



# LUNG ULTRASONOGRAPHY – A PARACLINICAL INVESTIGATION PROMOTER IN COMMUNITY-ACQUIRED PNEUMONIA DIAGNOSIS IN CHILDREN

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**Abstract:** Lung ultrasonography is an excellent alternative to chest radiography, with better sensitivity, specificity, positive and negative predictive values and, finally, with better accuracy. The lung ultrasonography is proven to be useful in trying to reduce the request of chest radiography. In the opinion of most specialists, lung ultrasonography is recommended to be a valuable tool for the diagnosis of community-acquired pneumonia in children. Considering the fact that clinical examination remains essential because it suspects the diagnosis, the evolution does not require radiologic follow-up, also the pathologic findings at the clinical examination may change over the course of a day, the possibility of the clinician to maintain the objectivity is essential. For this goal to be possible, it would be ideal that the clinician himself performs the ultrasonography (in real-time).

## INTRODUCTION

Community-acquired pneumonia (CAP) remains an important cause of morbidity and mortality, both in developed and developing countries. A 2013 report shows that CAP represents the most important causes of death among children younger than 5 years old (14,9 %).(1)

According to Great Britain Thoracic Society and Infectious Diseases American Society, CAP is characterized by specific signs and symptoms and occurs in previously healthy children, the infection being acquired outside the hospital. For these reasons it should be managed in the community.

The CAP diagnostic tools do not differ from those of lung infectious pathology, the general ones being:

- the anamnestic and clinical data,
- the laboratory diagnostic,
- the imagistic (radiologic) diagnostic.

The anamnestic-clinical data represent the first step of diagnostic. Of all suggestive signs and symptoms, tachypnea is considered the main indicator of clinical diagnostic. So, if the tachypnea is present, the antibiotic therapy is motivated (with the purpose of maintaining of a lower risk of mortality that can increase the risk of an overdiagnosis.

If tachypnea (> 50/minute, unconcerned of age group) is accompanied by other respiratory failure signs, then these symptoms represent the real predictors of radiologic pneumonia. However, the objective clinical exam became “highly subjective”, being able to vary from specialist to specialist.

A study conducted in 2014, including 516 children with CAP (according to WHO definition) and who were reviewed 4 days later by pediatricians, revealed the following: only 35,9 % were confirmed with pneumonia, while 2,7 % have been tagged as non-respiratory disease.(2)

The laboratory diagnosis is based, mainly, by microbiological diagnostic, by hemogram and inflammatory markers, not having not a high specificity. But, the

microbiological diagnostic seems to be “tainted” by the continuous development of utilized molecular method/technique on the one hand, and by H. influenzae and S. pneumoniae vaccination, on the other hand.

The newest diagnostic guides bring up the importance of “point-of-care tests/near-patient tests”, those tests performed near or at the site of a patient with the result leading to possible change in the care of the patient.(3)

Because the final scope of molecular techniques is that of differentiating viral and bacterial etiology, the multiplex RT-PCR represents a challenge for the future.(4)

*The imagistic (radiologic) diagnostic.* The radiologic case definition does not intend to differentiate the viral and bacterial CAP etiology. More than that, The Great Britain Thoracic Society does not recommend the routine lung radiography in patients managed in the community. The big question mark is put regarding the repetitiveness of lung radiography. In the context of these limits, can it be considered the lung radiography, the gold-standard in CAP diagnosis? The answer seems headed in a single direction: the lung radiography standardization offers the most probability of pneumococcal pneumonia.

With the exception of pneumococcal pneumonia, the utility of lung radiography is becoming more restrictive:

- the radiologic exam is not (always) necessary,
- the radiologic exam is not necessary during evolution,
- the radiologic exam is not necessary for the assessment of healing,
- only antero-posterior incidence (not lateral one) is recommended,
- there are restrictions in neonate and young infancy,
- incorrect positioning or insufficient lung expansion during inspiration can lead to erroneous results,
- last but not least, subjectivism among radiologists.

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## CLINICAL ASPECTS

### AIM

The research “niche” results just from the actual analysis of the community-acquired pneumonia. That is: the most studies were conducted only in adults, and in the most of these studies, the imagistic was performed by the imagistic specialist.

The paper intends to implement the lung ultrasonography as “point-of-care”, and the results to be conducted by the sonologist, near the patients (real-time lung ultrasonography): in hospital, pediatrician and pediatric pneumologist, and in the community, family and school doctor.

The main objective is to demonstrate the efficacy of lung ultrasonography in community-acquired pneumonia; the efficacy being established by:

- context of anamnestic-clinical and laboratory data,
- comparing to radiological method,
- by statistical method (specificity, sensitivity, positive predictive value, negative predictive value, accuracy).

The study of Shah revealed the results of ultrasonography and radiological lung comparison.(5)

**Table no. 1. The comparative study between lung ultrasonography and chest radiography in community-acquired pneumonia in children**

Statistical parameters	Lung ultrasonography	Lung radiography
Sensitivity	95,6 %	88,9 %
Specificity	93,3 %	86,7 %
Positive predictive value	97,7 %	95,2 %
Negative predictive value	87,5 %	72,2 %
Accuracy	94,5 %	86,7 %

The secondary objective is to evaluate the training process of sonologist (training time, level of performance).

Both objectives have the final scope, namely:

- reducing the prescription of antibiotics.
- reducing the demand for pulmonary radiography.

### MATERIALS AND METHODS

*For the main objective:*

The anamnestic-clinical data will be collected from clinical sheets

All the patients evaluated by lung radiography and diagnosed with community-acquired pneumonia will be tested by lung ultrasonography (study group):

- o upon admission,
- o in evolution,
- o upon discharge,
- o as needed,
- o first, by imagistic specialist, than, as the method deepens, by the doctoral student.

The control group will be evaluated by lung radiography upon admission and as needed.

*For the secondary objective:*

Studying the data regarding the lung ultrasonography features in community-acquired pneumonia.(6-9)

Practical applications (at least 25 lung ultrasonography):

- lung sliding (rhythmic movement of the pleural line with the breath (sliding of the visceral pleura on the parietal pleura),
- lung point (intermittent lung sliding, as in mild or moderate pneumothorax),
- double lung point (difference between upper and lower lung field),
- lung pulse (wide condensation process, close to the heart, pulsing synchronously with the heartbeat),
- A lines (horizontal lines, distal to the plural line -

- artifact generated by subpleural air - normal aspect,
- B lines (vertical lines, emerge from pleura and extend to the base; a few B lines = normal image; multiple B lines = interstitial disease; compact and multiple B lines = pulmonary edema, ARDS),
- pleural effusion (interruption of the pleural line, as hypoeogenic space, homogeneous, between visceral and parietal pleural lines),
- lung consolidation (density – hepatization; it can be accompanied by air bronchogram; in the absence of air bronchogram – differential diagnostic with atelectasis),
- Shred sign (consolidation with irregular edges),
- sandy beach sign or stratosphere sign or barcode sign (when sliding sign disappear appear hyperechogenic parallels horizontal lines, as in pneumotorax).

### RESULTS

The estimated results will be related with the main and secondary objectives, with the objectives of the previously research, and the epidemiological particularities of our country:

- long-term objective – the recognition of speciality of pediatric sonologist with an essential contribution in the management of community-acquired pneumonia in children
- extrapolate the features of lung ultrasonography in the respiratory pathology other than CAP, in cardiac pathology, and so on.

### CONCLUSIONS

The lung ultrasonography can reduce the request of chest radiography and represents a valuable tool for the diagnosis of community-acquired pneumonia in children. Also, it can decrease the length of stay and the cost of admittance.

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