

# THORACIC ULTRASOUND : EMERGING TOOL FOR CHEST PHYSICAL THERAPY

## INTRODUCTION

- Thoracic ultrasound (US) is used more and more in medicine and is considered as the « gold standard » regarding the respiratory system bedside assessment of the patient.
- Thoracic US will sometimes take precedence over pulmonary auscultation.
- Lung US involves numerous benefits such as :
  - good metrological qualities
  - information provided quickly, on a real-time basis and at the patient's bedside
  - safe and dynamic assessment of the pulmonary system
  - free of radiation and non invasive
  - easily portable
- Thoracic US is an operator dependent method that requires a certain level of practical skills.
- Lack of standardized training limits the use of lung US examination in chest physical therapy.

## PURPOSE

- Develop a standardized training program to optimize the use of thoracic US in chest physical therapy
- Identify the relevant content for chest physical therapy, educational methods, optimal ways to use the high-fidelity simulator for training purposes
- Determine appropriate methods of assessing the results achieved from the training

## METHODS

- Take a census of writings in the Databases : Medline, Pubmed, Google Scholar and PsychINFO
- Practice with US machine
- Practice with the CAE Vimedix high-fidelity ultrasonography simulator
- Practice with patients in intensive care unit

## RESULTS

### Training

Developed in accordance with the principles of the competency-based education model

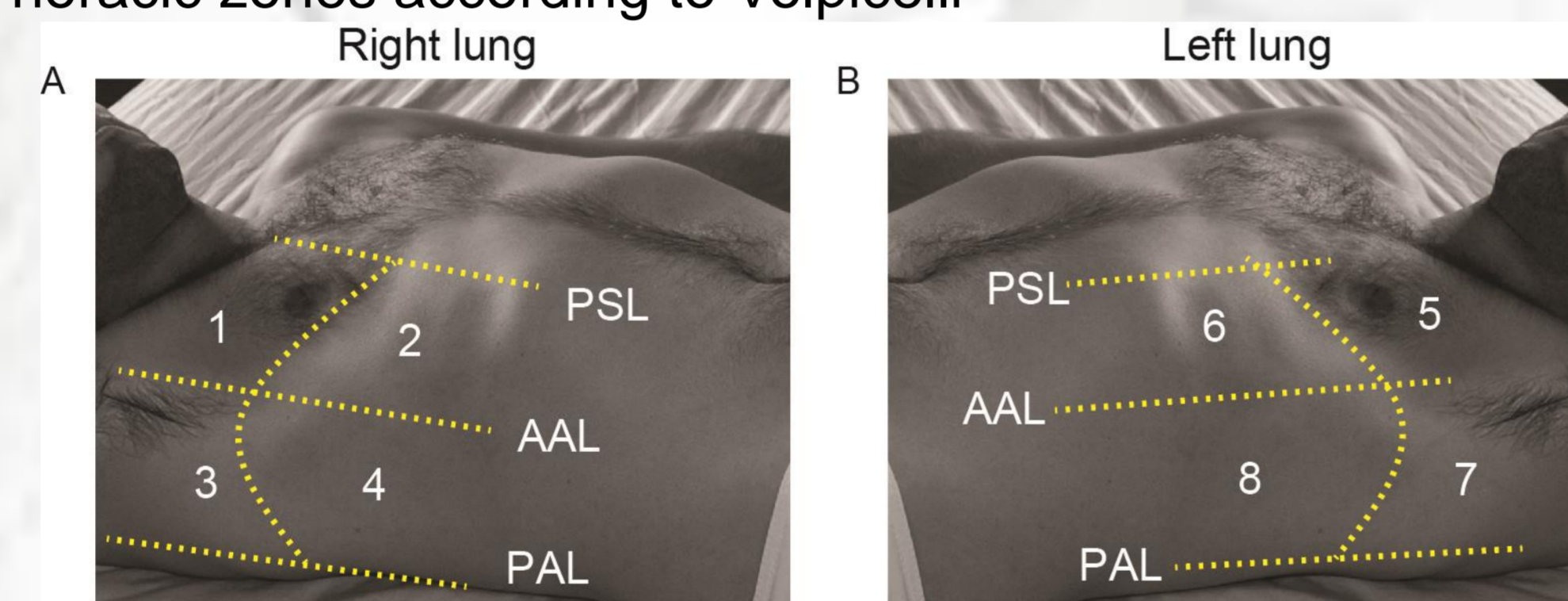
#### Content

##### Module 1 – Basic principles

- General principles of ultrasound
- Specific principles of lung examination
- Common artifacts (e.g. reverberation, shadow)
- Limitations of thoracic US

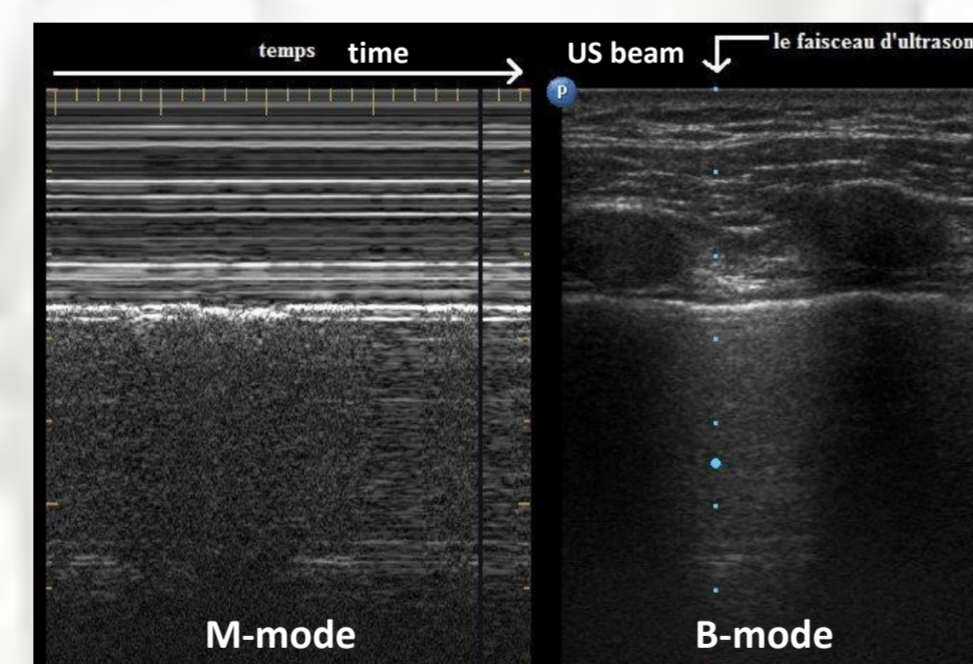
##### Module 2 – Ultrasound examination of the respiratory system

- Thoracic zones according to Volpicelli<sup>1</sup>



AAL : anterior axillary line; PAL : posterior axillary line; PSL : parasternal line  
 From *Basic Transesophageal and Critical Care Ultrasound* (Taylor and Francis 2016, CRC Press)

- Gain, depth, resolution
- Probe choice
- Orientation of structures relative to probe position
- Modes :
  - two-dimensional mode (B-mode) : brightness, real-time
  - time motion mode (M-mode) : visualization of structure motion as a function of time



Normal lung : seashore sign (left side)

From *Basic Transesophageal and Critical Care Ultrasound* (Taylor and Francis 2016, CRC Press)

##### Module 3 – Normal lung

##### Module 4 – Lung ultrasound

- Bilateral alveolar-interstitial syndrome (e.g. pulmonary edema, asthma)
- Local alveolar-interstitial syndrome (e.g. atelectasis, lobar pneumonia)
- Pulmonary embolism

##### Module 5 – Pleural ultrasound

- Pleural effusion
- Pneumothorax

##### Module 6 – Diaphragm dysfunction

#### Educational methods

##### Online course

- Formative modules
- Review quiz
- Formative integration exam
- Discussion forum
- Follow-up of participants by trainers

##### Practice with CAE Vimedix high-fidelity simulator

- Identification of pathologies in a real life context
- Case studies : participant must proceed with lung US examination to determine proper evaluation and treatment

##### Practice with patients

#### Methods of assessing training

##### Portfolio of images

- Reflexive type aimed at formative assessment
- Review and feedback from expert
- Improvement of skills to capture and interpret images

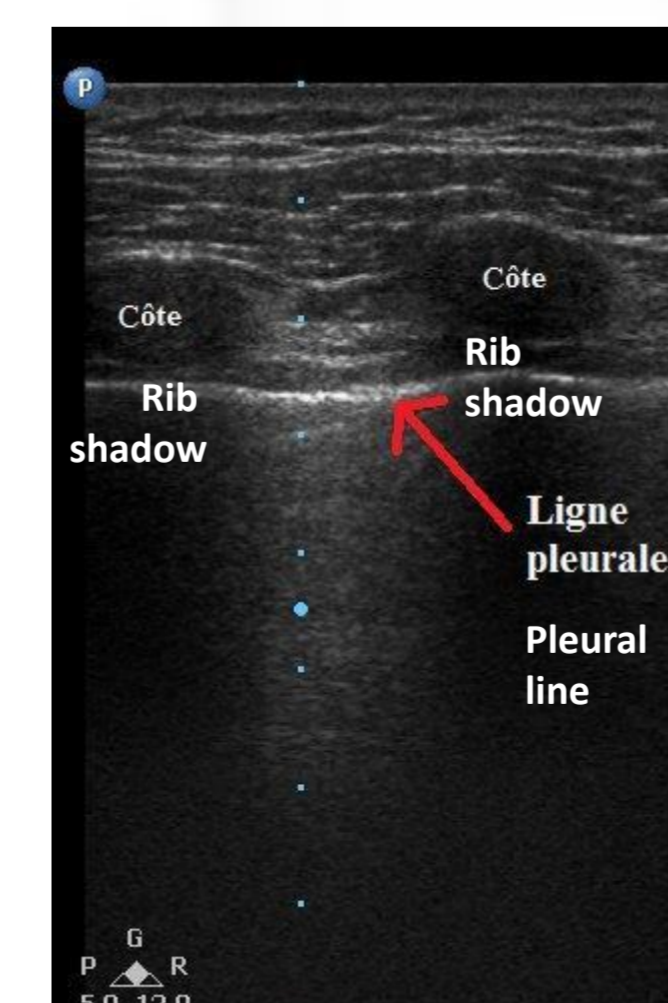
##### Practical exam

- Simulation of clinical environment using case studies :
  - with high-fidelity simulator
  - on standardized patients
- Assessment using an observation grid (e.g. Objective Structured Assessment of Ultrasound Skills (OSAUS))<sup>2</sup>

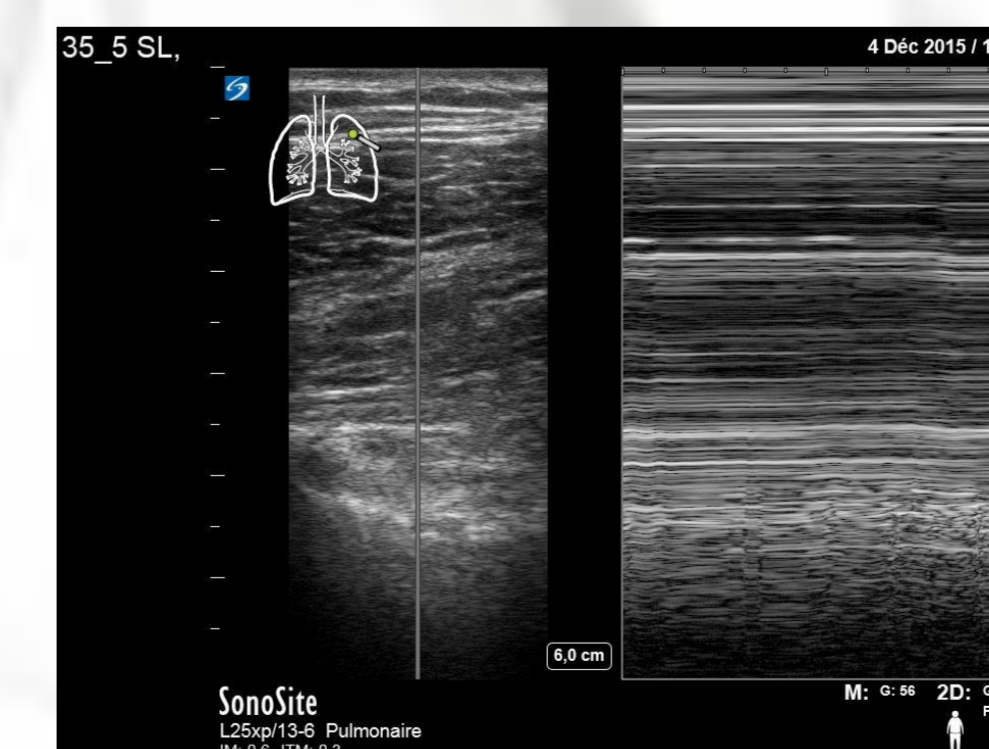
#### Image sample

From *Basic Transesophageal and Critical Care Ultrasound* (Taylor and Francis 2016, CRC Press)

##### Ultrasound machine

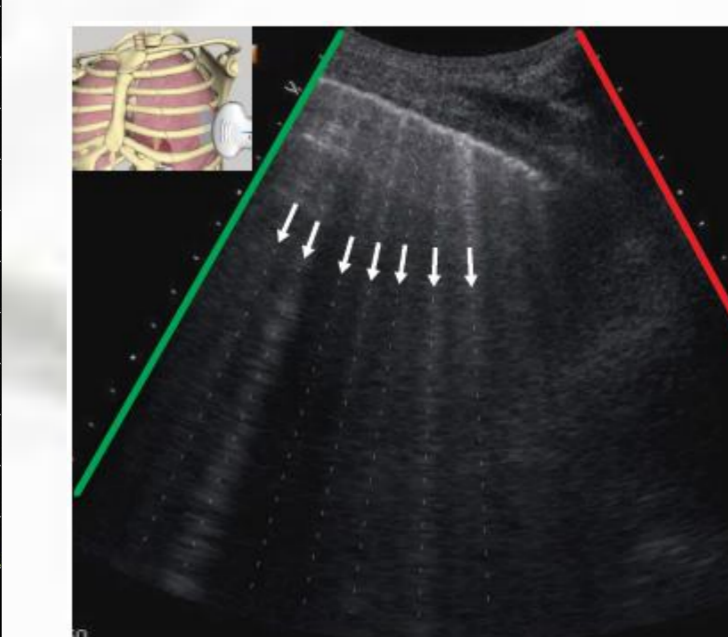


Normal lung : Bat sign



Pneumothorax : Barcode sign

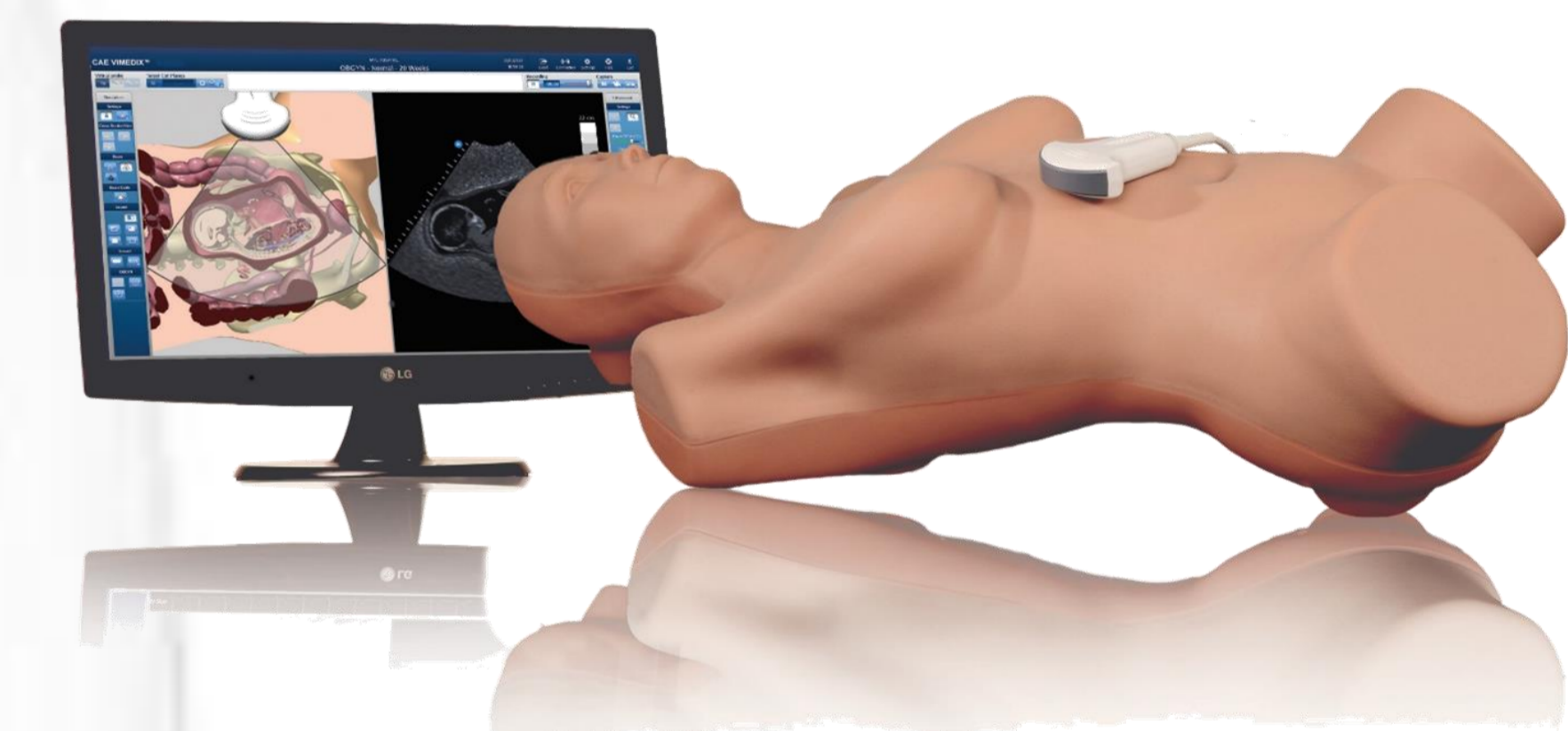
##### CAE Vimedix simulator



Alveolar-interstitial syndrome : B-lines

## DISCUSSION

- Use of various educational methods increases the learning efficiency.
- Practice on high-fidelity simulator provides efficient and secure training.
- Since thoracic US is an operator dependent method, the portfolio of images gives an objective meaning to progress accomplished in relation to skills.
- Evidence as to reliability and validity of the portfolio as an assessment method is insufficient.
- Practical exam combined with portfolio is recommended in order to adequately assess the competencies in using the thoracic US.



## CONCLUSION

- Training is the first step in order to integrate the use of thoracic US in chest physical therapy.
- The next step is aimed at assessing the quality of training provided.
- With a greater number of users properly trained, the added value of thoracic US as part of the practice of chest physical therapy could then be assessed.

## REFERENCES

1. Volpicelli G, Elbarbary M, Blaivas M, Lichtenstein DA, Mathis G, Kirkpatrick AW, et al. International evidence-based recommendations for point-of-care lung ultrasound. *Intensive Care Med.* 2012;38(4):577-91
2. Tolsgaard MG, Todsén T, Sørensen JL, Ringsted C, Lorentzen T, Ottesen B, et al. International multispecialty consensus on how to evaluate ultrasound competence: a Delphi consensus survey. *PLoS one.* 2013;8(2):e57687.