SONOGRAPHY OF CHEST IN DIAGNOSIS OF PNEUMONIA IN CHILDREN IN COMPARISON WITH CHEST X-RAY

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ABSTRACT

Background: Pneumonia is one of the most common infectious disease in children. Chest x-ray is the most common investigation ordered in diagnosis of pneumonia. Ultrasound is non-ionizing and safe. Therefore, the main aim of this study is to compare the diagnostic accuracy of Lung ultrasound with chest x-ray in diagnosis of pneumonia in children.

Objectives: To compare the diagnostic accuracy of Lung ultrasound with chest x-ray in diagnosis of pneumonia in children

Methods: 120 cases with clinical diagnosis of pneumonia and admitted in pediatric medical ward, mayo hospital from 2015 June to 2016 June were included in this study. chest x-ray and ultrasound were performed by two different radiologists in selected cases.

Results: Out of 120 cases, chest x-ray was positive in 115 cases, and lung ultrasound was positive in 117 cases. Out of 5 cases negative in x-ray, 4 cases were positive in ultrasound and out of three negative cases ultrasound, two were positive in x-ray. One case was not positive in x-ray as well as in ultrasound. The sensitivity and specificity of lung ultrasound was 98.2% and 20.0%. The positive rates of the air bronchograms, fluid bronchograms, pleural effusion, comet-tail sign and color flow within the consolidation were 107(91.4%), 79(67.5%), 57(66.9%), 42(35.8%) and 39(33.3%) respectively.

Conclusion: Lung ultrasound could be considered as an alternative to chest x-ray in diagnosis of pneumonia in children.

Key words: Chest x-ray, lung ultrasound, pneumonia

INTRODUCTION

Pneumonia is one of the most common infectious disease in children. This is one of the leading cause of mortality in infants and under five children. Study have shown the incidence of pneumonia in Pakistan is as high as 30%(1). More than 24,000 Pakistani children die from pneumonia each year(2). Chest x-ray is the most common investigation ordered in diagnosis of pneumonia. The diagnosis is based on the appearance of the consolidation on chest x-ray. So, there is exposure to ionization radiations in infants and children which may lead to the risk of cancer later in life(3). The other limitation of chest x-ray is high degree of intra and inter observer variation in interpretation. That may sometime cause over diagnosis of pneumonia and put the children in unnecessary antibiotics(4). Ultrasound is nonionizing and safer modality. It is routinely used in the diagnosis of pleural effusion, pneumothorax, and acute respiratory distress syndrome(5). However only few studies shows the role of ultrasound in diagnosis of pneumonia(6). Furthermore the thin body of the children also favors the sound wave to penetrate deep in the tissue which may aid in diagnosis(7). Therefore, the main aim of this study is to compare the diagnostic accuracy of Lung ultrasound with chest x-ray in diagnosis of pneumonia in children.

MATERIAL AND METHODS

This Analytical Cross-Sectional Study was conducted in Department of Pediatric Radiology, Mayo hospital Lahore from June 2015 to June 2016. 120 children of age less than 12 years and younger, with suspicion of infectious acute pneumonia and having at least three of the following items: axillary temperature equal or higher than 38°C, cough, dyspnea, heart rate higher than 100 beats per minute, saturation of oxygen lower or equal to 92% in ambient air were included in the study. Post-traumatic, post-operative and critically ill children admitted in ICU were excluded from the study. The details of symptoms as well as clinical findings of chest examination was recorded.

Lung ultrasound was performed by a trained radiologist in the department of Pediatric Radiology in Mayo hospital. Ultrasound examination was done immediately after the clinical examination with Toshiba 5-10 MHZ linear-array transducers. The technique of ultrasound exploration was accordance with international guidelines, and consists of examination of 8 areas from the chest wall. US images was examined for the presence of parenchymal consolidation, collapse, pleural effusion, comet-tail artefact, air-bronchograms, fluid-bronchograms and presence of color flow in consolidation area. All US images was interpreted in a blinded manner by two consultant radiologists who have experience in chest ultrasound. Patient then was sent for PA chest x-ray, finding was recorded in presences of consolidation (patchy air space opacity in lung filed), pleural effusion (unilateral or bilateral obliteration of costo-diagrammatic angels) by separate radiologist who were unaware of the ultrasound findings. All these findings were recorded in a predesigned proforma and was entered and analyzed using SPSS version 20.

RESULTS

In this study, 66(55.0%) were boys and 54(45.0%) were girls. The mean age of the patient was 5.74 years with range from 0.3 to 12 years. Table 1 summarize the clinical finding in the patients.

Table 3: Findings of lung ultrasound and chest x-ray

		Chest X-ray		Total
Chest Ultrasound		Positive	Negative	
	Positive	113	4	117
	Negative	2	1	3
	Total	115	5	120

DISCUSSION

Pneumonia is diagnosed previously based on clinical history and chest examination. Then Chest x-ray become the main investigation to diagnose pneumonia. Initially lung was not considered to be suitable organ to be visualized by ultrasound because of the different artefacts which were difficult to interpret, however with the recent concepts of interpretation of lung ultrasound, ultrasound has emerged as a new tool for the diagnosis of the pneumonia.(8, 9) It may be particularly useful in diagnosing the pneumonia in children whom may require the repetitive x-ray and cause frequent exposure to ionizingradiation. Different study has shown different sensitivity and specificity of lung ultrasound in

Table 1: Summary of the clinical findings

Fever	110(91.7%)			
Respiratory distress	81(67.5%)			
Cough	105(87.5%)			
Chest pain	52(43.4%)			
Altered sensorium	2(1.6%)			

Table 2: Summary	of the ultrasound	findings
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Consolidation in ultrasound				
Right	76(64.95%)			
Left	41(35.04%)			
	Positive	Negative		
Air-bronchogram	107(91.4%)	10(8.5%)		
Fluid-bronchogram	79(67.5%)	38(2.4%)		
Pleural Effusion	57(66.9%)	60(51.2%)		
Comet tail Artefact	42(35.8%)	75(64.1%)		
Color flow	39(33.3%)	78(66.6%)		

Out of 120 cases, chest x-ray was positive in 115 cases, and lung ultrasound was positive in 117 cases. Out of 5 cases negative in x-ray, 4 cases were positive in ultrasound and out of three negative cases in ultrasound, two were positive in x-ray. One case was not positive in x-ray as well as in ultrasound. The sensitivity and specificity of lung ultrasound was 98.2% and 20.0% The mean size of the consolidation was 47.03 cm² with SD of 45.7.

diagnosis of pneumonia. Ressig et al study shows sensitivity and specificity of lung ultrasound to be 94 % and 98%.(10) In this study the sensitivity of lung ultrasound was 98.2% as compared with X-ray 96.5%. the sensitivity of USG is slightly higher in our study because of the smaller body size of the children.

The ultrasound findings in pneumonia is a heterogeneous area in sub-pleural region along with air bronchograms, fluid-bronchograms, comet-tail artefact and presence of the color flow in Doppler studies (Figure:1) The positive rate of air-bronchogram in this study is 91.4%. the result is same as with the previous studies. Previous studies show the positive rate of the air bronchogram ranging from 86.7% to 97%.(11,

12)Similarly, the positive rate of the fluid bronchogram in our study is 67.5%. The study in adults shows the positive rate of fluid bronchogram low up to 20%.(13) In our study there is higher rate of fluid bronchogram. This may be because of the smaller body size of the children.



Figure 1: Ultrasound showing consolidation



Figure 2: Chest x-ray showing consolidation with air – bronchogram in right upper and mid zone

Comet-tail artefact is a sign of the pulmonary edema. However different studies have shown to be positive in pneumonia as well.(14)The positive rate of comet-tail artefact is slightly lower as compared to the other ultrasonographic findings. The positiverate of comet-tail artefact in our study is 35.8%. It is similar to the previous study.(12) The positive rate of plural effusion in our study is 66.9%. Similarly, the positive rate of the colorflow is 33.3%. These findings are in accordance with the previous studies.(15)

There are many advantages of ultrasound in diagnosis of pneumonia especially in children. It is easy to perform and could be done at the beside. There is no exposure to the ionizing radiation used in x-ray. It could be further used as an important tool in the follow-up of the patients with pneumonia. This further reduces the

use of the ionizing x-rays because children are four times more sensitive than the adults in the development of cancer.(16) In our study, the sensitivity of the ultrasound is slightly higher than the x-ray in diagnosis of the pneumonia. The sensitivity of ultrasound in this study is 98.2%. The result is similar to the study of Cortellaro et al, who found sensitivity of a 98% in adults.(17)Our result is also in accordance with various other studies.(13) Gehmacher et al study shows positive rate of 88.8% in adult patients with pneumonia detected by LUS.(18) Similarly, Reissig et alreported sensitivity of LUS to be 93.4% in adult population.(10) The positive rate of LUS is slightly higher in our study as compared to the other studies. This may be due to the smaller body size of the children. Lateral view may aid in diagnosis of the pneumonia which are not visualized in the PA view but this may lead to unnecessary exposure to the ionizing radiation. Ultrasound may fail to detect the pneumonia in those area where ultrasound beam is unable to reach like underneath the scapula and the axillary region.

Ultrasound shows a high detection rate in diagnosis of the pneumonia in children. But it is an operator dependent and needs a trained consultant in the interpretation of the images. There may be error in diagnosis with an inexpert.(19, 20) Chest x-ray may help initially in diagnosis of the pneumonia but ultrasound will be very helpful in the follow-up of the pneumonia. So, ultrasound should be used as a complimentary in the diagnosis of the pneumonia especially in pediatric population.

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