Chest Ultrasound for Simple and Complicated Bronchiolitis Differentiation

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Abstract

Background: Bronchiolitis usually occurs during the first year of life, with a peak incidence between 3 and 6 months of age. Chest Ultrasound has been proposed as a diagnostic tool in many diseases in the pediatric and neonatological settings. The aim of the present study was to differentiate simple versus complicated cases of bronchiolitis in infant by chest ultrasound. Patients and methods: A prospective observational study was conducted in Pediatric Department, Zagazig University Hospitals.Inclusion criteria included infants aged 1 month to 2 years fulfilling clinical criteria of acute bronchiolitis. Steps of performance included consent from relatives to participate in the study, complete history taking, full clinical examination, laboratory investigations, chest X-ray, chest Ultrasound and chest CT. Results: Our results showed that wheeze was the commonest presentation (100.0%) of the studied group followed by crepitation (12.3%) of them then Refusal of feeding (9.2%) and lastly fever (5.0%) of the studied group. There was (55.4%) of cases were complicated bronchiolitis by U/S and (44.6%) were simple. The commonest cases (96.9%) were discharged with only (3.1%) death rate. The X-ray was able to detect only (50.0%) of complicated cases and 29 cases (100.0%) were excluded by both. Conclusion: Chest ultrasound is considered more sensitive and specific than CXR in the diagnosis of complicated cases of acute bronchiolitis. These data suggest that a positive chest ultrasound may avoid the need to perform CXR in these patients.

Keywords: Bronchiolitis, Chest x-ray, chest ultrasound.

Introduction:

Acute bronchiolitis is defined as an acute infection and inflammation of the lower respiratory tract in children usually less than 2 years of age which is diagnosed clinically. It is the most common cause of admission worldwide during the winter periods especially in infancy. Respiratory syncytial virus (RSV) is thought to be the most common causative agent **(1).** Acute bronchiolitis should be a straight forward clinical diagnosis. The main obstacle, in the diagnosis, is that there is no consensual definition of the condition across the globe. This adds some difficulties to the analysis of the epidemiology, clinical course and hence the response to treatment strategies **(2).** Infants hospitalized for lower respiratory tract infection (LRTI), especially RSV and

rhinovirus, are at higher risk for recurrent wheezing and reduced pulmonary function, particularly during the first decade of life **(3).**

Chest radiographs are used to diagnose many diseases involving the chest wall, including its bones, and also other structures within the thoracic cavity including the lungs, heart, and great vessels. Pneumonia and congestive heart failure can be commonly diagnosed by chest radiograph **(4)**. Computed tomography (CT) plays an important role in the diagnosis and treatment of many clinical conditions involving the chest wall, mediastinum, pleura, pulmonary arteries, and lung parenchyma**.** Decreasing the CT radiation dose while maintaining diagnostic image quality is of critical importance in pediatric patients because of the greater radiosensitivity and longer life expectancy of children **(5).** Reasons to consider using CT over MRI include the availability of CT, higher spatial resolution, shorter examination, less need for sedation, and the presence of contraindications for MRI ratio **(6).** US evaluation of patients in both the erect and lateral decubitus positions can be useful for differentiating between freely flowing and loculated pleural fluid. Moreover,complex pleural effusion often requires a drainage procedure that can be facilitated with ultrasound guidance **(7)**. Therefore, the aim of this study was to differentiate simple versus complicated cases of bronchiolitis in infant by chest ultrasound.

Patients and methods:

This prospective observational study was conducted in Pediatric Department, Zagazig University Hospitals.Inclusion criteria included infants aged 1 month to 2 years fulfilling clinical criteria of acute bronchiolitis according to American Academy of Pediatrics and their relatives accepted to participate in the study.

Approval from ethical committee in the faculty of medicine (Institutional Research Board IRB). An official permission was obtained from Pulmonology and Allergy unit, Zagazig University Hospitals.

Exclusion criteria included patients less than 1 month and more than 2 years, patients whose relatives refused to participate in the study, patients with congenital heart disease, patients admitted to (NICU) for mechanical ventilation for long time and patients with chronic chest diseases.

Steps of performance included consent from relatives to participate in the study, complete history taking, full clinical examination, laboratory investigations, chest X-ray, chest Ultrasound and chest CT.

Chest X-ray:

X ray was performed in the Radiology unit of the hospital

Chest Ultrasound:

Chest US was performed in the Pulmonology and Allergy Unit of the hospital. Using LOGIQ V5 device Chest US was performed according to Lichtenstein BLUE protocol. The anterior points are called upper BLUE points and the anteromedial points lower BLUE points, after the protocol. The posterior points are called the

'posterolateral alveolar and/or pleural syndrome point', or PLAPS point. In addition, the protocol includes optional identification of the 'lung point'. Curvilinear probe was used for examination of deep structure as lung parenchyma, interstitial tissue and diaphragm because of the good penetration and large sector width to detect lung consolidation, B-lines and diaphragmatic movement.

Statistical analysis

Data were checked, entered and analyzed using SPSS version 23 for data processing. The following statistical methods were used for analysis of results of the present study. Data were expressed as number and percentage for qualitative variables and mean + standard deviation (SD) for quantitative one. Chi- square test (X^2) was used to find the association between row and column variables. Sensitivity and Specificity were used detect true positive and negative cases. For all above-mentioned statistical tests done, the threshold of significance was fixed at 5% level (P-value).

Results:

Our results showed that wheeze was the commonest presentation (100.0%) of the studied group followed by crepitation (12.3%) of them then Refusal of feeding (9.2%) and lastly fever (5.0%) of the studied group **(Figure 1)**. About (40.0%) of the studied group had moderate respiratory distress, (38.5%) had mild respiratory distress and (21.5%) had severe grade **(Table 1)**. There was (55.4%) of cases were complicated bronchiolitis by U/S and (44.6%) were simple **(Figure 2)**. The duration of hospital stay among the studied group was (2.87±1.4) ranged from (1 to 8) days, most of them (69.2%) stayed from (1 to 3 days) **(Table 2)**. The commonest cases (96.9%) were discharged with only (3.1%) death rate **(Table 3)**. Concerning to the diagnostic ability of X-ray in detection of complicated bronchiolitis compared with U/S, the X-ray was able to detect only (50.0%) of complicated cases and 29 cases (100.0%) were excluded by both **(Table 4)**.
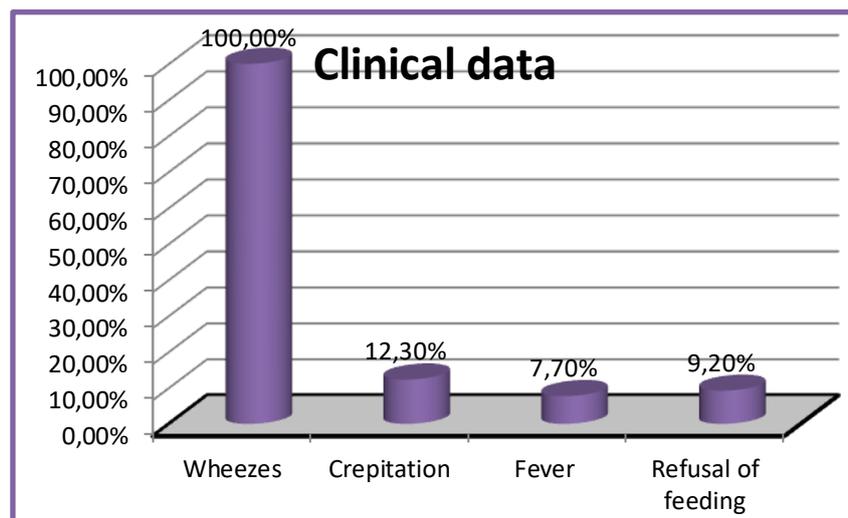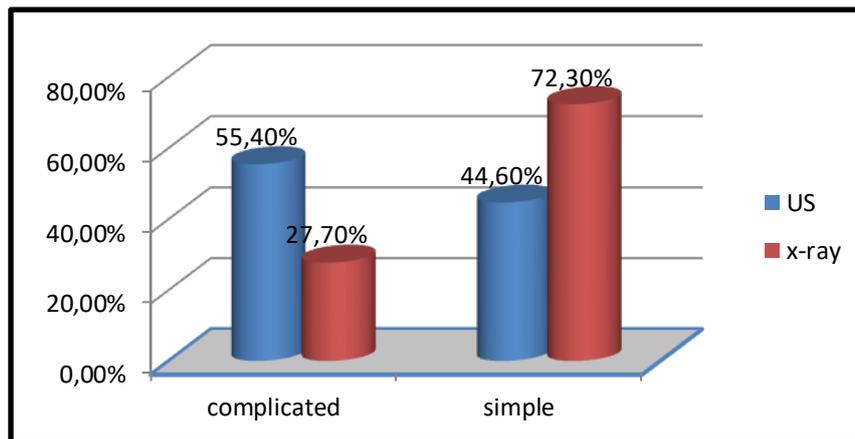

Figure (1): Bar chart for clinical data among the studied group.

Table (1): Grading of respiratory distress among the studied group:

Grading of respiratory distress	NO(65)	%
Mild	25	38.5%
Moderate	26	40.0%
Severe	14	21.5%

Fig (2): Bar chart for complicated and simple bronchiolitis by X-ray and U/S among the studied group:

Table (2): Hospital stay among the studied group:

Variable	The studied group(65) mean ± SD (Range) Median	
Hospital stay *(days):*	2.87±1.4 (1-8) 3	
Variable	**NO(65)**	**%**
Hospital stay *1-3 days* *3-6 days* *6-9 days*	45 18 2	69.2% 27.7% 3.1%

Table (3): Prognosis of the studied group:

Prognosis	The studied group(65)	
	NO(65)	**%**
Discharged	63	96.9%
Died	2	3.1%

Table (4): The diagnostic ability of X-ray in detection of complicated bronchiolitis compared with U/S:

Variable	Total NO. (65)	positive by X-ray only NO. (%)	positive by U/S only NO. (%)	Both positive (True positive)	Both negative (True negative)
Complicated bronchiolitis	36	0.0 (0.0%)	18.0 (50.0%)	18.0 (50.0%)	29 (100.0%)

Discussion:

To our knowledge our study is unique when investigating the role of chest ultrasound in children with acute bronchiolitis. The aim of this study is to differentiate betwen simple and complicated cases of bronchiolitis in infant.

Risks of total cancer and of specific types were increased by 30–60% among children with a history of post-natal X-ray exposure **(8).** Compared with never exposed children, those who reported three or more X-ray examinations post-natally were at significantly increased risk of cancer: acute leukemia, lymphoma, and brain tumor were all 1.5- to 2.0-fold higher. The long-term risk associated with radiation exposure should be considered in the risk-benefit assessment behind appropriate prescription of diagnostic testing **(9).** This study shows that wheeze was the commonest presentation (100.0%) of the studied group followed by crepitation (12.3%) of them. This comes in agreement with **Openshaw et al, (10)**who reported that most of the cases presented with wheezes and some more severe cases had crepitations.

In our study the duration of hospital stay among the studied group was (2.87±1.4) ranged from (1 to 8) days, most of them (69.2%) stayed from (1 to 3 days). These results are more or less similar to results reported by **Mansbach et al, (11)** who stated that the mean duration of hospital stay was 2 days. Most of our cases (96.9%) were discharged with only (3.1%) death rate. These results nearly agree with **Ramagopal et al, (12)** who reported (0%) as mortality rate of bronchiolitis.

In this study, there was statistically significant difference between US and X-ray in detection of complicated bronchiolitis with no (0.0%) false positive cases and 18 (50.0%) false negative complicated bronchiolitis when using US as a confirmatory test toX-ray. In this study, the X-ray was able to detect only (50.0%) of complicated cases and 29 cases (100.0%) were excluded by both. This results are in agreement with **Lee and Siegel (7)** who revealed that chest ultrasound can be performed quickly and easily in critically ill patients. It is more accurate than both physical examination and chest radiography in diagnosing pulmonary diseases. It enhances safety by avoiding ionizing radiation and the need cons. Also, **Copetti and Cattarossi (8)** who

suggested that Chest ultrasound has been shown to be useful also in children with pneumonia, performing even better than CXR, when compared to chest CT.

Conclusion:

Chest ultrasound is considered more sensitive and specific than CXR in the diagnosis of complicated cases of acute bronchiolitis. These data suggest that a positive chest ultrasound may avoid the need to perform CXR in these patients.

 No conflict of interest.

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