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Assessment of role of Ultrasound in diagnosis of pneumonia in children

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Abstract
Background: The present study was conducted for assessing the role of ultrasound in diagnosis of pneumonia in children.
Materials and Methods: A total of 50 children within the age range of 5 years to 15 years were included in the present study. Written consent was obtained from the parents/guardians of all the patients after explaining in detail the entire research protocol. Only those subjects were included in the present study in which clinical signs and symptoms were suggestive of pneumonia. Radiographic examination was carried out in all the patients. Detailed demographic and clinical history of all the patients was also recorded. Ultrasound was done in all the patients.
Results: After doing chest radiographic analysis, it was seen that pneumonia was confirmed in 82 percent of the cases. On ultrasonographic assessment, it was seen that pneumonia was confirmed in 92 percent of the cases. In five patients, with negative chest radiographic findings and positive ultrasound findings, diagnosis was confirmed by chest radiographic.
Conclusion: Chest ultrasound is a reliable tool for the diagnosis of pneumonia, probably being superior to chest radiography.

Keywords: pneumonia, ultrasound, children

1. Introduction
Children and infants with pneumonia may present with a number of clinical symptoms and signs such as fever, cough and tachypnoea. A minority of children present with fever. of unknown origin and may have no respiratory symptoms or signs. If no clinical signs are present, the diagnosis of pneumonia is unlikely [1, 2]. Community-acquired pneumonia (CAP) is a major health problem. In the United States CAP is responsible for 1.7 million hospital admissions per year and is the seventh leading cause of death, with an age-adjusted mortality rate up to 22%. Core measures that constitute emergency department (ED) care of CAP patients include blood culture collection before first antibiotic administration, administration of initial antibiotics within 6 h of ED arrival and appropriate antibiotic selection [1-3]. An adequate treatment is thus reliant on an early diagnosis of pneumonia, yet the diagnosis is not always clear at presentation to the ED. In a retrospective chart review of patients admitted with pneumonia, 22% of patients presented some reason for diagnostic uncertainty that could result in delayed antibiotics delivery. The accuracy of chest radiography (CXR), which remains the daily reference for lung imaging and a cornerstone for the diagnosis of pneumonia according to the American Thoracic Society criteria, is 65% when compared with CT scan [4-6]. Certain anatomical characteristics in children, such as a thinner chest wall and smaller thoracic width and lung mass, facilitate US imaging and ensure good-quality images of the lung. In noncooperative young patients, the examination is more time consuming but is usually feasible [6, 7]. Hence; the present study was conducted for assessing the role of ultrasound in diagnosis of pneumonia in children.

Materials and Methods
The present study was conducted for assessing the role of ultrasound in diagnosis of pneumonia in children. A total of 50 children within the age range of 5 years to 15 years were included in the present study. Written consent was obtained from the parents/guardians of all the patients after explaining in detail the entire research protocol. Only those subjects were included in the present study in which clinical signs and symptoms were suggestive of pneumonia. Radiographic examination was carried out in all the patients.

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Detailed demographic and clinical history of all the patients was also recorded. Ultrasound was done in all the patients. All the findings were recorded in Microsoft excel sheet and were subjected to statistical analysis using SPSS software.

Results
Mean age of the paediatric subjects included in the present study was 13.1 years. Majority proportion of the subjects of the present study were boys (66 percent). Significant proportion of subjects of the present study were of urban residence. After doing chest radiographic analysis, it was seen that pneumonia was confirmed in 82 percent of the cases. On ultrasonographic assessment, it was seen that pneumonia was confirmed in 92 percent of the cases. In five patients, with negative chest radiographic findings and positive ultrasound findings, diagnosis was confirmed by chest radiographic.

Table 1: Chest radiographic findings in clinical suspected pneumonia patients

Chest findings	Number	Percentage
Pneumonia	41	82
Non-significant	9	18
Total	50	100

Table 2: Ultrasound findings in clinical suspected pneumonia patients

Ultrasound findings	Number	Percentage
Pneumonia	46	92
Non-significant	4	8
Total	50	100

Discussion
In some pneumonia patients, radiological examination is necessary, and the chest X-ray (CXR) is still considered to be the first imaging step for diagnosing pneumonia in children. Computed tomography (CT) has a high level of accuracy but cannot used as a first-line radiological examination due to high exposure to ionising radiation, availability and cost. In adults, lung ultrasonography (US) has been shown to be a very promising technique for its high sensitivity in detecting pleural effusion, lung embolism, pneumonia, pneumothorax, alveolar-interstitial syndrome and atelectasis, whereas there is limited research on this topic in children [7- 10]. Hence; the present study was conducted for assessing the role of ultrasound in diagnosis of pneumonia in children.

Mean age of the paediatric subjects included in the present study was 13.1 years. Majority proportion of the subjects of the present study were boys (66 percent). Significant proportion of subjects of the present study were of urban residence. After doing chest radiographic analysis, it was seen that pneumonia was confirmed in 82 percent of the cases. Cortellaro F *et al*, in a previous study, evaluated the diagnostic accuracy of bedside lung ultrasound and chest radiography (CXR) in patients with suspected pneumonia compared with CT scan and final diagnosis at discharge. Design A prospective clinical study. Lung ultrasound and CXR were performed in sequence in adult patients admitted to the emergency department (ED) for suspected pneumonia. A chest CT scan was performed during hospital stay when clinically indicated. 120 patients entered the study. A discharge diagnosis of pneumonia was confirmed in 81 (67.5%). The first CXR was positive in 54/81 patients

(sensitivity 67%; 95% CI 56.4% to 76.9%) and negative in 33/39 (specificity 85%; 95% CI 73.3% to 95.9%), whereas lung ultrasound was positive in 80/81 (sensitivity 98%; 95% CI 93.3% to 99.9%) and negative in 37/39. A CT scan was performed in 30 patients (26 of which were positive for pneumonia); in this subgroup the first CXR was diagnostic for pneumonia in 18/26 cases (sensitivity 69%), whereas ultrasound was positive in 25/26 (sensitivity 96%). The feasibility of ultrasound was 100% and the examination was always performed in less than 5 min [10].

On ultrasonographic assessment, it was seen that pneumonia was confirmed in 92 percent of the cases. In five patients, with negative chest radiographic findings and positive ultrasound findings, diagnosis was confirmed by chest radiographic. Caiulo VA *et al*. described the ultrasonographic appearance of community acquired pneumonia (CAP) at presentation and during the follow-up. A total of 102 patients with clinical signs and symptoms suggesting pneumonia, who underwent a clinically driven CXR, were evaluated by LUS on the same day. LUS signs of pneumonia included subpleural lung consolidation, B-lines, pleural line abnormalities, and pleural effusion. A final diagnosis of pneumonia was confirmed in 89/102 patients. LUS was positive for the diagnosis of pneumonia in 88/89 patients, whereas CXR was positive in 81/89. Only one patient with normal LUS examination had an abnormal CXR, whereas 8 patients with normal CXR had an abnormal LUS. LUS was able to detect pleural effusion resulting from complicated pneumonia in 16 cases, whereas CXR detected pleural effusion in 3 cases. LUS is a simple and reliable imaging tool, not inferior to CXR in identifying pleuro-pulmonary alterations in children with suspected pneumonia [11].

Conclusion
From the above results, the authors conclude that chest ultrasound is a reliable tool for the diagnosis of pneumonia, probably being superior to chest radiography.

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