**What is the utility of lung ultrasound in helping to diagnose pneumonia?**

**Iwona Dziewa D.O. PGY-2**

**January 19th, 2017**

Pneumonia is a major cause of mortality and morbidity worldwide. It is defined as an infection of the lower respiratory tract associated with respiratory symptoms, fever and evidence of parenchymal involvement on physical examination or x-ray. Pneumonia is a clinical diagnosis. However, in certain situations, such as in severe disease or when clinical findings are inconclusive, radiographic confirmation of pneumonia may be needed. While chest x-rays (CXR) are convenient due their ease of use and access, numerous studies have shown that there is wide variability in their interpretation. Another disadvantage is that x-rays are a source of ionizing radiation. Although x-rays provide a small dose of radiation compared to other tests such as computed tomography (CT), children are thought to be more sensitive than adults to the induction of cancer due to their more rapidly dividing cells and longer life expectancy. Ultrasound (US) is increasingly being used to diagnose lung conditions such as pleural effusion, empyema, pneumothorax, pulmonary embolism and pneumonia. The advantages of US are that it is rapid, portable and does not involve radiation. However, the current guidelines do not recommend lung US as a diagnostic method of pneumonia. This has led to my PICO question: in hospitalized children with clinical suspicion of pneumonia, how does lung US compare to CXR in helping to diagnose community-acquired pneumonia (CAP)?

A PubMed literature search was performed using key words: “pediatric,” “community acquired pneumonia,” “ultrasound” and “chest x-ray”. The search yielded 54 articles, and three relevant articles were used for this critical appraisal. Caiulo et al. (2013) performed a prospective observational study with the aim to evaluate the reliability of lung US in diagnosing lung abnormalities associated with pneumonia. This study shows that US is superior to CXR. The positive likelihood ratios for both US and CXR are infinity and raise the post-test probabilities to 100%, thus showing that both tests are very good for ruling in pneumonia. The negative likelihood ratio for US is lower than that for CXR showing that US is better at ruling out pneumonia. One limitation is that it is a single center study. Another limitation is that the study was not performed in the United States and used the British Thoracic Society guidelines as the standard for the diagnosis of pneumonia. However, these guidelines are similar to the guidelines used in the United States, which makes this study applicable. Another important result of this study was a subgroup analysis showing that US is better than CXR in identifying pleural effusions in CAP.

Reali et al. (2014) performed a prospective observational study with the intention to define the accuracy of US in the diagnosis of CAP. This study shows that US is more sensitive and specific than CXR. The positive likelihood ratio for US is higher than that for CXR, showing that US is better at ruling in pneumonia. The negative likelihood ratio for US is lower than that for CXR showing that US is better at ruling out pneumonia. The limitations of this study are that it was a single center study and that it was not performed in the United States. However, the study is applicable because it follows the British Thoracic Society guidelines for diagnosis of pneumonia, which are similar to American guidelines. Just as in the study by Caiulo at al., subgroup analysis showed that US is superior to CXR at identifying pleural effusions.

Esposito et al. (2014) performed a prospective cross-sectional study with the objective to evaluate ultrasonography in the diagnosis of CAP. In this study, pneumonia was diagnosed in CXR-confirmed cases only. However, it is a non-inferiority study, showing that US is nearly as reliable as CXR in diagnosing pneumonia. US had a high positive LR and a low negative LR showing that US is good for both ruling in and ruling out pneumonia. The limitations are that this is a single center study and that it was not performed in the United States. However, similarly to the previous two studies, the British Thoracic Society guidelines were used as diagnostic standard of pneumonia in addition to CXR. This study also showed that US is superior to CXR at identifying pleural effusions.

It is important to note that in all three studies, ultrasound operators had variable training in lung ultrasonography. Thus, results could be influenced by the operator’s experience and further studies are needed to examine inter-observer variability.

In conclusion, these studies suggest that US is a valuable tool in diagnosis of CAP. US has a high detection rate in identifying pneumonia in children with clinical suspicion of pneumonia. Detection rate is comparable to if not higher than with CXR. Also, all studies show that US is significantly better at identifying pleural effusions and should be utilized for this purpose. Nevertheless, multicenter studies are needed to examine concordance between operators in performing US examinations because results could be influenced by the operator’s experience.

**References:**

Bradley JS, Byington CL, Shah SS, Alverson B, Carter ER, Harrison C, Kaplan SL, Mace SE, McCracken GH Jr, Moore MR, St Peter SD, Stockwell JA, Swanson JT: The management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. Clin Infect Dis 2011, 53: e25–e76.

British Thoracic Society Standards of Care Committee. British Thoracic Society guidelines for the management of community acquired pneumonia in childhood. Thorax 2002;57: i1–i24.

Copetti R, Cattarossi L: Ultrasound diagnosis of pneumonia in children. Radiol Med 2008; 113: 190–198.

Caiulo VA, Gargani L, Caiulo S, Fisicaro A, Moramarco F, Latini G, Picano E, Mele G: Lung ultrasound characteristics of community-acquired pneumonia in hospitalized children. Pediatr Pulmonol 2013; 48: 280–287.

Esposito S, Papa SS, Borzani I, et al. Performance of lung ultrasonography in children with community-acquired pneumonia. Ital J Pediatr. 2014; 40:37.

Rani S Gereige, Pablo Marcelo Laufer: Pneumonia. Pediatrics in Review 2013, 34 (10): 438-56.

Reali F, Sferrazza Papa GF, Carlucci P, et al. Can lung ultrasound replace chest radiography for the diagnosis of pneumonia in hospitalized children? Respiration. 2014; 88(2):112–115.

Shah VP, Tunik MG, Tsung JW: Prospective evaluation of point-of-care ultrasonography for the diagnosis of pneumonia in children and young adults. JAMA Pediatr 2013; 167: 119–125.

World Health Organization. Pneumonia. Fact Sheet No. 331. Available at: www. who.int/mediacentre/factsheets/fs331/en/. Accessed January 6th, 2016.