LUNG ULTRASOUND IN ICU
OVERVIEW

- Need for USG
- Mechanics of USG
- Principles of lung USG
- BLUE protocol
- Alveolar syndrome
- Interstitial syndrome
- Weaning assessment
- Pneumonia / VAP
- Prone position
  ventilation assessment
- ETT positioning
- Post extubation stridor
Need for USG??

- Supplement clinical assessment in critically ill

- Stethoscope of modern intensivist!!

- Absence of radiation, better portability, real-time imaging, and the ability to perform dynamic imaging, faster, relatively cheap

- Convenience
USG – THEN AND NOW !!!
USG – THEN AND NOW !!!
# Transducers

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>2-5</th>
<th>5-12</th>
<th>1.5-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footprint (cm²)</td>
<td>Large (6x1.5)</td>
<td>Large (5x1)</td>
<td>Small (2.5x1.5)</td>
</tr>
<tr>
<td>Axial resolution</td>
<td>Good to average</td>
<td>Very good</td>
<td>Good to average</td>
</tr>
<tr>
<td>Penetration</td>
<td>Good</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>Uses</td>
<td>Abdomen</td>
<td>Vascular</td>
<td>Echo, Lung, Pleura</td>
</tr>
</tbody>
</table>
# Probes

- **Cardiac**
- **Abdominal**
- **Endocavity**
- **Vascular**
  - **Lungs**
  - 2.5-3.5 MHz
  - 3.5-5.0 MHz
  - 5.0-7.5 MHz
  - 7.5-10 MHz
  - 5 mhz curvilinear probe is ideal (low frequency for deeper tissue)
USG – Tissue interactions
MODES OF USG

B Mode: Brightness
- 2D Image
- Intensity of brightness: strength of echo

M mode: Motion
- What the line see vs time
- Stationary stuff: Straight line
- Moving things: curved/ dot
LUNG USG
LUNG USG – ARTIFACTS

Diagram showing the progression of reflections from a transducer, leading to a comet-tail artifact.
SCANNING PROCEDURE

- Position patient, arm abducted
- Adjust depth of usg window to 5-8cm
- Longitudinal placement of transducer between ribs
- Systematic scanning, apex to base of both sides
NORMAL PLEURAL USG

- Sonographer should visualise two rib shadows with hyperechoic pleural line moving back and forth

- Bat sign

- Lung sliding should be seen
LUNG USG: CRITICALLY ILL

The bat sign
The A-line
Lung sliding
The quad sign
The sinusoid sign
The tissue-like sign
The shred sign
The B-line (& lung rockets)
The stratosphere sign
The lung point
The lung pulse
Dynamic air bronchogram
Two ribs with posterior shadowing represents the wings of the bat, and the hyperechoic pleural line, its body. Between these two ribs, the two layers of pleura are seen sliding across one another.
A LINES

- Horizontal lines parallel to chest wall
- Brightly echogenic
- Located between rib shadows when probe positioned longitudinally
B LINES

- Arise at the border between aerated and compressed lung
- Multiple ray-like, or comet-tail, vertical lines
- Extend from the pleural line to the lower edge of the screen without fading
- Move synchronously with the lung during respiration and tend to erase A lines
B LINES

Figure 6 – B-lines on lung ultrasound. Although B-lines are seen in normal individuals, the number and intensity of B-lines are directly proportional to the degree of pulmonary, septal, or alveolar edema. Adapted from Lichtenstein et al.\textsuperscript{[23]}
E LINES

- Suspected when subcutaneous emphysema can be palpated
- Vertical lines start at a level external to the ribs extending deep into chest
- Similar to B lines, but arise from chest wall and not pleural line
LUNG PULSE (T LINES)

- Rhythmic movement of the pleura in synchrony with the cardiac rhythm
- Best viewed in areas of the lung adjacent to the heart, at the pleural line
- Result of cardiac vibrations being transmitted to the lung pleura in poorly aerated lung
QUAD SIGN/SINUSOIDAL SIGN

- Characteristic of pleural effusion
- "quad sign" - fluid is framed within four borders: pleural line, lung line, acoustic shadows of two ribs (or diaphragm)
- "sinusoid sign" - appears in the M-mode as a result of alteration of respiratory transverse interpleural space
SEA SHORE SIGN/ BAR CODE SIGN

- Dynamic sign
- Best seen at apex in supine position
- Present in normal lung
- The motionless portion of the chest above the pleural line creates horizontal 'waves,' and the sliding below the pleural line creates a granular pattern, the 'sand'
LUNG POINT

- Defines the border of pneumothorax
- Helps in defining size of pneumothorax
- Not seen in cases of total lung collapse
Tissue sign & shred sign

TISSUE LIKE SIGN

SHRED SIGN
BLUE PROTOCOL

- Bedside lung ultrasound in emergency
- In <3 minutes
- Step-by-step diagnosis of the main causes of acute respiratory failure
- six diseases seen in 97% of patients in the emergency room with overall 90.5% accuracy


The BLUE protocol

Lung sliding

- present
  - B-profile
    - PULMONARY EDEMA
      - Thrombosed vein
        - PULMONARY EMBOLISM
          - PLAPS
            - PNEUMONIA
          - no PLAPS
            - COPD or ASTHMA
      - Free veins
        - PNEUMONIA
  - A-profile
    - Sequential venous analysis
      - PNEUMONIA
  - A/B or C-profile
    - PNEUMONIA
  - B'-profile
    - plus lung point
      - PNEUMOTHORAX
    - without lung point
      - Need for other diagnostic modalities

- any
  - abolished
  - A'-profile
    - PNEUMONIA

This decision tree is not designed for providing 100% of diagnoses of acute dyspnea. It has been simplified with the target of overall accuracy just > 90% (90.5%)
USG: Pnuemothorax
# US FOR DIAGNOSIS OF PNEUMOTHORAX

<table>
<thead>
<tr>
<th>Ultrasound Feature</th>
<th>Patient Population</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Lung Sliding</td>
<td>328 Surgical And Trauma</td>
<td>95.5%</td>
<td>100%</td>
</tr>
<tr>
<td>No Lung Sliding</td>
<td>111 Medical ICU</td>
<td>95.3%</td>
<td>91.1%</td>
</tr>
<tr>
<td>No B Lines “Comet Tails”</td>
<td>114 Med-surgical Unit</td>
<td>100%</td>
<td>60%</td>
</tr>
<tr>
<td>Combined</td>
<td>617</td>
<td>100%</td>
<td>96.5%</td>
</tr>
<tr>
<td>Lung Point</td>
<td>233 Med-surgical Unit</td>
<td>66%</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Chan SSW et al Acad Emerg Med Jan 2003 Vol 10 1*
USG : PNEUMOTHORAX

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cxray</td>
<td>52%</td>
<td>99%</td>
</tr>
<tr>
<td>USG</td>
<td>88%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Zhang et al; meta-analysis. CHEST 2011

- Disappearance of lung sliding in 100%
- The lung point is 100% specific for pneumothorax but only moderately sensitive
ALVEOLAR SYNDROME

Atelectasis

- intercostal space narrowing
- liver and spleen elevated

Compressive atelectasis within transudative effusions demonstrates sinusoidal movements of the lung tip with respiration

Pneumonia

- lung volume is maintained
- hyperechoic (hepatization) than atelectasis

Dynamic air bronchograms- 94% specific for pneumonia, although sensitivity is only 61%¹

¹D Lichtenstein: The Dynamic Air Bronchogram Chest 2009;135(6)
USG- CONSOLIDATION

- Probe at PLAPS point
- 90% sensitive and 98% specific
- No lung sliding with tissue or shred sign

INTERSTITIAL SYNDROME

Interstitial syndrome is caused by:

1. Pulmonary oedema - either haemodynamic (fluid overload, cardiac failure) or permeability induced (acute lung injury / ARDS)

2. Interstitial pneumonia or pneumonitis

3. Lung fibrosis
INTERSTITIAL SYNDROME

- Multiple B lines are the sonographic sign
- Ideally-8 region scan
  - or
  - rapid 2 region scan
  - or
  - 28 rib interspaces

(Volpicelli et al, Intensive care medicine 2012 38 577-591)
8 REGION SCAN

- Positive: $\geq 3$ B lines
  $\geq 2$ regions each side

Volpicelli et al, Intensive care medicine 2012 38
577-591
Positive: $\geq 3$ B-line each area

## TOTAL B LINE SCORE (TBS)

<table>
<thead>
<tr>
<th></th>
<th>Mid-axillary</th>
<th>Anterior axillary</th>
<th>Mid-clavicular</th>
<th>Parasternal</th>
<th>Intercostal space</th>
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<tbody>
<tr>
<td>Right side</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Left side</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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Jambrik et al Am J Cardiol 2004:93 1265-70
TBS was significantly correlated with extra vascular lung water index

Diagnosis of pulmonary edema

<table>
<thead>
<tr>
<th></th>
<th>SENSITIVITY</th>
<th>SPECIFICITY</th>
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</thead>
<tbody>
<tr>
<td>TBS $\geq 39$</td>
<td>91.7</td>
<td>75</td>
</tr>
<tr>
<td>BLUE POINT (+ VE in all 4 regions)</td>
<td>33.3</td>
<td>100</td>
</tr>
<tr>
<td>8 REGIONS (+ ve in 2/4 regions each side)</td>
<td>50</td>
<td>96</td>
</tr>
</tbody>
</table>

*Pirompanich P et al., Critical care 2015*
Hydrostatic edema vs ARDS

- Acutely ill patients with hypoxemia and a bilateral B-line pattern

- Ultrasound detect pleural line abnormalities in ARDS
  - thickenings > 2 mm
  - evidence of small subpleural consolidations
  - coarse appearance of the pleural line,
    (rare in cardiogenic edema)

- Areas of sparing are found in 100% of patients with ARDS but are not present in cardiogenic edema
Interstitial syndrome: B3 Vs B7

- B7: Interlobular - septa process, Diffuse pulmonary fibrosis
  - 3 mm

- B3: Interlobular - alveolar process, ARDS/pulmonary edema
  - 7 mm
<table>
<thead>
<tr>
<th></th>
<th>Ac cardiogenic pulm edema</th>
<th>Chronic heart failure</th>
<th>ARDS</th>
<th>Pulm fibrosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical setting</strong></td>
<td>Acute</td>
<td>Chronic</td>
<td>Acute</td>
<td>Chronic</td>
</tr>
<tr>
<td><strong>No of B lines</strong></td>
<td>++++</td>
<td>+/++/+++</td>
<td>++++</td>
<td>+/++/+++</td>
</tr>
<tr>
<td><strong>B lines distribution</strong></td>
<td>Multiple, diffuse, B/L</td>
<td>Multiple, diffuse, B/L</td>
<td>Non homogenous distribution, spared areas</td>
<td>More frequently base of lungs</td>
</tr>
<tr>
<td><strong>Other LUS signs</strong></td>
<td>Pl effusion</td>
<td>Pl effusion</td>
<td>Pl effusion, consolidations</td>
<td>Pl thickening</td>
</tr>
<tr>
<td><strong>ECHO</strong></td>
<td>Abnormal</td>
<td>Abnormal</td>
<td>Likely normal</td>
<td>Likely normal</td>
</tr>
</tbody>
</table>
Hypoxemia

Perform

Bilateral lung ultrasound

Atelectasis and consolidation?

Dependant regions

Pleural effusion?

Anterior regions

Lung sliding?

Bilateral

Alveolar interstitial syndrome

No

Unilateral

Pneumonia

No

Minimal

Consider pulmonary embolism

Yes

Lung pulse?

Bilateral

Alveolar interstitial syndrome

No

Consider mainstem intubation

Minimal

Consider pulmonary embolism

Lung point?

Pneumothorax

Yes

Consider pneumothorax

No

No

Other imaging modalities
FALLS PROTOCOL

- Fluid administration limited by lung sonography
- It is the adaptation of BLUE protocol in patients with acute circulatory failure
- Simple real time echo with lung ultrasound
- Endpoint of fluid therapy- appearance of b lines
The FALLS-protocol (Schematic decision tree)

Acute circulatory failure

- Simple emergency cardiac Sonography
  - Tamponade, pulmonary embolism

- Lung Ultrasound (BLUE-protocol)
  - Pneumothorax
    - Usually Obstructive shock

- B-profile
  - Usually Cardiogenic shock
    * Use SVC or IVC analysis etc if noncardiogenic pulmonary edema suspected

- A-profile
  - Usually Hypovolemic shock
  - No clinical improvement B-profile is generated
    - Usually Septic shock

- FALLS-protocol (fluid therapy)
  - Clinical improvement
USG – Pleural Effusion

- Confirm the diagnosis, allows distinction between effusion and consolidation
- USG (97%) is more accurate than CXR (47%)
- Distinction between transudative and exudative effusion
THORACOCENTESIS

- Identify best site to perform puncture
- Know the depth of adjacent organs
- Reduces complications
Safety of Ultrasound-Guided Thoracentesis in Patients Receiving Mechanical Ventilation*

Paul H. Mayo, MD, FCCP; Hayden R. Goltz, DO; Mehran Tafreshi, MD, FCCP; Peter Doelken, MD, FCCP
USG - Thoracocentesis

- 211 patients MV patients requiring thoracocentesis
- 232 USG guided taps were done (by critical care physicians without radiologist support)
- Pneumothorax occurred in 3 of 232 (1.3%)
VENTILATOR WEANING

- DT assessed by ultrasound is an excellent predictor of weaning outcome in mechanically ventilated COPD patients
- DT was significantly different between patients who failed and patients who succeeded SBT
- Success of SBT

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT &gt; 40%</td>
<td>88</td>
<td>92</td>
<td>95</td>
<td>82</td>
</tr>
<tr>
<td>RSBI &lt;105</td>
<td>95</td>
<td>90</td>
<td>96</td>
<td>92</td>
</tr>
</tbody>
</table>

Gamal Agmy, Samiaa Hamdy, Sherin Farghally European Respiratory Journal 2015 46: OA3264
Lung recruitment

1. Check lung aeration

   - Evidence of lung collapse?
     - YES
     - NO

   - YES: Keep protective ventilation
   - NO: Check hemodynamics

2. Check hemodynamics

   - Stable hemodynamics?
     - YES: iv fluids, inotropes, vasoactive drugs
     - NO: Find lung’s opening and closing pressures
Lung recruitment
USG & Recruitment

- Highly significant correlation was found between PEEP-induced lung recruitment measured by PV curves and ultrasound reaeration score ($\rho = 0.88; P < 0.0001$)

- Ultrasound reaeration score of
  - $\geq 8$: PEEP-induced lung recruitment greater than 600 ml
  - $\leq 4$: PEEP-induced lung recruitment ranging from 75 to 450 ml

- A statistically significant correlation was found between LUS reaeration score and PEEP-induced increase in $Pa(O_2)$ ($\rho = 0.63; P < 0.05$)
USG : Pneumonia

- Four signs:
  - interstitial syndrome
  - abnormal pleural line
  - alveolar consolidation
  - pleural effusion

- Combining four USG signs: sensitivity 94.6% for diagnosing CAP

USG : Pneumonia

Effectiveness of lung ultrasonography for diagnosis of pneumonia in adults: a systematic review and meta-analysis

Yang Xia, Yinghua Ying, Shaobin Wang, Wen Li, Huahao Shen

J Thorac Dis 2016;8(10):2822-2831
USG: Pneumonia

- 14 articles
- LUS:
  - pooled sensitivity of 0.904 (0.884–0.921)
  - pooled specificity of 0.884 (0.861–0.904)
  - pooled + ve LR of 6.6 (3.7–11.7)
  - pooled - ve LR of 0.08 (0.04–0.19)
  - AUC: 0.9611

- AUC for LUS and CXR was 0.972 and 0.867 respectively and the Z statistic of the two sROC curves was 2.31
USG - VAP

- Early diagnosis
- Response to antibiotics
USG : VAP

Lung Ultrasound for Early Diagnosis of Ventilator-Associated Pneumonia.
Mongodi S¹, Via G², Girard M³, Rouquette L⁴, Misset B⁵, Braschi A⁶, Moioli F⁵, Bouhemad B⁷.

Author information

Abstract
BACKGROUND: Lung ultrasound (LUS) has been successfully applied for monitoring aeration in ventilator-associated pneumonia (VAP) and to diagnose and monitor community-acquired pneumonia. However, no scientific evidence is yet available on whether LUS reliably improves the diagnosis of VAP.

METHODS: In a multicenter prospective study of 99 patients with suspected VAP, we investigated the diagnostic performance of LUS findings of infection, subpleural consolidation, lobar consolidation, and dynamic arborescent/linear air bronchogram. We also evaluated the combination of LUS with direct microbiologic examination of endotracheal aspirates (EA). Scores for LUS findings and EA were analyzed in two ways. First, the clinical-LUS score (ventilator-associated pneumonia lung ultrasound score [VPLUS]) was calculated as follows: ≥ 2 areas with subpleural consolidations, 1 point; ≥ 1 area with dynamic arborescent/linear air bronchogram, 2 points; and purulent EA, 1 point. Second, the VPLUS-direct gram stain examination (EAGram) was scored as follows: ≥ 2 areas with subpleural consolidations, 1 point; ≥ 1 area with dynamic arborescent/linear air bronchogram, 2 points; purulent EA, 1 point; and positive direct gram stain EA examination, 2 points.

RESULTS: For the diagnosis of VAP, subpleural consolidation and dynamic arborescent/linear air bronchogram had a positive predictive value of 86% with a positive likelihood ratio of 2.8. Two dynamic linear/arborescent air bronchograms produced a positive predictive value of 94% with a positive likelihood ratio of 7.1. The area under the curve for VPLUS-EAGram and VPLUS were 0.832 and 0.743, respectively. VPLUS-EAGram ≥ 3 had 77% (58-90) specificity and 78% (65-88) sensitivity; VPLUS ≥ 2 had 69% (50-84) specificity and 71% (58-81) sensitivity.

CONCLUSIONS: By detecting ultrasound features of infection, LUS was a reliable tool for early VAP diagnosis at the bedside.
### USG : VAP

<table>
<thead>
<tr>
<th>Condition</th>
<th>PPV</th>
<th>+ ve likelihood ratio</th>
</tr>
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<tbody>
<tr>
<td>Subpleural consolidation + air bronchogram</td>
<td>86%</td>
<td>2.8</td>
</tr>
<tr>
<td>2 dynamic linear/arborescent air bronchograms</td>
<td>94%</td>
<td>7.1</td>
</tr>
</tbody>
</table>
### USG : VAP

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
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</thead>
<tbody>
<tr>
<td>VPLUS- EA</td>
<td>77</td>
<td>78</td>
</tr>
<tr>
<td>VPLUS</td>
<td>69</td>
<td>71</td>
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Ultrasound assessment of antibiotic-induced pulmonary reaeration in ventilator-associated pneumonia.


Abstract

OBJECTIVES: To compare lung reaeration measured by bedside chest radiography, lung computed tomography, and lung ultrasound in patients with ventilator-associated pneumonia treated by antibiotics.

DESIGN: Computed tomography, chest radiography, and lung ultrasound were performed before (day 0) and 7 days following initiation of antibiotics.

SETTING: A 26-bed multidisciplinary intensive care unit in La Pitié-Salpêtrière hospital (University Paris-6).

PATIENTS: Thirty critically ill patients studied over the first 10 days of developing ventilator-associated pneumonia.

INTERVENTIONS: Antibiotic administration.

MEASUREMENTS AND MAIN RESULTS: Computed tomography reaeration was measured as the additional volume of gas present within both lungs following 7 days of antimicrobial therapy. Lung ultrasound of the entire chest wall was performed and four entities were defined: consolidation; multiple irregularly spaced B-lines; multiple abutting ultrasound lung "comets" issued from the pleural line or a small subpleural consolidation; normal aeration. For each of the 12 regions examined, ultrasound changes were measured between day 0 and 7 and a reaeration score was calculated. An ultrasound score $>5$ was associated with a computed tomography reaeration $>400$ mL and a successful antimicrobial therapy. An ultrasound score $<-10$ was associated with a loss of computed tomography aeration $>400$ mL and a failure of antibiotics. A highly significant correlation was found between computed tomography and ultrasound lung reaeration ($\rho = 0.85$, $p < .0001$). Chest radiography was inaccurate in predicting lung reaeration.

CONCLUSIONS: Lung reaeration can be accurately estimated with bedside lung ultrasound in patients with ventilator-associated pneumonia treated by antibiotics. Lung ultrasound can also detect the failure of antibiotics to reaerate the lung.
USG : VAP

- Ultrasound score >5 was associated with a CT reaeration >400 mL and a successful antimicrobial therapy.

- Ultrasound score <-10 was associated with a loss of CT aeration >400 mL and a failure of antibiotics.

- A highly significant correlation was found between computed tomography and ultrasound lung reaeration (Rho = 0.85, p < .0001).
USG : Prone ventilation


Lung ultrasound can be used to predict the potential of prone positioning and assess prognosis in patients with acute respiratory distress syndrome.

Wang XT¹, Ding X¹, Zhang HM¹, Chen H¹, Su LX¹, Liu DW²; Chinese Critical Ultrasound Study Group (CCUSG).

Author information

Abstract

BACKGROUND: It is very important to assess the effectiveness of prone positioning (PP) in patients with severe acute respiratory distress syndrome (ARDS). However, it is difficult to identify patients who may benefit from PP. The purpose of this study was to investigate whether prone positioning potential (PPP) can be predicted by lung ultrasound in patients with ARDS.

METHODS: In this prospective study, 45 patients with ARDS were included for the assessment of PPP. A PP lung ultrasound examination (PLUE) protocol was performed in the dorsal regions of the lung in 16 areas at H0, H3, and H6 (0, 3, and 6 h after PP). The ultrasonography videos were blindly evaluated by two expert clinicians to classify the lung regions as normal pattern (N), moderate loss of lung aeration (B1), severe loss of lung aeration (B2), and consolidation (C). The aeration scores were collected at H0, H3, and H6. According to the ratio of partial pressure of arterial oxygen to fraction of inspired oxygen (P/F ratio) at 7 days, patients were classified into PPP-positive (P/F ratio >300) and PPP-negative groups; also, the patients were classified into survival and nonsurvival groups according to 28-day mortality.

RESULTS: Aeration scores was compared at H0, H3, and H6. The scores were significantly reduced between H3 and H0, but there was no difference between H3 and H6. The aeration score variation (ASV) of the PPP-positive group between H3 and H0 was significantly higher than that in the PPP-negative group, and the sensitivity and specificity of ASV ≥5.5 for the PPP-positive group were 73.9% and 86.4%, respectively. The area under the receiver operating characteristic curve (AUROC) was 0.852 for the ASV. The ASV between H3 and H0 in the survival group was significantly higher than in the nonsurvival group. The sensitivity and specificity of ASV
USG : Prone ventilation

Sensitivity and specificity of ASV ≥5.5 for the PPP-positive group were 73.9% and 86.4%, respectively.
USG : Post extubation stridor

- Air column during balloon cuff inflation (hyperechoic)
- True cords are over both sides of air column (hypoechoic)
- Cartilages are behind the true vocal cords and beside the air column (hyperechoic)

Ding LW, Sand HC, Wu HD et al. Laryngeal USG a useful method in predicting post extubation stridor
USG : Post extubation stridor

Air column during balloon cuff deflation (air column width increased)

*Ding LW, Sand HC, Wu HD et al* laryngeal USG a useful method in predicting post extubation stridor
### USG: Post extubation stridor

<table>
<thead>
<tr>
<th></th>
<th>Median Non stridor group</th>
<th>Stridor group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air leak vol</td>
<td>300 ml</td>
<td>25 ml</td>
</tr>
<tr>
<td>Air column width</td>
<td>6.4 mm</td>
<td>4.5 mm</td>
</tr>
</tbody>
</table>
Laryngeal ultrasonography versus cuff leak test in predicting postextubation stridor.

Mikaeli H¹, Yazdchi M², Tarzamni MK³, Ansarin K¹, Ghasemzadeh M¹.

Abstract

INTRODUCTION: Although cuff leak test has been proposed as a simple method of predicting the occurrence of postextubation stridor, cut-off point of cuff-leak volume substantially differs between previous studies. In addition, laryngeal ultrasonography including measurement of air column width could predict postextubation stridor. The aim of the present study was to evaluate the value of laryngeal ultrasonography versus cuff leak test in predicting postextubation stridor.

METHODS: In a prospective study, all patients intubated for a minimum of 24 h for acute respiratory failure, airway protection and other causes were included. Patients were evaluated for postextubation stridor and need for reintubation after extubation. The cuff leak volume was defined as a difference between expiratory tidal volumes with the cuff inflated and deflated. Laryngeal air column width was defined as the width of air passed through the vocal cords as determined by laryngeal ultrasonography. The air-column width difference was the width difference between balloon-cuff inflation and deflation.

RESULTS: Forty one intubated patients with the mean age of 57.16±20.07 years were included. Postextubation stridor was observed in 4 patients (9.75%). Cuff leak test (cut off point: 249 mL) showed sensitivity and specificity of 75% and 59%, respectively. In addition, laryngeal ultrasonography (cut off point for air column width: 10.95 mm) resulted in sensitivity and specificity of 50% and 54%, respectively. Positive predictive value of both methods were <20%.

CONCLUSION: Both cuff leak test and laryngeal ultrasonography have low positive predictive value and sensitivity in predicting postextubation stridor and should be used with caution in this regard.
AIRWAY USG

- Assessment prior to intubation

  The Feasibility of Ultrasound to Assess Subglottic Diameter
  Karim Lakhal, Anesth Analg 2007;104:611-4

- Assessment prior to tracheostomy

  Bedside Ultrasound Screening for Pretracheal Vascular Structures May Minimize the Risks of Percutaneous Dilatational Tracheostomy

- U/S guided tracheostomy

  Real-time ultrasound-guided percutaneous dilatational tracheostomy: a feasibility study
  Venkatakishna Rajajee, Critical Care 2011, 15:R67
ETT POSITION

Translaryngeal Ultrasound

Intratracheal

Tip visible

Yes

May be too high, measure distance below VC

No

Remove and reintubate

Pleural Ultrasound

Bilateral sliding pleura

Yes

Tube position OK

No

Unilateral sliding pleura

Mainstem intubation
Pull tube back 1-2 cm
Take home message

- USG over CXR ➔
  - Pleural effusion
  - Pnuemothorax

- Blue protocol in acute respiratory failure

- Interpreting lung aeration
  (needs further validation and uniformity)

- Weaning from MV
- VAP
- Assessing prone ventilation
- Lung recruitment