e-ISSN: 0976-822X, p-ISSN:2861-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(4); 227-232

Original Research Article

Hospital-Based Observational Assessment of the Correlation of USG with X-Ray for the Evaluation of Pleural Effusion

Raunak Deo[1], Ajay Ranjan[2]

[1]Senior Resident, Department of Radio-Diagnosis, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India

[2]Senior Resident, Department of Radio-Diagnosis, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India

Received: 11-02-2023 / Revised: 04-03-2023 / Accepted: 22-03-2023
Corresponding author: Dr. Ajay Ranjan
Conflict of interest: Nil

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 Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India, for a period of 8 months. The source of data for this study includes a total of 30 patients referred to the Department of Radio-Diagnosis Imaging for chest radiography and ultrasonography from OPD/IPD/ED of Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar. Among these, 18 (60%) were male, and 12 (40%) were female, with an average age of 36.4 years.

Results: Results from USG showed 15 (50%) males and 5 (16.66%) females had pleural effusion in the right lung, whereas 7 (23.34%) females and 3 (16.66%) males had pleural effusion in the left lung. In x-ray images, 12 (40%) males and 6 (20%) females showed pleural effusion in the right lung, and 6 (20%) females and 6 (20%) males had effusion in their left lung. The average volume of effusion in males was 35.50 in the left lung and in the right lung was 120.40. In average female effusion in the right lung was 102.90, and in the left was 64.36 mL. For the right lung minimum volume of fluid level was 36.4 ml and 340 mL was the maximum volume, and the average volume was 93.98 mL. In the left lung minimum of 36.4 ml of fluid was detected, and the maximum recorded was 220.2 mL, and the average volume recorded was 60.1 mL.

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

Keywords: Ultrasonography, Pleural Effusion, Pleural Cavity, Inflammation.

Introduction

Hospitalists commonly encounter pleural effusions, and their detection and characterization by point-of-care ultrasound can guide management. Approximately 44% to 57% of hospitalized patients with bacterial pneumonia, [1,2], and up to 62% of intensive care unit (ICU) patients [3] have a pleural effusion. For patients with a parapneumonic effusion, hospitalists can use ultrasound to quantify and characterize pleural fluid to determine whether diagnostic or therapeutic drainage is indicated, as well as guide performance of thoracentesis. For patients with lung cancer, detection of a malignant pleural effusion changes staging to stage IV, regardless of tumor size or lymph node involvement, and hospitalists may discuss more appropriate treatment options with patients and consultants. Routine use of pleural ultrasonography may help hospitalists provide high-value care by reducing ancillary testing, including computerized tomography (CT) scans that expose patients to ionizing radiation and reducing complications of thoracentesis. However, many hospitalists may need to become more familiar with the use of point-of-care ultrasound. A national survey in 2012 revealed only 25% of internal medicine residencies have formal curricula to teach point-of-care ultrasonography. [4]

Pleural effusion is an excessive accumulation of fluid in the pleural space resulting from excess fluid production, decreased absorption, or both. [5] Approximately 1-10 mL of fluid is normally present in the pleural space [5-9], maintained by the balance between the hydrostatic and oncotic forces in the visceral and parietal pleural vessels and extensive lymphatic drainage. [5,6] Pleural effusion results when this equilibrium is disrupted. The daily production of pleural fluid is about 10 mL [7] or 0.01- 0.02 mL/kg/hr [10], which is absorbed continuously, such that the remaining pleural fluid is about 0.1-0.2 mL per kilogram of body weight. [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 Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India, for a period of 8 months. The source of data for this study includes a total of 30 patients referred to the Department of Radio-Diagnosis Imaging for chest radiography and ultrasonography from OPD/IPD/ED of Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar. Among these, 18 (60%) were male, and 12 (40%) were female, with an average age of 36.4 years.

Inclusion Criteria

- All the Patients with post-diagnosed pleural effusion, All the patients with IPD & OPD, both male & female patients, were included; no age limitation.

Exclusion Criteria

- Pregnancy, those patients who were not diagnosed with pleural effusion.

After the X-Ray of the Chest is done, if the case 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	18 (60)
Female	12 (40)
Pleural effusion USG Findings	
Male	
Right Lung	15 (50)
Left Lung	3 (16.66)
Female	
Right Lung	5 (16.66)
Left Lung	7 (23.34)
X-Ray USG Findings	
Male	
Right Lung	12 (40)
Left Lung	6 (20)
Female	
Right Lung	6 (20)
Left Lung	6 (20)

In this prospective study, 30 patients were included, out of which 18 (60%) were male, and 12 (40%) were female; the average age of the patient was 36.4 years. In this study, we included only those patients who undergo for both scan x-ray as well as USG to identify the pleural effusion. Results from USG showed 15 (50%) males and 5 (16.66%) females had pleural effusion in the right lung, whereas 7 (23.34%) females and 3 (16.66%) males had pleural effusion in the left lung. In x-ray images, 12 (40%) males and 6 (20%) females showed pleural effusion in the right lung, and 6 (20%) females and 6 (20%) males had effusion in their left lung.

Table 2: Comparison of 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 the right lung minimum volume of fluid level was 36.4 ml and 340 mL was the maximum volume, and the average volume was 93.98 mL. In the left lung minimum of 36.4 ml of fluid was detected, and the maximum recorded was 220.2 mL, and the average volume recorded was 60.1 mL.

Table 3: Average of Pleural Effusion between male and female

Gender	Right Lung	Left Lung
Male	120.40	35.50
Female	64.36	102.90

The average volume of effusion in males was 35.50 in the left lung and in the right lung was 120.40. In average female effusion in the right lung was 102.90, and in the 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. [9] 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. 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. [15] 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. [16] Supine anterior-posterior chest radiographs can miss a significant proportion of large effusions seen on chest CT, [17] ultrasound, [18] and lateral decubitus radiographs. [19] Pleural effusions are frequently mistaken for parenchymal opacities on portable anterior-posterior chest radiographs. [17]

The effective management of pleural effusion requires early recognition, some form of volume estimation, and identification of the underlying etiology. [20] 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. [21] 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. [21] 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. [21]

A transudate pleural effusion as a result of imbalanced hydrostatic or oncotic strain. The 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 that purposes the 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 small 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 hypoechoic (darker) when compared to the isochoric reference of the liver and spleen, while the air-filled lung is hyperechoic (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. [24,25]

Conclusion

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

References

1. Light RW, Girard WM, Jenkinson SG, George RB. Parapneumonic effusions. Am J Med. 1980;69(4):507–512.
2. Daryle DA, Potts DE, Sahn SA. The incidence and clinical correlates of parapneumonic effusions in pneumococcal pneumonia. Chest. 1978 ;74(2):170–173.
3. Mattison LE, Coppage L, Alderman DF, Herlong JO, Sahn SA. Pleural effusions in the medical ICU: prevalence, causes, and clinical implications. Chest. 1997;111(4): 101 8–1023.
4. Schnobrich DJ, Gladding S, Olson AP, Duran-Nelson A. Point-of-care ultrasound in internal medicine: a national survey of educational leadership. J Grad Med Educ. 2013;5 (3):498–502.
5. Diaz-Guzman E, Dweik RA. Diagnosis and management of pleural effusions: a practical approach. Comprehensive therapy. 2007 Dec; 33:237-46.
6. Noppen M. Normal volume and cellular contents of pleural fluid. Current opinion in pulmonary medicine. 2001 Jul 1;7(4):180-2.
7. Müller NL. Imaging of the pleura. Radiology. 1993 Feb;186(2):297-309.
8. Na MJ. Diagnostic tools of pleural effusion. Tuberculosis and respiratory diseases. 2014 May 29;76(5):199-210.

9. Light RW. Pleural diseases. 6th ed. Philadelphia, PA: Lippincott Williams & Wilkins, 2013.
10. Guarize J, Spaggiari L. Pleural effusion. In: Schwab M, ed. Encyclopedia of cancer. Berlin: Springer-Verlag, 2011;2923-2926.
11. Eibenberger KL, Dock WI, Ammann ME, Dorffner R, Hörmann MF, Grabenwöger F. Quantification of pleural effusions: sonography versus radiography. Radiology. 1994 Jun;191 (3):681-4.
12. Azoulay E. Pleural effusions in the intensive care unit. Curr Opin Pulm Med 2003; 9:291-297.
13. Collins JD, Burwell D, Furmanski S, Lorber P, Steckel RJ. Minimal detectable pleural effusions: a roentgen pathology model. Radiology. 1972 Oct;105(1):51-3.
14. Qureshi NR, Rahman NM, Gleeson FV. Thoracic ultrasound in the diagnosis of malignant pleural effusion. Thorax. 2009 Feb 1;64(2): 139-43.
15. Blackmore CC, Black WC, Dallas RV, Crow HC. Pleural fluid volume estimation: a chest radiograph prediction rule. Acad Radiol. 1996; 3(2):103–109.
16. Brixey AG, Luo Y, Skouras V, Awdankiewicz A, Light RW. The efficacy of chest radiographs in detecting parapneumonic effusions. Respirology. 2011;16(6):1000–1004.
17. Kitazono MT, Lau CT, Parada AN, Renjen P, Miller WT Jr. Differentiation of pleural effusions from parenchymal opacities: accuracy of bedside chest radiography. AJR Am J Roentgenol. 2010;194(2):407–412.
18. Emamian SA, Kaasbol MA, Olsen JF, Pedersen JF. Accuracy of the diagnosis of pleural effusion on supine chest X-ray. Eur Radiol. 1997; 7(1):57–60.
19. Ruskin JA, Gurney JW, Thorsen MK, Goodman LR. Detection of pleural effusions on supine chest radiographs. AJR Am J Roentgenol. 1987;148(4) :681–683.
20. Oguntoyinbo AE, Adeoye PO, Rahman GA, Abdulkadir AY. Radiological And Clinical Pattern of Pleural Effusion In Ilorin. Chest. 2008; 4:5.
21. Eibenberger KL, Dock WI, Ammann ME, Dorffner R, Hörmann MF, Grabenwöger F. Quantification of pleural effusions: sonography versus radiography. Radiology. 1994 Jun;191 (3):681-4.
22. Mathis G. Pleura. In: Mathis G, ed. Chest sonography. 3rd ed. Heidelberg: Springer-Verlag, 2011;30-32.
23. D'Agostino HP, Edens MA. Physiology, pleural fluid. In Stat Pearls [Internet] 2021 Sep 1. Stat Pearls Publishing.
24. McLoud TC, Flower CD. Imaging the pleura: sonography, CT, and MR imaging. AJR. American Journal of roentgenology,1991:156(6):1145-1153
25. Tamubango Kitoko H. Marqueurs de définition du statut martial néonatal. Journal of Medical Research and Health Sciences, 2023; 6(2): 2441–2449.