# THE USE OF NEW LUNG ULTRASOUND SCORE AS A PREDICTOR OF WEANING OUTCOME IN MECHANICALLY VENTILATED PATIENTS

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## INTRODUCTION

Mechanical ventilation (MV) is the most common therapeutic modality used for critically ill patients. MV is a critical intervention to sustain life in acute or emergent settings. This procedure involves applying positive pressure breaths and relies on the airway system's compliance and resistance.

To maximize the benefits of the ventilator and minimize the risk of complications in critically ill patients, it is important to avoid both premature extubation and unnecessary prolongation of MV.

Using ultrasound can help to predict the weaning and extubation outcome as it is easy to use, non invasive, available and repeatable at the bedside

Diaphragm ultrasound is used to assess and measure diaphragm excursion and diaphragm thickening fraction

Lung ultrasound is used to measure modified lung ultrasound score (0-24) it is better than classical LUS score (0-36) as it is easier and decreases the movement of critically ill patients at beds.

## AIM OF THE WORK

The aim of our work was to evaluate and assess the value of lung and diaphragm ultrasound to predict weaning and extubation outcome, using diaphragm thickening fraction (DTF), diaphragm excursion (DE), modified lung ultrasound score (mLUS score) and rapid shallow breathing index (RSBI).

## PATIENTS AND METHODS

This study included 65 mechanically ventilated patients admitted to Critical Care Medicine Department in the Alexandria Main University Hospital from January 2024 to November 2024. Excluded patients were children, pregnant females, Tracheostomized patients, who diagnosed with neuromuscular diseases and who presented by chest trauma.

Age, sex, APACHE II score, ICU stay and MV days of each patients were recorded

**RSBI** was calculated from respiratory rate (RR) divided by tidal volume (TV) in litres.

**DE**, by using curved probe in the right anterior subcostal area, was measured as the distance between the diaphragm movement at end of inspiration & at end of expiration.

**DTF**, by using linear probe over the zone of apposition, was measured as (diaphragm thickening difference) / (diaphragm thickening at end expiration) × 100%.

**mLUS score**, by using curved probe to examine both lungs, was ranged (0-24)

Each lung was separated into 4 regions (upper anterior, lower anterior, lateral, posterobasal) and each region received score (0-3) according to pulmonary ventilation.

## RESULTS

**Table 1:** Predict performance for different parameters to predict Success (n=42) from Failure (n=23)

| | AUC | p | 95% C.I | Cut off | Sensitivity | Specificity | PPV | NPV |
|---|---|---|---|---|---|---|---|---|
| **RSBI** | 0.685 | 0.014* | 0.550 – 0.821 | ≤105 | 64.29 | 56.52 | 73.0 | 46.4 |
| **DTF** | 0.829 | <0.001* | 0.703 – 0.955 | >39.4 | 88.10 | 86.96 | 92.5 | 80.0 |
| **DE** | 0.871 | <0.001* | 0.772 – 0.971 | >1.1# | 90.48 | 86.96 | 92.7 | 83.3 |
| **MLUS score** | 0.774 | <0.001* | 0.641 – 0.907 | ≤8 | 73.81 | 69.57 | 81.6 | 59.3 |

AUC: Area Under a Curve
p value: Probability value
CI: Confidence Intervals
NPV: Negative predictive value
PPV: Positive predictive value
*: Statistically significant at p ≤ 0.05
#Cut off had been choose according to Youden index

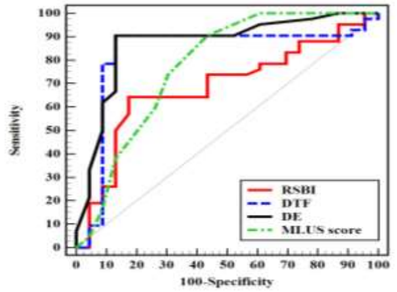


**Figure1:** ROC curve for different parameters to predict Success (n = 42) from Failure Extubation (n = 23)

**Table 2:** Correlation between MV Days and ICU Stay with different parameters in Total group (n = 65)

| | | MV Days | ICU Stay |
|---|---|---|---|
| **RSBI** | r | 0.342* | 0.315* |
| | p | 0.005* | 0.010* |
| **DTF** | r | -0.564* | -0.612* |
| | p | <0.001* | <0.001* |
| **DE** | r | -0.630* | -0.598* |
| | p | <0.001* | <0.001* |
| **MLUS score** | r | 0.679* | 0.690* |
| | p | <0.001* | <0.001* |

**r: Pearson coefficient**
*: Statistically significant at p ≤ 0.05

**Table 3:** Relation among Mortality with different parameters in Total group (n=65)

| | Mortality | | U | p |
|---|---|---|---|---|
| | Died (n = 10) | Survive (n = 55) | | |
| **RSBI** | | | | |
| Min – Max. | 68.50 – 121.00 | 61.20 – 117.7 | 147.50* | 0.020* |
| Mean ± SD. | 102.64 ± 17.93 | 86.39 ± 17.74 | | |
| Median (IQR) | 106.7 (95.77 – 115.3) | 77.10 (72.60 – 103.2) | | |
| **DTF** | | | | |
| Min – Max. | 16.10 – 41.80 | 19.70 – 60.80 | 154.0* | 0.026* |
| Mean ± SD. | 35.04 ± 10.04 | 42.72 ± 10.71 | | |
| Median (IQR) | 34.20 (27.50 – 44.70) | 45.10 (32.85 – 50.95) | | |
| **DE** | | | | |
| Min – Max. | 0.50 – 1.60 | 0.70 – 2.30 | 151.0* | 0.024* |
| Mean ± SD. | 0.98 ± 0.45 | 1.33 ± 0.40 | | |
| Median (IQR) | 0.75 (0.70 – 1.30) | 1.40 (1.05 – 1.65) | | |
| **MLUS score** | | | | |
| Min – Max. | 7.00 – 16.00 | 4.00 – 15.00 | 141.50* | 0.014* |
| Mean ± SD. | 9.90 ± 2.51 | 7.67 ± 2.19 | | |
| Median (IQR) | 9.5 (7.00 – 13.00) | 7.00 (6.00– 9.00) | | |

SD: **Standard deviation**
p: p value for Relation among
*: Statistically significant at p ≤ 0.05
**U: Mann Whitney test**
**Mortality** with **different parameters**

## CONCLUSION

Diaphragm US is better than lung US and RSBI to predict successful weaning from MV. DE sensitivity and specificity were higher than DTF, and both of them had sensitivity and specificity higher than mLUS score and RSBI.

RSBI had the least sensitivity & specificity to predict the weaning success.

There was positive correlation between mLUS and RSBI with MV days, ICU stay and 28 days mortality. Conversely, DE & DTF were negatively correlated with MV days, ICU stay and 28 days mortality.