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Original Research Article

To Evaluate the Correlation of Ultrasound with X-Ray for Determining the Amount of Aspirated Effusion and Evaluate Pleural Effusion

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Abstract

Aim: The aim of the present study was to evaluate the correlation of ultrasound with X-Ray for determining the amount of aspirated effusion and evaluate pleural effusion.

Methods: The present study was conducted at Patna Medical College and Hospital, Patna, Bihar, India for the period of May 2020 to April 2021. The source of data for this study includes total 50 patients referred to department of Radio- Diagnosis Imaging for chest radiography and ultrasonography from OPD/IPD/ED of Patna Medical College and Hospital, Patna, Bihar, India.

Results: In this prospective study 50 patients were included, out of which 31 (62%) were male and 19 (38%) were female, the average age of patient were 37.3 years. In this study we included only those patients who undergo for both scan x-ray as well as USG for identify the pleural effusion. Results from USG showed 25 (50%) male and 9 (18%) females had pleural effusion in right lung whereas 10 (20%) female and 6 (12%) males had pleural effusion in left lung. In x-ray images 20 (40%) males and 9 (18%) females showed pleural effusion in right lung and 11 (22%) female, 10 (20%) males had effusion in their left lung. For right lung minimum volume of fluid level 36.4 ml and 340 mL was maximum volume and the average volume was 93.98 mL. In left lung minimum 36.4 ml of fluid was detected and maximum recorded was 220.2 mL and average volume recorded is 60.1 mL. Average volume of effusion in male was 35.50 in left lung and in right lung were 120.40. In female average effusion in right lung were 102.90 and in left was 64.36 mL.

Conclusion: USG is some distance superior than simple X-Ray in locating of minimal pleural & also for quantification of effusion pleural furthermore, intervention like pleural faucet can also done. USG can locate low amount of fluid presence even less than 3 ml, while X- ray fails to help diagnose such low quantity of fluid.

Keywords: ultrasonography, pleural effusion, pleural cavity, inflammation

Introduction

Several medical conditions are responsible for pleural effusion (PLEFF), with volume overload, congestive heart failure, and pleuropulmonary infection representing the most common causes in the intensive care unit (ICU). [1] Fluid accumulation can take place due to an imbalance of hydrostatic and oncotic pressure across the lung capillaries, increased pleural membrane capillary permeability, and lymphatic obstruction. [2] Furthermore, the factors known to promote lung edema formation in the clinical setting (fluid loading, myocardial depression, hypoalbuminemia) usually coexist, and may exceed the normally high absorptive capacity of the lungs and parietal pleural lymphatics, resulting in exacerbation of PLEFF.

PLEFF occurs frequently in ICU patients with an incidence that varies according to the diagnostic technique used (from 8% following physical examination to more than 60% after routine imaging). [3,4] It is also associated with a high crude mortality rate. [5] Indeed, PLEFF can worsen gas exchange, hemodynamic stability, and respiratory dynamics. Drainage can improve oxygenation, respiratory mechanics, and compliance by enhancing the ventilation: perfusion ratio and by re-expanding areas of collapsed parenchymal lung. [6,7] Although percutaneous pleural drain insertion is frequently carried out in the ICU, inaccurate insertion of the tube can have tragic consequences. [8,9] Complications with the insertion of chest

drains have been reported in up to 20–30% of cases; some of these complications can be potentially fatal (i.e., perforation of the lung, heart, liver, esophagus, spleen, and inferior vena cava). [10]

Compared to radiography, ultrasonography has the advantage of being non-invasive, cost-effective, readily available, and repeatable. It is also radiation-free. Furthermore, chest ultrasonography shows better sensitivity and reliability than radiography. [11,12] While a minimum of 150 mL is required to detect effusion by radiography in the erect position [13], effusions as small as 5 mL can be detected ultrasonographically with 100% sensitivity. [14] Pleural effusion is frequently managed by thoracocentesis. Sometimes, the actual amount of effusion is at variance with the clinical presentation, and it is doubtful whether to drain. The ideal ultrasonographic formula for pleural effusion volume estimation should be simple, accurate, and rapidly/easily performed.

The aim of the present study was to evaluate the correlation of ultrasound with X-Ray for determining the amount of aspirated effusion and evaluate pleural effusion.

Materials and methods

The present study was conducted at Patna Medical College and Hospital, Patna, Bihar, India for the period of May 2020 to April 2021. The source of data for this study includes total 50 patients referred to department of Radio- Diagnosis Imaging for chest radiography and ultrasonography from OPD/IPD/ED of Patna Medical College and Hospital, Patna, Bihar, India.

Inclusion Criteria

- All the Patient with post-diagnosed of pleural effusion, All the patient IPD & OPD, Both male & female patient were included, No age limitation

Exclusion Criteria

- Pregnancy, Those patients who were not diagnosed with pleural effusion

After the X Ray of Chest is done, if case of any doubt of Pleural effusion, the USG Chest is performed and vice versa.

Statistical Analysis

The data were analyzed using SPSS ver. 20 for Windows (IBM Corp., Armonk, NY, USA). Pearson correlation analysis was performed to determine the extent of correlation between ultrasonographically estimated effusion volumes and the actual volume drained.

Results

Table 1: Demographic details

Gender	N%
Male	31 (62)
Female	19 (38)
Pleural effusion USG Findings	
Male	
Right Lung	25 (50)
Left Lung	6 (12)
Female	
Right Lung	9 (18)
Left Lung	10 (20)
X Ray USG Findings	
Male	
Right Lung	20 (40)
Left Lung	11 (22)
Female	
Right Lung	9 (18)
Left Lung	10 (20)

In this prospective study 50 patients were included, out of which 31 (62%) were male and 19 (38%) were female, the average age of patient were 37.3 years. In this study we included only those patients who undergo for both scan x-ray as well as USG for identify the pleural effusion. Results from USG showed 25 (50%) male and 9 (18%) females had pleural effusion in right lung whereas 10 (20%) female and 6 (12%) males had pleural effusion in left lung. In x-ray images 20 (40%) males and 9 (18%) females showed pleural effusion in right lung and 11 (22%) female, 10 (20%) males had effusion in their left lung.

Table 2: Comparison pleural effusion between male and female

Male		Female	
Right Lung	**Left Lung**	**Right Lung**	**Left Lung**
46	0	0	36.4
102	60	0	183.7
0	43.7	0	210
340	0	220	0
105.5	220.2	0	186
160	0	175	0
0	55.7	46.4	108.2
350	0		
36.4	46		
0	43		
180	0		
100	0		
112.8	0		

For right lung minimum volume of fluid level 36.4 ml and 340 mL was maximum volume and the average volume was 93.98 mL. In left lung minimum 36.4 ml of fluid was detected and maximum recorded was 220.2 mL and average volume recorded is 60.1 mL.

Table 3: Average of Plueral Effusion between male and female

Gender	Right Lung	Left Lung
Male	120.40	35.50
Female	64.36	102.90

Average volume of effusion in male was 35.50 in left lung and in right lung were 120.40. In female average effusion in right lung were 102.90 and in left was 64.36 mL.

Discussion

Pleural effusions are most commonly associated with heart failure, pneumonia, cancer, pulmonary embolism, viral disease, coronary artery bypass surgery, and cirrhosis with ascites. The most common symptoms related to pleural effusion are nonspecific and often indistinguishable from those of the underlying disease process, including cough, dyspnea, and pleuritic chest pain. [15] Chest radiography has traditionally been used to diagnose pleural effusions. Free-flowing pleural fluid collects in the most dependent portions of the thorax, initially in the subpulmonic space followed by the costophrenic recesses. Pleural fluid is detectable in the costophrenic recesses on lateral upright chest radiograph after 50 mL has accumulated. In this prospective study 50 patients were included, out of which 31 (62%) were male and 19 (38%) were female, the average age of patient were 37.3 years. In this study we included only those patients who undergo for both scan x-ray as well as USG for identify the pleural effusion. Results from USG showed 25 (50%) male and 9 (18%) females had pleural effusion in right lung whereas 10 (20%) female and 6 (12%) males had pleural effusion in left lung. In x-ray images 20 (40%) males and 9 (18%) females showed pleural effusion in right lung and 11 (22%) female, 10 (20%) males had effusion in their left lung. On standard posterior-anterior chest radiograph, blunting of the costophrenic recesses and obliteration of the hemidiaphragm are seen when >200 mL and >500 mL of pleural fluid have accumulated, respectively. [16] However, upright chest radiographs can miss a considerable number of effusions, including as many as 10% of parapneumonic effusions large enough to indicate need for drainage. [17] Supine anterior-posterior chest radiographs can miss a significant proportion of large effusions seen on chest CT, [18] ultrasound, [19] and lateral decubitus radiographs. [20] Pleural effusions are frequently mistaken for parenchymal opacities on portable anterior-posterior chest radiographs. [18]

For right lung minimum volume of fluid level 36.4 ml and 340 mL was maximum volume and the average volume was 93.98 mL. In left lung minimum 36.4 ml of fluid was detected and maximum recorded was 220.2 mL and average volume recorded is 60.1 mL. The effective management of pleural effusion requires early recognition, some form of volume estimation, and identification of the underlying etiology. [21] The clinical diagnosis is often difficult when the amount of effusion is relatively small or when there is underlying lung consolidation, making it expedient to obtain radiological evidence. Eibenberger et al.

[22] reported a significant and high correlation (r=0.80) between the actual volume drained and the ultrasonographic estimates they derived using the supine 1 formula. Contrary to their findings, that formula yielded r=0.62 in this study. Mathis[22] observed that the deviations of the estimated volume from the real volume could be considerable with this formula (supine 1). Its limitations include the fact that the same volume of pleural fluid in individuals with different-sized thoracic/pleural cavities tends to be underestimated in the larger thoracic cavities and vice versa. Similarly, diaphragmatic elevation affects the estimated effusion volume. [22] The other recognized limitation of the supine 1 formula is the effect of the lung parenchymal status on the shape of the pleural fluid. A poorly aerated/collapsed lower lobe will likely displace underlying pleural fluid, thus yielding an estimated volume smaller than the actual volume.

Average volume of effusion in male was 35.50 in left lung and in right lung were 120.40. In female average effusion in right lung were 102.90 and in left was 64.36 mL. A transudate pleural effusion as a result of imbalanced hydrostatic or oncotic strain. He most common causes are: coronary heart failure, cease stage kidney sickness, peritoneal dialysis and myxoedema. An exudate pleural effusion occurs when there may be an inflammation which purpose endothelium to grow to be leakier and allow free passage of lymphatic fluid. The most commonplace reasons are: bacterial pneumonia, viral contamination, pulmonary embolism and T.B. [23]

Because fluid is reliant and accumulates posteriorly, a chest radiograph taken in the supine position can detect a large amount of fluid with few imaging changes. Because a veil-like increased density of the hemithorax may be seen, identifying similar-sized bilateral effusion is difficult because the densities of the lungs will be similar. USG can detect a little quantity of fluid (3-5 ml) that would be missed by a radiograph. Radiography's sensitivity is defined as the ability to detect a minimum of 50 mL of fluid. The USG examination of a patient in a sitting posture is preferable because it allows for more exact pleural effusion quantification. The free fluid is collected in the dependent space in this position, whereas it is located in a posterior region with the patient in a supine position. The difference between Loculated pleural fluid and Thickened pleura may be easily distinguished using ultrasound. It enables for the recognition of nearby structures such as the chest wall, hemidiaphragm, and visceral pleural surface. Pleural fluid is generally hypo echoic (darker) when compared to the isochoric reference of the liver and spleen, while air-filled lung is hyper echoic (brighter). Ultrasound is clearly more sensitive than a lateral Decubitus chest radiograph for detecting pleural effusions, and when compared to chest X-ray, Ultrasound of the chest has been reported to have "95 percent sensitivity for detecting pleural lesions in Patients with a white out" on chest Radiography. Loculated Pleural Fluid and Thickened Pleura are easily distinguished using ultrasound. Even with little fluid collections, it is effective in guiding thoracentesis. [24]

Conclusion

USG is some distance superior than simple X-Ray in locating of minimal pleural & also for quantification of effusion pleural furthermore, intervention like pleural faucet can also done. USG can locate low amount of fluid presence even less than 3 ml, while X- ray fails to help diagnose such low quantity of fluid.

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