September 23rd, 2023 09:00 - 11:00

# PARALLEL SESSION 32 - LUNG 5

## ID 448. Transcutaneous electromyography of the diaphragm as a novel triggering modality for non-invasive ventilation

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Background
Nasal intermittent positive pressure ventilation (nIPPV) is increasingly used in clinical practice and should ideally be synchronized to the spontaneous breathing efforts of the patient. However, traditional synchronization modalities like a flow sensor or abdominal pressure capsule are hampered by air leakage at the interface or insufficient sensitivity. Therefore, the aim of this study is to develop and test a new triggering modality based on the electrical activity of the diaphragm, measured with transcutaneous electromyography (dEMG).

Methods
A software algorithm was developed which processes raw dEMG data in real-time and detects the inspiratory efforts of the infant. First, the algorithm was tested in offline simulations and subsequently tested in real-time using an in-vitro bench set-

up. Prerecorded dEMG and flow data of mechanically ventilated infants were fed to the algorithm and the dEMG-based triggers were compared to the ventilator detected inspirations (flow-based). If the dEMG trigger lay was <200 ms pre- or post a flow trigger, it was considered a match. The main outcome measures were (1) the percentage of matched breaths (2) the detected respiratory rate (RR) based on flow and dEMG and (3) the ability to actually trigger the ventilator.

Results

Prerecorded data of 13 patients (mean GA 38.4±3.0 weeks), including 16,973 flow breaths, were used in the bench. dEMG detected less (14,170 breaths, 83.5%), due to artefacts in the EMG signal or overdetection in the flow signal. 45.8% of the dEMG triggers were matched in time with inspiration, while the remaining dEMG triggers were outside the matching window. The average detected RR was similar (58.7 vs 57.8 breaths/min) for flow and dEMG, respectively. Lastly, all dEMG-triggers were sent successfully to the ventilator which generated a corresponding pressure inflation.

Conclusion

For the first time dEMG has been used to trigger a ventilator during nIPPV. These first results show it is technically feasible to trigger a ventilator based on transcutaneous dEMG, but currently the trigger delay is too long. The next step is to optimize the triggering algorithm, before investigating the level of improvement in nIPPV synchronization in a clinical study.

None declared considering this abstract

# ID 201. The Role of Lung Ultrasonography in The Perioperative Evaluation Of Pulmonary Edema in Newborns with Critical Congenital Heart Disease

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Background: In newborns with critical CHD, pulmonary edema may be experienced longer and more severely. There are several studies that show that lung ultrasonography detects pulmonary edema better than chest X-ray. Our aim in this study was to evaluate pulmonary edema by lung ultrasonography in operated newborns with critical congenital heart disease and to evaluate its effectiveness in the treatment of pulmonary edema.

Methods: In this prospective observational clinical study, bedside lung ultrasonography was performed for pulmonary edema in 44 newborns operated for critical CHD. Ultrasonography was performed four times in the perioperative period and the newborns had routine chest Xray and echocardiographic evaluation taken on the day of ultrasonography. The correlation of Lung ultrasonography with radiological imaging and clinical findings of the newborn was examined.

Results: Mean gestational age and birth weight were 38.3 ± 1.7 weeks and 3026 ± 432 gram, respectively. In the perioperative period, a statistically significant correlation was found between moderate-severe pulmonary edema on lung ultrasonography, pulmonary edema findings on chest X-ray and clinical findings of

pulmonary edema in newborns [respectively ($p<0.001$) ($p<0.05$)]. In addition, a significant correlation between the degree of moderate–severe pulmonary edema in lung ultrasonography and pulmonary hypertension in echocardiographic evaluation was found only in the preoperative period (p:0.04).

Conclusion: Besides the use of ultrasonography in detecting pulmonary edema and directing the treatment of pulmonary edema, its secondary contribution is that it can be used effectively in predicting the duration of hospitalization and mechanical ventilation support.

None declared

# ID 506. BIOREACTANCE-DERIVED THORACIC FLUID CONTENT (TFC) AND RESPIRATORY DISTRESS IN PRETERM INFANTS

**Professor Lizelle Van Wyk**[1], Professor Johan Smith[1], Professor John Lawrenson[1], Professor Carl J Lombard[2], Professor Willem–Pieter de Boode[3]

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Background

The most common respiratory pathology in preterm neonates is respiratory distress of the newborn (RDS) for which the mainstay of treatment is nasal continuous positive airway pressure (nCPAP) and surfactant replacement therapy (SRT). Thoracic fluid content (TFC) is a non–invasive thoracic electrical biosensing technology (TEBT) parameter. TFC has been shown to correlate RDS and TTN (transient tachypnoea of the newborn) in term and late–preterm infants. Bioreactance, a type of TEBT, has not been used to determine the effect of different respiratory support modes on TFC in preterm infants.

Methods

This was a retrospective descriptive study of TFC data collected during a prospective method comparison study utilizing bioreactance and transthoracic echocardiography measuring cardiac output in preterm neonates. TFC, TFCd (dynamic TFC) and TFCd0( change from baseline) were measured at pre–defined times pre– and post–intervention (CPAP and CPAP+SRT groups) and compared to infants requiring no respiratory support (NONE group).

Parents provided informed consent and the study was approved by the Stellenbosch University HREC

Results

63 infants were included. The mean gestational age was 31.3 (±2.7) weeks and mean birth weight 1563 (±3)g, of which 63% were ⩽32 weeks and 46% were <1500g. 31% of infants had RDS and 22% TTN. 22% of infants required no respiratory support, 57% CPAP only and 21% required CPAP with SRT.

TFC and TFCd0 differed at all time points between NONE and CPAP/ CPAP+SRT groups but not between CPAP and CPAP+SRT groups. TFC and TFCd0 were significantly associated with gestational age as well as pre- and post measurements in the CPAP and CPAP+SRT groups.

Conclusion

This is the first study of TFC in preterm neonates utilizing bioreactance technology to show an effect of various respiratory support methods on TFC. TFC changed with CPAP and SRT administration even after accounting for gestational age and birthweight. TFC and TFCd0 may be able to be used to determine the severity of RDS and predict SRT requirement. More research is required to confirm these findings.

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# ID 41. Lung Ultrasound Detects Regional Aeration Inhomogeneity in Ventilated Preterm Lambs

Miss Laura He[1], **Dr Arun Sett**[1]

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Introduction:

Preterm infants often develop inhomogeneous lung aeration which may contribute to lung injury. Lung ultrasound (LUS) and electrical impedance tomography (EIT) can non-invasively monitor lung volume in real-time. EIT detects inhomogeneous aeration but is predominantly limited to the research setting. Although more readily available, the ability of LUS to detect inhomogeneous aeration is unknown. The aim of this study was to determine whether LUS detects regional inhomogeneity as detected by EIT in preterm lambs.

Methods:

LUS and EIT were simultaneously performed on mechanically ventilated preterm lambs. LUS images from the non-dependent and dependent regions were acquired bilaterally. Ultrasound images were blindly graded. Regional inhomogeneity was determined by calculating the observed to predicted aeration ratio from the EIT reconstructive model. Ultrasound measurements were compared with regional aeration ratios derived from EIT using one-way ANOVA with repeated measures.

Results:

LUS was performed in 32 lambs (mean (SD) gestation 125 (1) days). 128 images were acquired. LUS scores were greater in the upper anterior compared to lower lateral regions of the left (3.4 vs 2.9, $p=0.1$) and right lung (3.4 vs 2.7, $p<0.0087$). The left and right upper regions also had greater LUS scores compared to the right lower (3.4

vs 2.7, p<0.0087) and left lower (3.7 vs 2.9, p=0.1) regions respectively. These corresponded with regional differences detected by EIT, which demonstrated relative over–expansion of the non–dependent lung compared to dependent regions (Figure 1).

Conclusion:

LUS may have potential to measure regional aeration, which should be further explored in human studies.

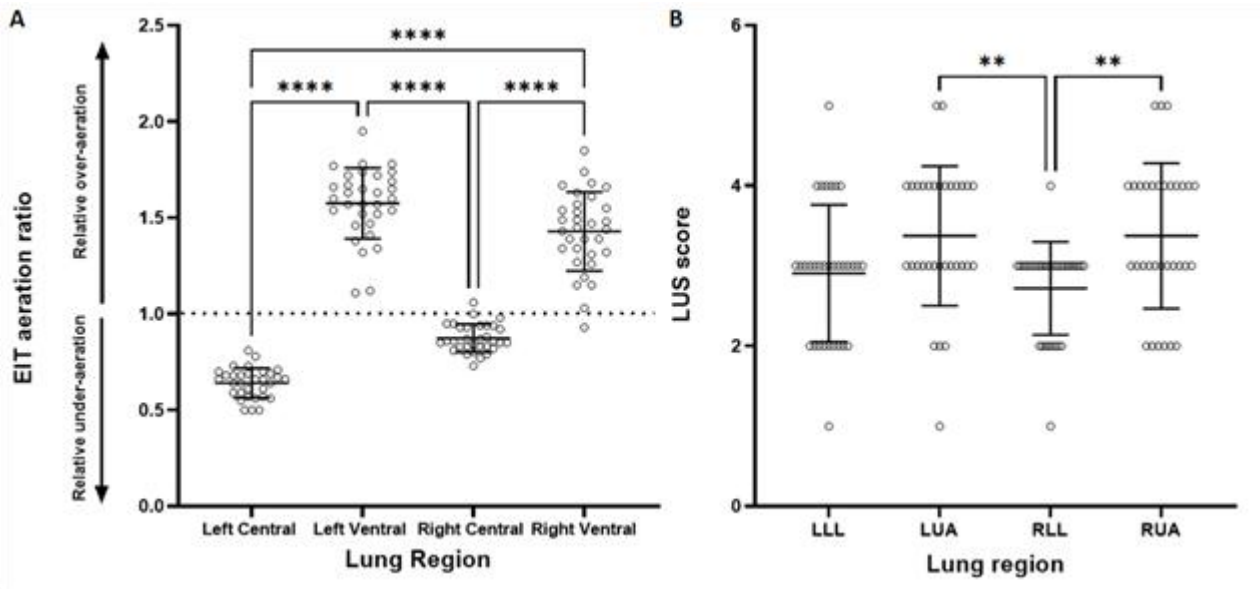


Figure 1: Regional aeration differences detected by EIT (A) and LUS (B). LLL; left lower lateral, LUA; left upper lateral, RLL; right lower lateral, RUA; right upper lateral.

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None declared