



Role of Chest Ultrasound in Differentiation between Simple and Complicated Bronchiolitis in Zagazig University Hospitals

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ABSTRACT

Introduction: Acute bronchiolitis is defined as inflammatory injury of the bronchioles, caused by droplet inhalation of viruses. The most common causative agent is the Respiratory Syncytial Virus (RSV), responsible for the most severe infection. Recently, Chest Ultrasound has been introduced as a diagnostic tool in many of the pediatric and neonatal respiratory diseases. The main advantages of chest ultrasound are the low risk of irradiation, the feasibility of a bedside evaluation, and the short time needed for the examination. **Objective:** The purpose of this study was to differentiate between simple and complicated cases of bronchiolitis. **Method:** We carried out a prospective observational study on 65 cases of bronchiolitis. Chest X ray and Chest Ultrasound were done for all cases, findings of both were compared. **Results:** There was statistically difference between Chest X ray and Chest Ultrasound in detection of complicated bronchiolitis. **Conclusion:** Chest Ultrasound is more accurate, sensitive and specific than Chest X ray in detection of complicated bronchiolitis.

Keywords: bronchiolitis, chest, ultrasound, complicated.



INTRODUCTION

Acute bronchiolitis is defined as inflammatory injury of the bronchioles. It is a viral lower respiratory tract infection caused most commonly by Respiratory Syncytial Virus (RSV).

It affects children younger than 24 months and is responsible for most causes of hospitalization in infants (1).

The pathophysiology of bronchiolitis includes edema and/or fibrosis of airways smaller than 2 mm in diameter and the alveolar ducts with an increased production of mucus and necrosis of the epithelial cells of the small airways that leads to a heterogeneous obstruction of the distal bronchioles (2).

The recent American Academy of Pediatrics guidelines states that the diagnosis of bronchiolitis is clinical and chest x-ray (CXR) should be performed only for severe cases with pulmonary complications or in cases of Intensive Care Unit (ICU) admission(3).

However, there are different protocols for diagnosis of acute bronchiolitis across hospitals and CXR is still performed in about 50% of

bronchiolitis to exclude different complications. (4)

Chest ultrasound is a non-ionizing radiation, easily done and available technique. In the recent years it has been introduced as a diagnostic tool for diagnosing pneumonia in adults and children, with significantly high sensitivity and specificity. Interestingly, Chest ultrasound showed a great validity for use to differentiate between bacterial and viral pneumonia (5). For this, Chest Ultrasound may be used to diagnose or rule out bacterial pneumonia in children with clinical bronchiolitis and to identify whether to start antibiotics or not. However, nowadays chest ultrasound is not included in the diagnostic work-up of bronchiolitis. In fact, few studies have described the sonographic findings of bronchiolitis(6).

PATIENTS AND METHODS

We conducted this cross-sectional study in Pulmonology and Allergy Unit, Pediatrics Department, Zagazig University Hospitals during the period from May 2019 to January 2020.

Written consent was obtained from all participants' parents, the study was approved by the research ethical committee of Faculty of

Medicine, Zagazig University. The study was done according to The code of Ethics of the World Medical Association (Declaration of Helnsinki) for studies involving humans.

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.

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 investigation including complete blood count , C-reactive protein, chest X-ray, Chest Ultrasound.

Chest Ultrasound was done according to BLUE protocol, Two hands with size equivalent to the patient's hands are placed on patient's chest on one side with the upper hand touching the clavicles while excluding thumbs, then three points are identified:

Upper anterior point

At the site of the base of the middle and ring fingers on the upper hand. It overlies the upper lobe.

Lower anterior point

At the middle of the palm on the lower hand. It lies overlies the middle or lingular lobe.

Postero-lateral point

At the intersection between horizontal line from the lower anterior point and the posterior axillary line. It overlies the lower lobe.

Statistical analysis

Assuming that number of patients with bronchiolitis attending at Zagazig University Hospitals was 96 patients and the PPV of chest ultrasound was 85%, the sample was calculated to be 65 using OPEN-EPI with power of test 80% (Caiulo et al., 2011)(10).Data were checked, entered and analyzed using SPSS version 23 for data processing.Data were expressed as number and percentage for qualitative variables and mean

+ standard deviation (SD) for quantitative one. Categorical variables were described using their absolute frequencies and to compare the proportion of categorical data, chi square test was when appropriate

RESULTS

This study included 65 infant with bronchiolitis for differentiation by U/S to simple or complicated case. The age of the study group was (11.2±2.4) ranged from (7-16) days, (41.5%) of them were in the age group from 7 to 10 days, (50.8%) were females, most of them were rural (66.2%) with low socio-economic level (61.5%) and (7.7%) had a family history of asthma. Table (1)

This study showed that peri-chondrial thickening was the commonest X-ray finding (49.2%) followed by subpleural lung consolidation (27.7%) and the least one was Hyperinflation (24.6%). Table (2)

This study shows that irregular pleural Lines were the commonest US finding (52.3%) followed by sub-pleural lung consolidation (46.8%) and compact and focal multiple B Lines each of them (41.5%) then equal percent of pleural effusion & normal pattern (13.8%) and the least one was occult pneumothorax (3.1%). Table (3)

This study shows that (27.7%) of cases were complicated bronchiolitis by X-ray and (72.3%) were simple. Table (4)

However, (55.4%) of cases were complicated bronchiolitis by U/S and (44.6%) were simple. Table (5)

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 to X-ray. Table 6

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. Table 7

Our study shows that the X-ray has the ability to diagnose (50.0%) of actual complicated cases when using final U/S as confirmatory test and can exclude (100.0%) of negative cases with overall (72.3%) accuracy. Table 8

Table 1: Socio-demographic data of the studied group

Variable	The studied group(65) mean \pm SD (Range) median	
Age (months):	11.2 \pm 2.4 (7-16) 11	
Variable	N(65)	%
Age distribution		
7-10 months	27	41.5%
11-13 months	25	38.5%
13-16 months	13	20.0%
Sex:		
Male	32	49.2%
Female	33	50.8%
Residence		
Rural	43	66.2%
Urban	22	33.8%
Socio-economic class		
Low	40	61.5%
Moderate	25	38.5%
Family history of asthma		
Positive	5	7.7%
Negative	60	92.3%

Table 2: X-ray findings among the studied group

X-ray findings	N(65)	%
Peri-bronchial thickening		
Positive	32	49.2%
Negative	33	50.8%
Lung Consolidation		
Positive	18	27.7%
Negative	47	72.3%
Hyperinflation		
Positive	16	24.6%
Negative	49	75.4%

Table 3: Ultrasound findings among the studied group

Ultrasound findings	N(65)	%
Compact B Lines		
Positive	27	41.5%
Negative	38	58.5%
Pleural Effusion		
Positive	9	13.8%
Negative	56	86.2%
Occult Pneumothorax		
Positive	2	3.1%
Negative	63	96.9%
Subpleural lung Consolidation		
Positive	30	46.2%
Negative	35	53.8%
Irregular Pleural Lines		

Ultrasound findings	N(65)	%
<i>Positive</i>	34	52.3%
<i>Negative</i>	31	47.7%
Focal Multiple B-Lines		
<i>Positive</i>	27	41.5%
<i>Negative</i>	38	58.5%
Normal Pattern		
<i>Positive</i>	9	13.8%
<i>Negative</i>	56	86.2%

Table 4: Complicated cases among the studied group by X-ray

Complicated cases by X-ray	The studied group(65)	
	N(65)	%
Complicated	18	27.7%
Simple	47	72.3%

Table 5: Complicated cases among the studied group by U/S

Complicated cases by U/S	The studied group(65)	
	N(65)	%
Complicated	36	55.4%
Simple	29	44.6%

Table 6: Comparing complicated and simple bronchiolitis using X-ray and Ultrasound

X-ray		Ultrasound findings				χ^2	p-value
		Complicated N.(36) %		Simple N.(29) %			
Bronchiolitis	Complicated (18)	18	50.0%	0.0	0.0%	20.1	0.001**
	Simple (47)	18	50.0%	29	100.0%		

Table 7: The diagnostic ability of X-ray in detection of complicated bronchiolitis comparing with U/S diagnosis

Variable	Total NO. (65)	positive by X- ray only NO. (%)	positive U/S only NO. (%)	by 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%)

Table 8: The overall diagnostic ability of X-ray in detection of complicated bronchiolitis comparing with U/S diagnosis

Variable	U/S diagnosis				
	Sensitivity	Specificity	PVP	PVN	Accuracy
X-ray	50.0%	100.0%	100.0%	61.7%	72.3%

DISCUSSION

Bronchiolitis is defined as inflammatory injury of the bronchioles, caused by droplet inhalation of viruses. It represents the leading cause of hospitalization in infants (1).

The main causative agent of bronchiolitis is Respiratory Syncytial Virus (RSV), which mostly recurs as seasonal epidemics (7).

The management of bronchiolitis is mainly supportive and no specific antiviral therapy is routinely used to decrease the viral infection and the severity of disease (8).

The recent American Academy of Pediatrics guidelines states that the diagnosis of bronchiolitis is clinical and chest x-ray (CXR) should be performed only for severe cases with pulmonary complications or in cases of Intensive Care Unit (ICU) admission (3).

Chest ultrasound is a non-ionizing radiation, easily done and available technique. In the recent years it has been introduced as a diagnostic tool for diagnosing pneumonia in adults and children, with significantly high sensitivity and specificity.

Interestingly, Chest ultrasound showed a great validity for use to differentiate between bacterial and viral pneumonia (9).

This study shows that peri-chondrial thickening was the commonest X-ray finding (49.2%) followed by subpleural lung consolidation (27.7%) and the least one was Hyperinflation (24.6%).

In a similar study by Caiulo et al., The CXR findings were the following: Peri-bronchial thickening was seen in 40.3% of patients, lung consolidation was found in 30.7% of infants, hyperinflation of the chest was evident in 1.9% of infants. CXR appeared to be normal in 26.9% of infants with bronchiolitis (10).

This study shows that irregular pleural Lines were the commonest US finding (52.3%) followed by sub-pleural lung consolidation (46.8%) and compact and focal multiple B Lines each of them (41.5%) then equal percent of pleural effusion & normal pattern (13.8%) and the least one was occult pneumothorax (3.1%). In our study (12.3%) of cases had respiratory failure.

A study by **Caiulo et al** found that chest ultrasound findings in infants with bronchiolitis were the following: in 84.6% of cases there were subpleural lung consolidations. However, 65.3% of cases had numerous compact B-lines. In 44.2% of cases, there were pleural line abnormalities. In 5.7% of cases minimal pleural effusion was found. Only 1.9% had a small pneumothorax. 9.6% of cases showed normal pattern of chest ultrasound(11).

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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 to X-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.

Our study shows that the X-ray has the ability to diagnose (50.0%) of actual complicated cases when using final U/S as confirmatory test and can exclude (100.0%) of negative cases with overall (72.3%) accuracy.

Similarly, **Copetti and Cattarossi** stated that Chest ultrasound has been shown to be better in children with complicated bronchiolitis when compared to CXR (12).

CONCLUSION

From the results of this study we concluded that Chest Ultrasound is more accurate in diagnosing complicated cases of acute bronchiolitis than CXR. These data suggest that a positive Chest Ultrasound may avoid the need to perform CXR in these patients.

Conflict of Interest : Nil

Limitations of the study: Availability of Chest Ultrasound.

Financial Disclosures : governmental, Faculty of medicine Zagazig university

REFERENCES

1. Meissner HC. Viral Bronchiolitis in Children. *N Engl J Med.* 2016 Jan 7;374(1):62-72.
2. Wagner T. Bronchiolitis. *Pediatr Rev.* 2009 Oct;30(10):386-95; quiz 395.
3. Ralston SL, Lieberthal AS, Meissner HC, Alverson BK, Baley JE, Gadomski AM, Johnson DW, Light MJ, Marafa NF, Mendonca EA, Phelan KJ, Zorc JJ, Stanko-Lopp D, Brown MA, Nathanson I, Rosenblum E, Sayles S 3rd, Hernandez-Cancio S; American Academy of Pediatrics. Clinical practice guideline: the diagnosis, management, and prevention of bronchiolitis. *Pediatrics.* 2014 Nov;134(5):e1474-502.
4. McCulloh RJ, Smitherman SE, Koehn KL, Alverson BK. Assessing the impact of national guidelines on the management of children

- hospitalized for acute bronchiolitis. *Pediatr Pulmonol.* 2014;49(7):688–94.
5. Jones BP, Tay ET, Elikashvili I, Sanders JE, Paul AZ, Nelson BP, et al. Feasibility and safety of substituting lung ultrasonography for chest radiography when diagnosing pneumonia in children: a randomized controlled trial. *Chest.* 2016;150(1):131–8.
 6. Cohen JS, Hughes N, Tat S, Chamberlain JM, Teach SJ, Boniface K. The utility of bedside lung ultrasound findings in bronchiolitis. *Pediatr Emerg Care.* 2017;33(2):97–100.
 7. Vandini S, Biagi C, Lanari M. Respiratory syncytial virus: the influence of serotype and genotype variability on clinical course of infection. *Int J Mol Sci* 2017;18(8) pii: E1717.
 8. Vandini S, Faldella G, Lanari M. Latest options for treatment of bronchiolitis in infants. *Expert Rev Respir Med.* 2016;9:1–9.
 9. Tsung JW, Kessler DO, Shah VP. Prospective application of clinicianperformed lung ultrasonography during the 2009 H1N1 influenza a pandemic: distinguishing viral from bacterial pneumonia. *Crit Ultrasound J.*2012;4:16.
 10. Caiulo VA, Gargani L, Caiulo S, Fiscaro A, Moramarco F, Latini G, Picano E. Lung ultrasound in bronchiolitis: comparison with CXR. *Eur J Pediatr.* 2011; 170:1427–33.
 11. Caiulo VA, Gargani L, Caiulo S, Fiscaro A, Moramarco F, Latini G, Picano E. Lung ultrasound in bronchiolitis: comparison with chest X-ray. *Eur J Pediatr* 2011:1-8.
 12. Copetti R, Cattarossi L. Ultrasound diagnosis of pneumonia in children. *Radiol Med.* 2008 Mar;113(2):190-8.

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