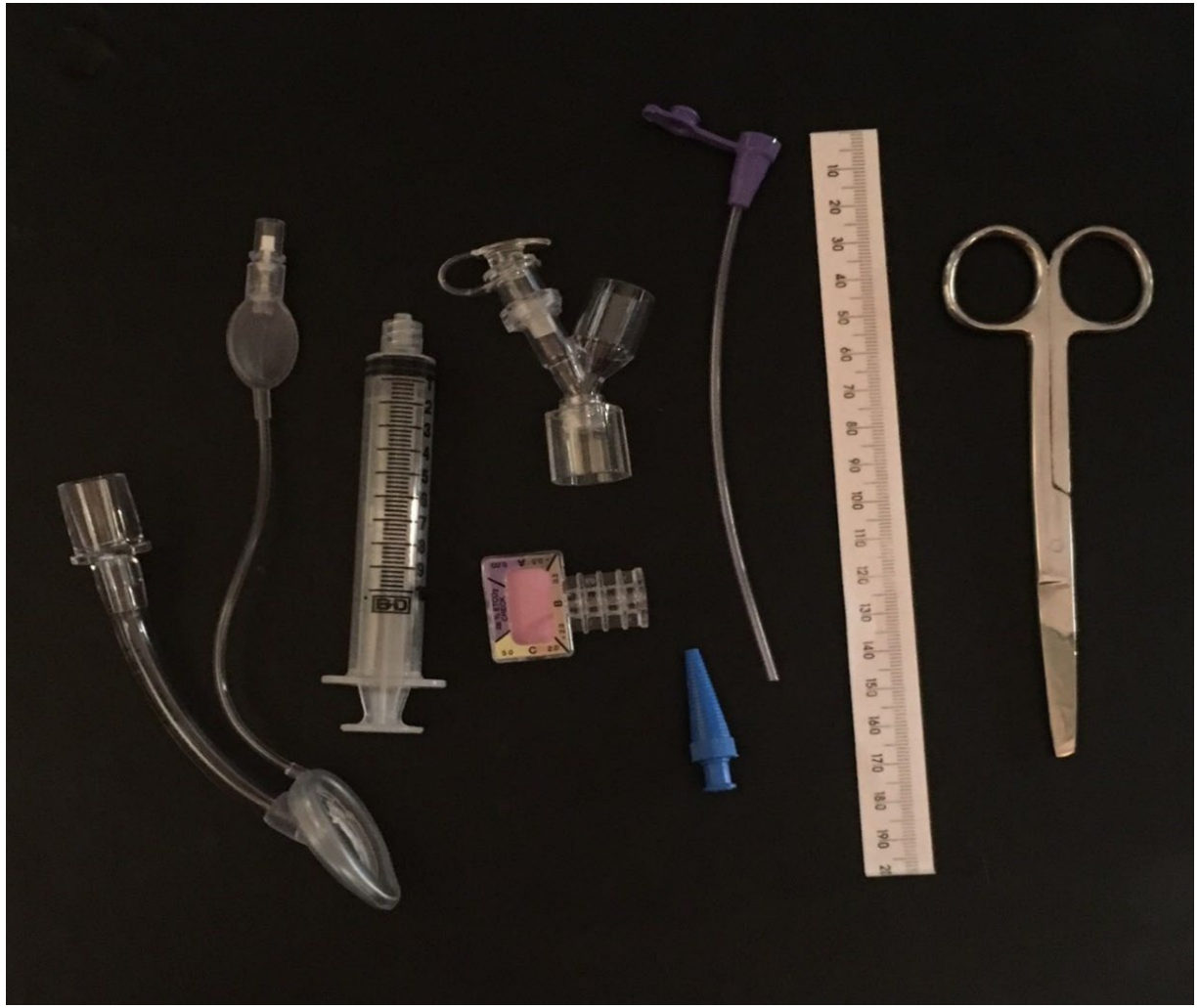
Roberts, et al. Laryngeal mask airway for surfactant administration in neonates: A randomized, controlled trial. *J Pediatr.* 2018; 193: 40-46

When should you do SALSA?

Situation	Recommendation
FiO2 21%	Surfactant not indicated
FiO2 22-25%	Decision based on degree of symptoms and trend
FiO2 25-40%	FiO2 stable or increasing, administer surfactant
Relatively high FiO2 (40-60%), infant newly born and transitioning	FiO2 stable or increasing, administer surfactant
	FiO2 decreasing, hold on administration and follow the trend. Decision to administer based on FiO2 plateau and degree of symptoms

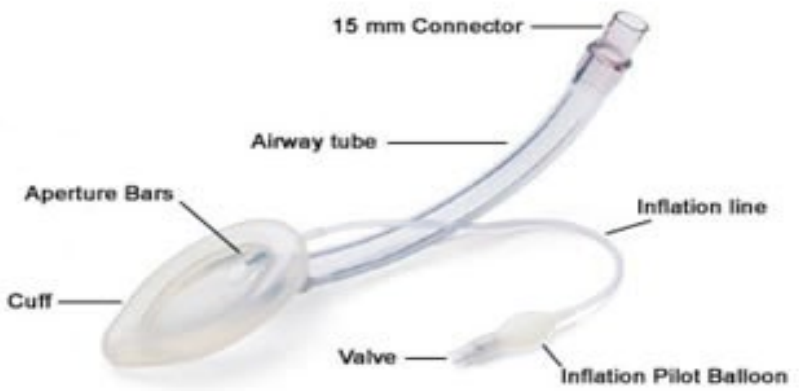
How do you do SALSA?

LMA Supplies



Equipment is versatile based on what is available at your institution

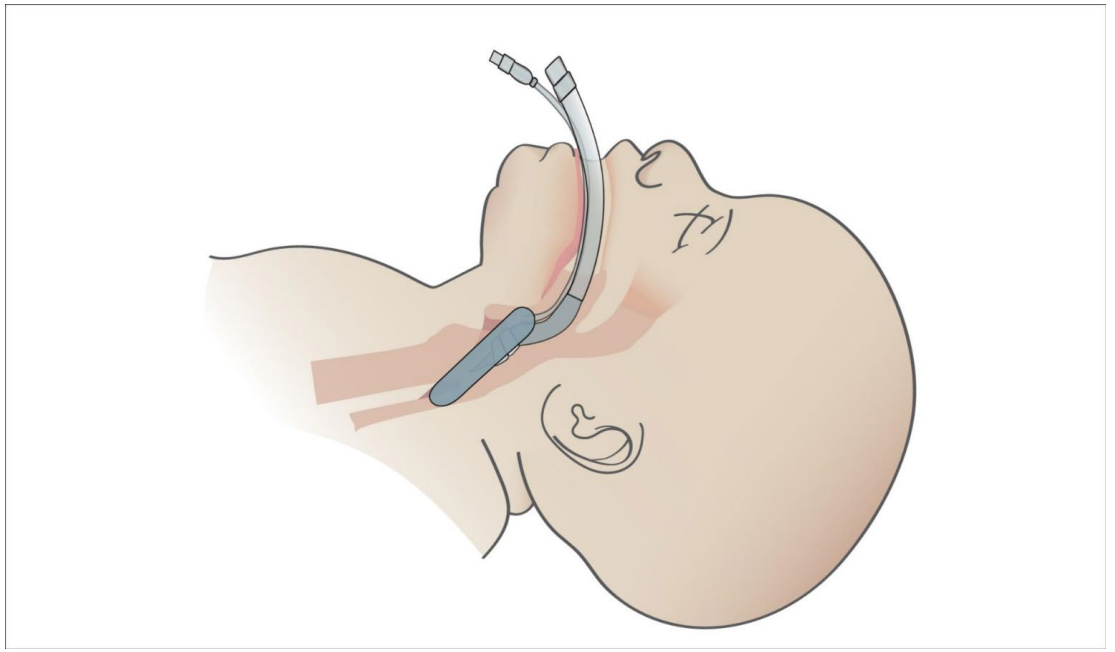
Laryngeal Mask Airway



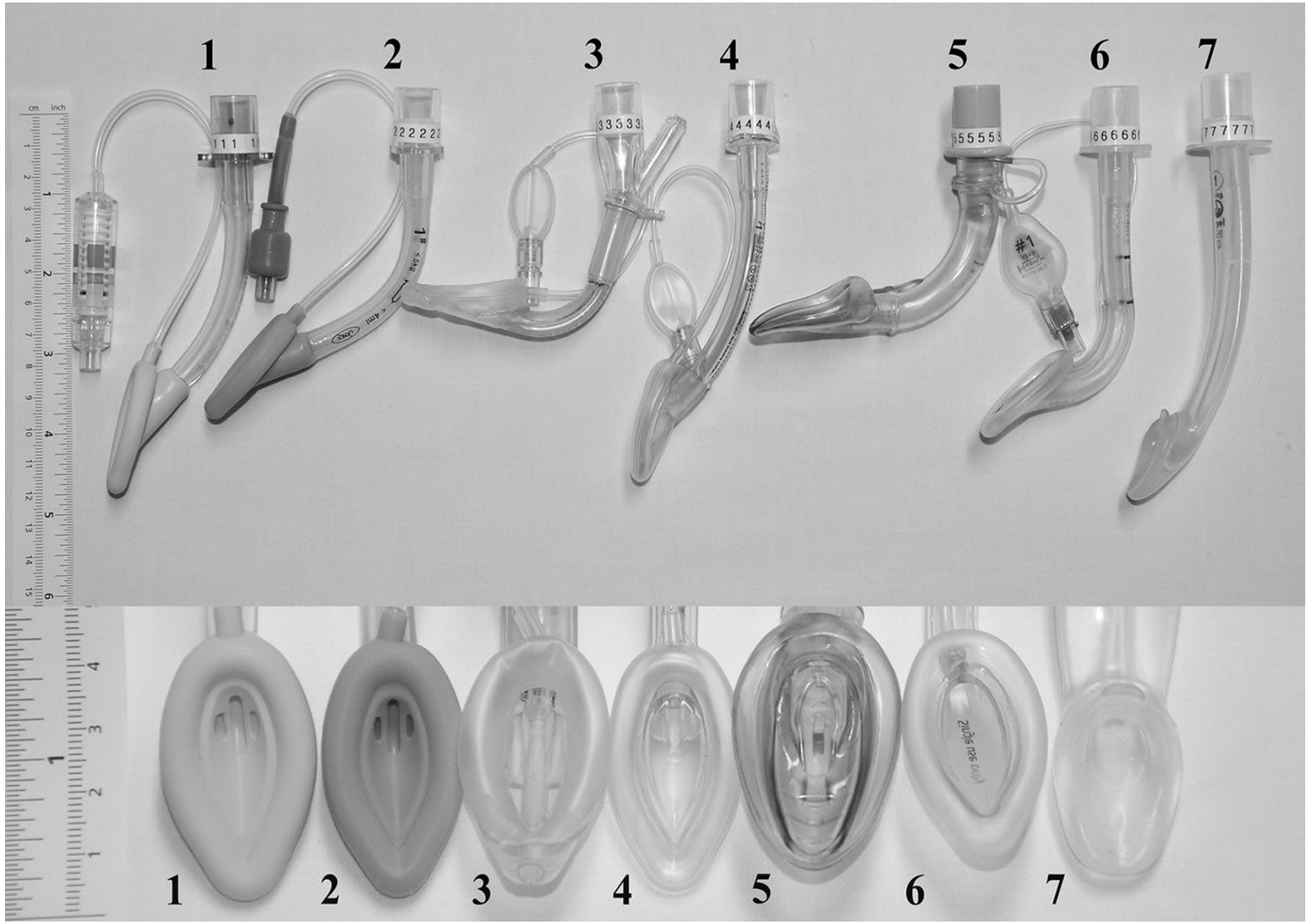
LMA® Unique™



iGel®



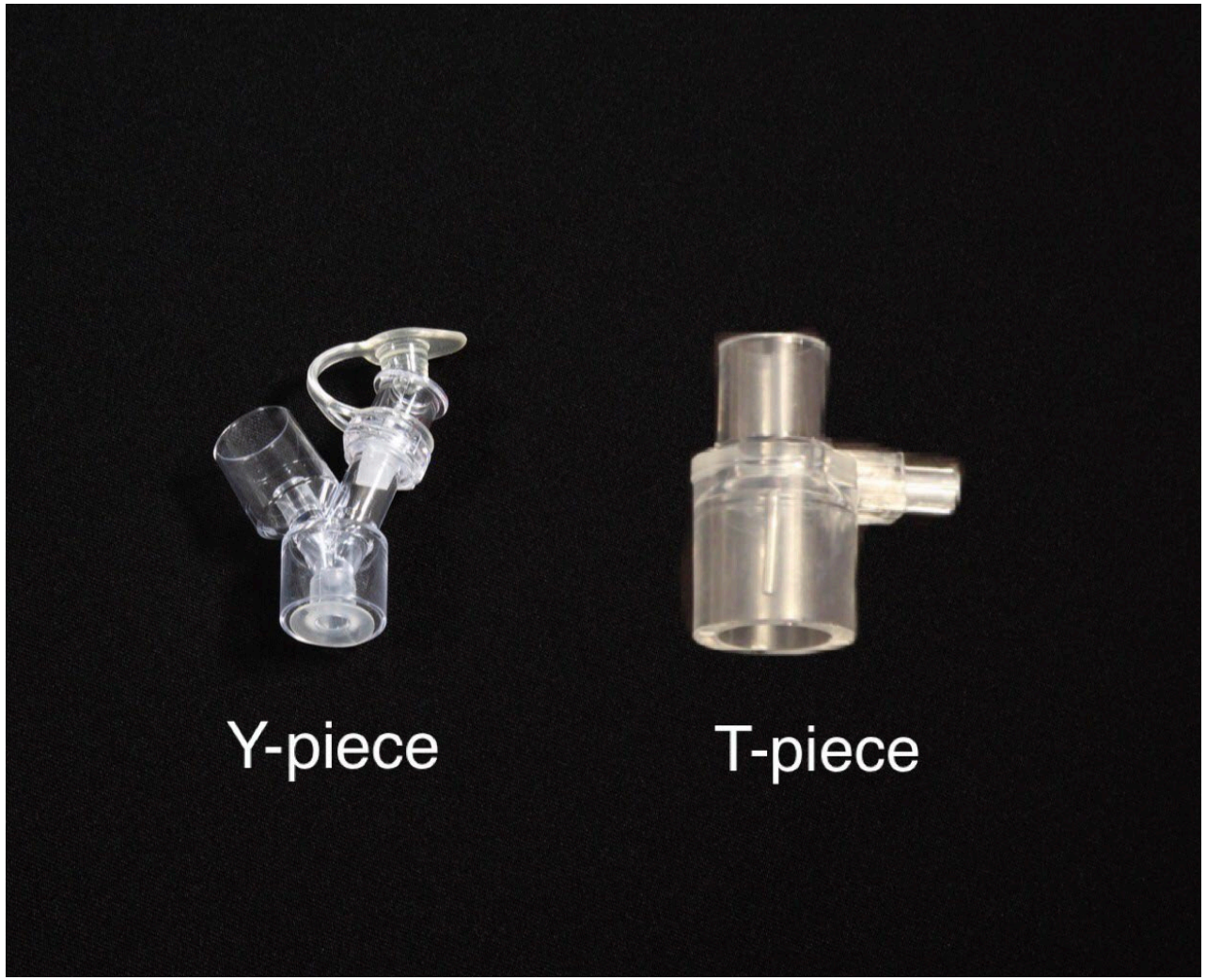
LMAs



(1) Ultimate (Ultimate Medical, Tianjin Medis, China), (2) PRO-Breathe (Well Lead Medical, China), (3) LMA Supreme (The Laryngeal Mask, Seychelles), (4) Unique LMA (The Laryngeal Mask), (5) air-Qsp (Cookgas, Malaysia), (6) AuroOnce (Ambu A/S, Ballerup, Denmark) and (7) i-gel (Intersurgical, Wokingham, Berkshire, UK)

Used with permission from Tracy MB. Arch Dis Child Fetal Neonatal Ed 2018;103:F271–F276

Adapters



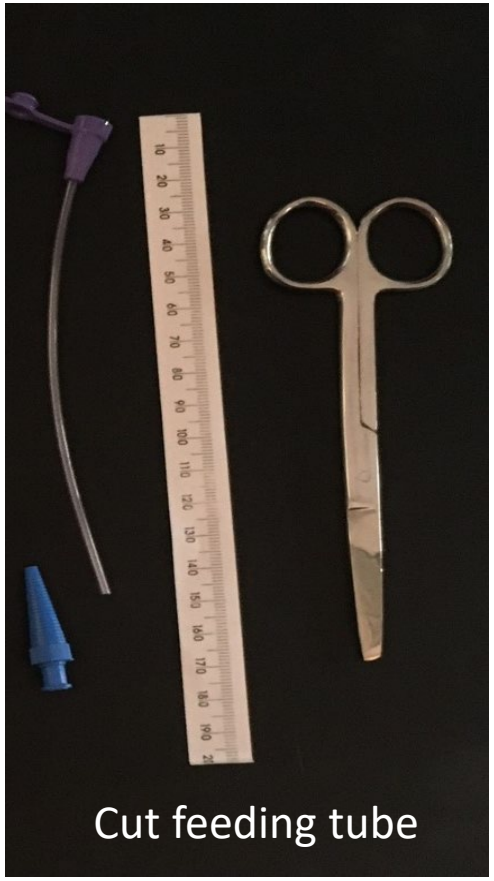
Surfactant Administration



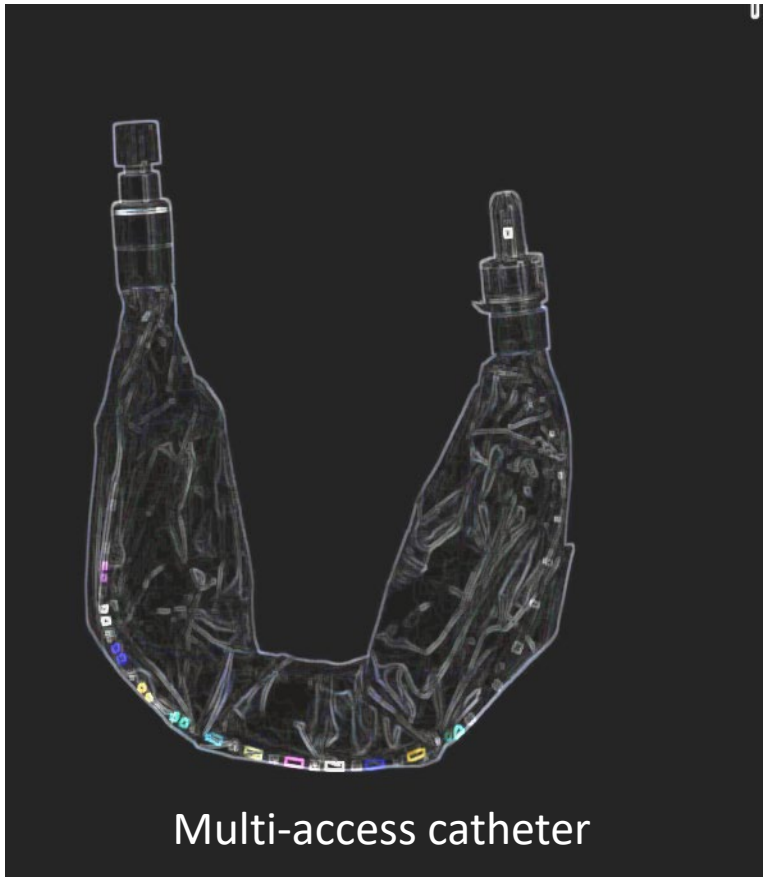
Surfactant Administration



“Y” adapter



Cut feeding tube



Multi-access catheter

CO_2 Detectors

EMMA™



Capnography

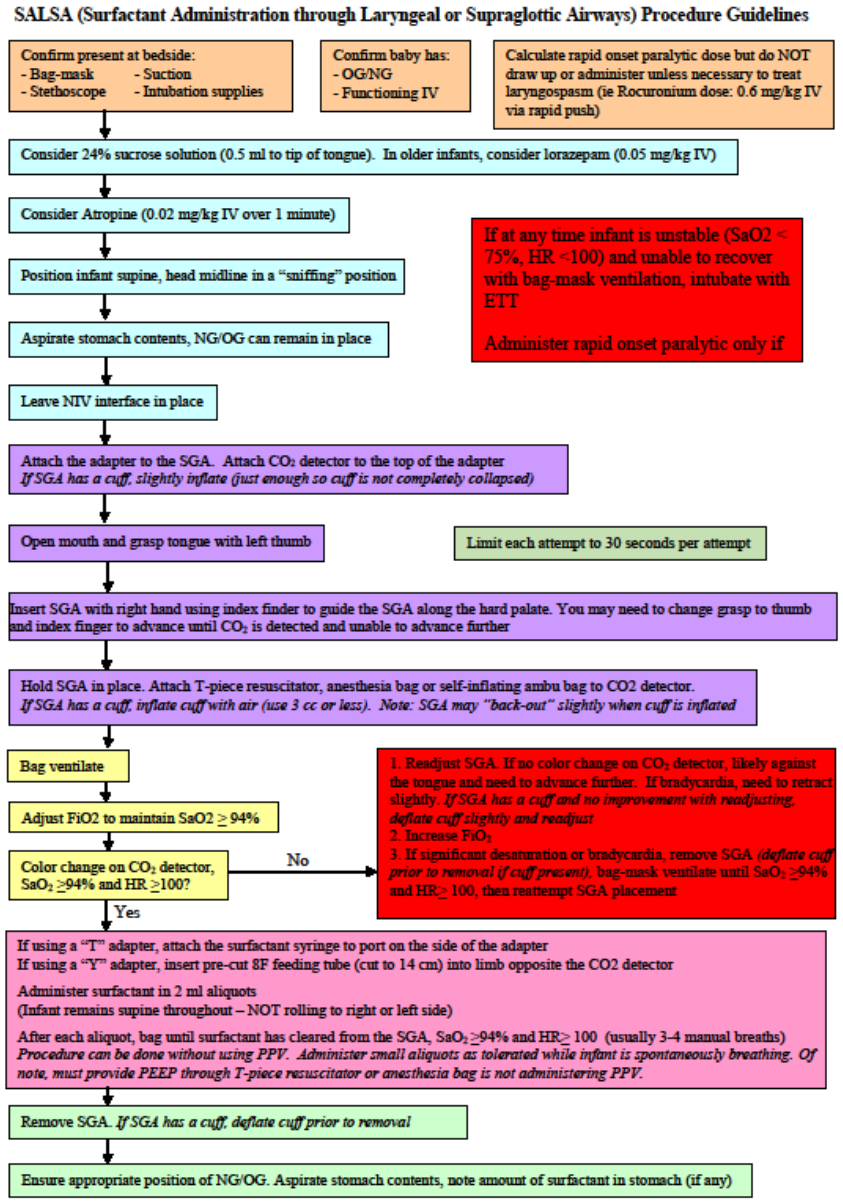
PediCap®

NeoStat®



Colorimeter

Capnography is preferable but colorimetric CO_2 detectors also work well



Procedure flow chart which can be downloaded and used at the bedside: https://documentcloud.adobe.com/link/track?uri=urn:aaid:scds:US:83001e7d-4044-4ee3-807b-0e01c9691a80



Used with parent permission. University of Minnesota

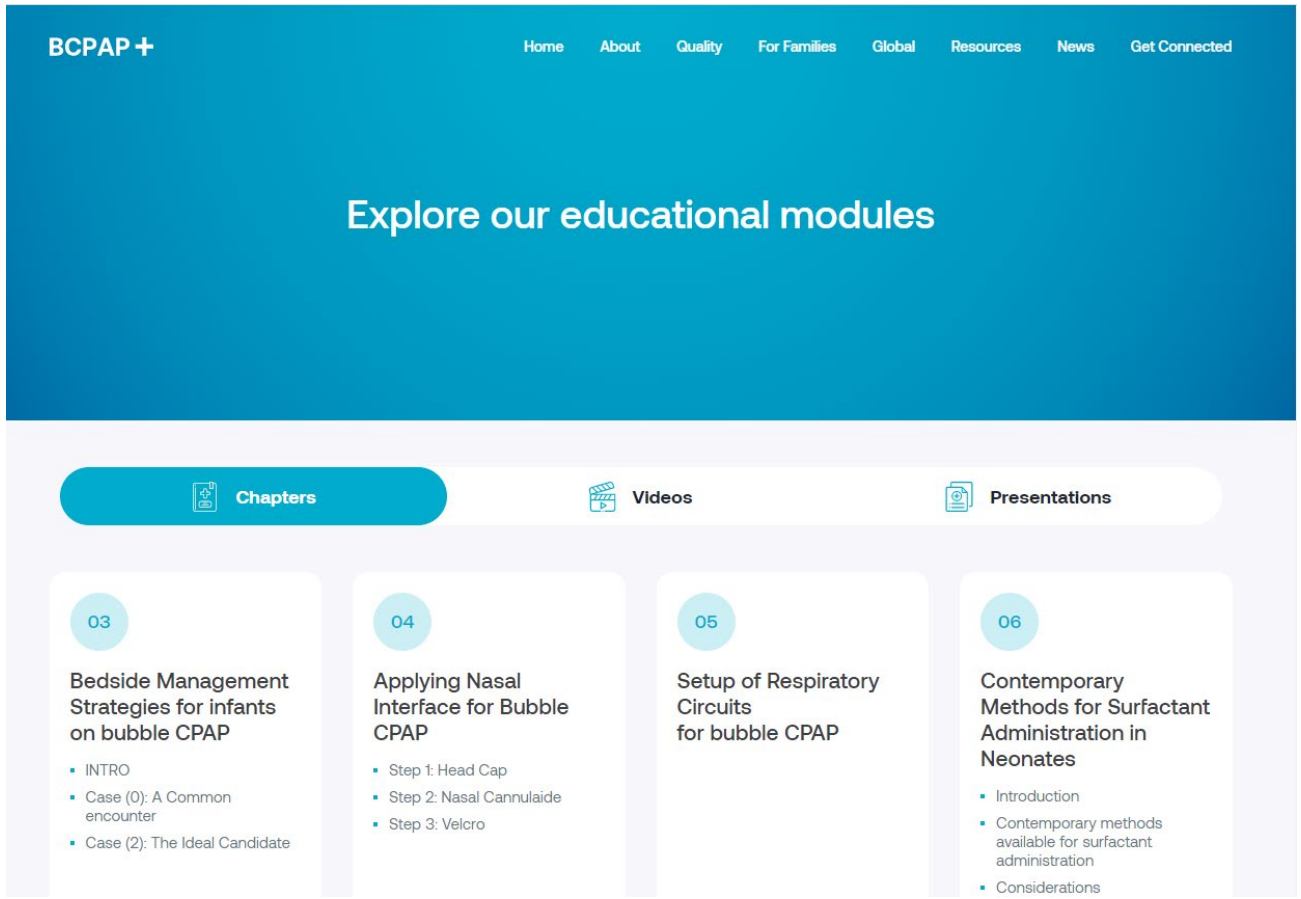
Video of the procedure performed in the clinical setting:
https://www.youtube.com/watch?v=ioXGyfVLdyE



“Step-by-Step” instructional video

https://www.youtube.com/watch?v=lig9l4BgIy4





Bubble CPAP training website

https://www.bcpap.org/modules/

Modules 6 and 7

Step-by-Step guidelines

NeoReviews™
AN OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

ARTICLE

Surfactant Administration Through Laryngeal or Supraglottic Airways

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§Department of Pediatrics, Division of Neonatology, University of Minnesota, Minneapolis, MN
¶Co-first authors

PRACTICE GAPS

1. Minimally invasive methods of delivering surfactant continue to advance and these practices have been shown to improve the success of noninvasive ventilation.
2. Surfactant administration through laryngeal or supraglottic airways is technically easy, is well-tolerated, and has broad application to a wide variety of practice settings.

Published October 2021

YouTube Channel

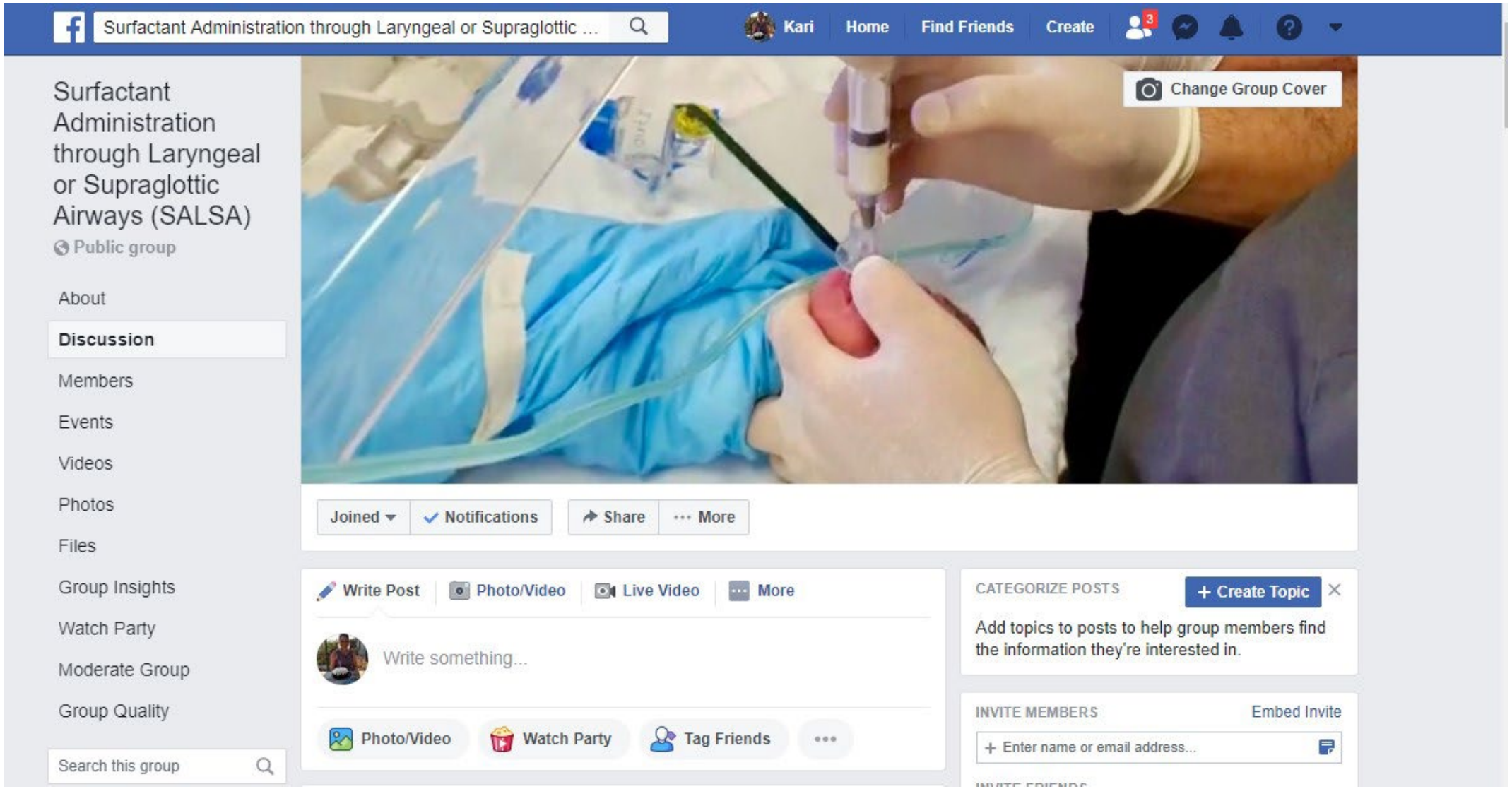
https://youtu.be/8QRxb4rToqE

SALSA

Surfactant Administration through Laryngeal or Supraglottic Airway

SALSA Facebook page

Join us!



Conclusion….



Yes!

You can have bCPAP and surfactant too!

Please email me at rober694@umn.edu

Will LMAs be available for ≤ 1250g?



Can you help me implement SALSA at my institution?



Please email me at rober694@umn.edu

References: MIST

Procedure Trials

Dargaville P, Alyappan A, De Paoli AG, Kuschel CA. Minimally-invasive surfactant therapy in preterm infants on continuous positive airway pressure. Arch Dis Child Fetal Neonatal Ed 2013; 98: F122-6.

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Krajewski P, Chudzik A, Strzalko- Gloskowska B, et al. Surfactant administration without intubation in preterm infants with respiratory distress syndrome- our experiences, J Matern Fetal Neonatal Med 2015; 28: 1161-1164.

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