



RESEARCH ARTICLE

A STUDY ON ULTRASONIC EVALUATION OF PLURAL EFFUSION FOR DIAGNOSIS AND IT'S
COMPARISION WITH CHEST X-RAY

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ABSTRACT

Pleural effusion is excess fluid that accumulates between the two pleural layers, the fluid-filled space that surrounds the lungs. Excessive amounts of such fluid can impair breathing by limiting the expansion of the lungs during ventilation. This is an open label, comparative, analytical interventional and prospective study done in the Department of Respiratory Medicine, Government Medical College Hospital, Kota during period Oct. 2013 to Sept. 2014. On the basis of history, clinical examination and various investigation 100 study cases of pleural effusion were taken from Respiratory medicine ward. The aim of study to evaluate the role of ultrasonography in diagnosis of pleural effusion and its comparison to chest radiography. In our study, we were able to diagnose pleural effusion in 63 patients. Out of these cases; 47 (75%) cases had effusion in right sided, 14 (22%) had left sided while 2 (4%) had bilateral effusion. The majority of cases had minimal effusion occupying less than 1/3rd of hemi thorax. USG diagnosed 96 cases of pleural effusion; 65 (68%) cases had right sided pleural effusion, 22 (23%) had left sided effusion and 9 (10%) were bilateral effusion. An analysis of data obtained, we concluded that chest radiograph had a sensitivity of 66%, specificity 81%, while USG had a sensitivity of 96%, specificity 100% and diagnostic accuracy of 100%. Thus ultrasonography is superior in diagnosis of pleural effusion by detecting 33 extra cases.

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INTRODUCTION

Pleural effusion is excess fluid that accumulates between the two pleural layers, the fluid-filled space that surrounds the lungs. Excessive amounts of such fluid can impair breathing by limiting the expansion of the lungs during ventilation. (Wong et al., 2009) Pleural effusion is usually diagnosed on the basis of medical history and physical examination, and confirmed by chest x-ray and ultrasonography. Once accumulated fluid is more than 300 ml, there are usually detectable clinical signs in the patient, such as decreased movement of the chest on the affected side, stony dullness to percussion over the fluid, diminished breath sounds on the affected side, decreased vocal resonance and fremitus (though this is an inconsistent and unreliable sign), and pleural friction rub. Above the effusion, where the lung is compressed, there may be bronchial

breathing and egophony. Pleural effusions are a common diagnostic problem in clinical practice, as the list of causes is quite exhaustive (Light, 2001). The etiological distribution of pleural effusions in various series depends on the geographical area, patient's age, underlying systemic diseases, immunity status and common infections and advances in the diagnostic methods. The difficulty in determining the cause of pleural effusion is shown by the fact that in many series "unknown etiology" constitutes nearly 15%. (Pleural effusion 2002) Exudative effusions require to be separated into infectious causes ie. bacterial, viral or other infections and non infectious causes ie. Malignancy, rheumatic diseases. The most common causes in most series are infections and malignancy. In the West the most common cause is parapneumonic effusions followed by malignancy, while in India it is tubercular effusion followed by malignant effusion (Maldhure et al., 1994) and parapneumonic effusion because India has the highest prevalence of tuberculosis in the world with 2/3rds of all TB

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patients being in India. (Park, 2005) Pleural tuberculosis is second extra pulmonary TB in frequency after TB lymphadenitis.

MATERIALS AND METHODS

This is an open label, comparative, analytical, Interventional and prospective study was carried out on patients with signs and symptoms suggestive of pleural effusion above 18 yrs of age of either sex admitted in Dept. of Respiratory medicine, Government Medical College and Hospital Kota, during a period of one year Oct. 2013 to Sept. 2014.

Method of Collection of data

This study was done in 100 cases of pleural effusion. The diagnosis was established by a detailed history, clinical examination followed by chest X- ray & chest ultrasonography.

According to the aims and objectives, patients were studied as follows:-

1. Patients with clinical suspicion of pleural effusion were subjected to chest radiology and ultrasonic examinations. The diagnosis of pleural effusion was confirmed by needle aspiration and the results of radiology and ultrasonic examinations were compared.
2. Patients with chest roentgenologically suggestive of pleural thickening were subjected to ultrasonography and subsequent thoracocentesis to determine the presence of fluid, if any.
3. Repeat x-ray done in all cases within 24 hours of the procedure to see fluid status and air in space if any.

Inclusion criteria

1. Both male and female patient with age more than 18 years presenting with clinical features of pleural effusion admitted in Respiratory ward.
2. Patients who had given valid consent.

Exclusion Criteria

1. Patients who had not given valid consent.
2. Hemodynamically unstable patients.

Ethical consideration

The study was approved by ethics committee of the Government Medical College, kota. The approval number is F3() /Acad/Ethicl comm./MCK/2014/1087.

Radiological Examination

Postero-anterior, Lateral and Lateral decubitus film with the use of horizontal beam were taken whenever required in patients to diagnose pleural effusion.

Ultrasonic Examination

The undermentioned materials were used

1. Machine – transthoracic chest ultrasound with modern ultrasound unit B

2. 5 MHz curvilinear probe
3. Liquid Paraffin
4. Painting brush
5. Towels and Bowel

The ultrasonic examination was performed by B – mode real – time sector and linear probes at New medical college and hospital Kota. Various longitudinal and transverse scans were taken in the supine oblique or sitting positions using a suitable approach (Intercostal, Subcostal, Suprasternal, Subxiphoid, Parasternal and Supraclavicular). The liver examination was done routinely in all cases to compare echo pattern of chest opacity and to detect any associated and unassociated hepatic pathology. The echo pattern of various lesions were grouped as anechoic, hypoechoic, isoechoic and hyperechoic with reference to the liver. In the presence of pleural fluid, the initial echoes from the skin, intercostal muscles, and parietal pleura are separated from the pulmonary echoes by a relatively echo-free zone, since the ultrasonic beam traverses the relatively homogeneous fluid with little absorption and little reflection until the pulmonary tissue is encountered. The width of the echo – free zone is dependent upon the thickness of the fluid. In the presence of pleural thickening an additional echo from the surface of the thickened pleura is recorded on the echogram separately from those echoes from the thoracic wall.

Needle Puncture

In each patient a needle puncture was performed. The localization of fluid and site for needle puncture was determined by ultrasonic method in cases where thoracocentesis was unsuccessful with chest x-ray. During the puncture, try to withdraw all the fluids from pleural cavity was done. The amount of fluid removed was carefully measured and send for biochemistry, pathological and microbiological analysis to find out etiology of effusion.

Table 1. Age and sex distribution in study cases

S.N	Age groups (in years)	Male	Female	Total
1.	< 20	6	2	8
2.	21-30	14	4	18
3.	31-40	15	5	20
4.	41-50	20	3	23
5.	51-60	6	3	9
6.	> 60	18	4	22
Total Study Cases		79	21	100

The Table 1 shows that most of patients comprising of 61% belong to age group 21 to 50 years. Patients below 20 years were 8% and Patients above 60 years of age were 22%. Table 2 shows that the most common finding was homogenous opacities with absent air bronchogram in lower zone suggestive of pleural effusion with or without infiltration in 53 cases, homogenous loculated opacities and consolidation in 20 cases followed by fibrosis, emphysematous changes or old healed lesions findings in 15 cases. Table 3 shows that On using Chest radiography we could diagnose fluid in 63 cases, including 47 on right side, 14 left side & 2 in bilateral sides, out of 100 study cases. While Ultrasonography detected fluid in all 96 (100%) cases, including 65 right, 22 left and 9 bilateral sides out of 100 study cases.

Table 2. Chest x-ray findings in study cases tubercular v/s non-tubercular pleural effusion

S.N	Chest X-ray findings	Tubercular cases	Non tuberculosis cases	Total
1 (a)	Pleural effusion with infiltration	23	10	33
(b)	Pleural effusion without infiltration	10	10	20
2	Cavitary lesion	3	1	04
3	Heterogenous opacities & infiltration	7	2	09
4	Homogenous loculated opacities / lower zone consolidation or haziness	15	5	20
5	Fibrosis/ emphysematous changes / old healed lesions	12	3	15
6	Cardiomegaly	0	3	3
7	Mass lesion	0	3	3
8	Sub pulmonary effusion	1	0	1
9	Hilar Lymphadenopathy /LN & Pleural calcification	6 (4+2)	4	10
10	Miliary lesion	2	0	2

Table 3. Side of pleural effusion by chest radiography v/s ultrasonography

S.N	Effusion Side	Chest X- Ray	Ultrasonography	Extra cases detected by USG
1	Right hemithorax	47	65	18
2	Left hemithorax	14	22	8
3	Bilateral	2	9	7
Total effusion cases		63	96	33

Table 4. Evaluation of Pleural effusion types by CXR v/s USG in study cases

S.N	Pleural Effusion types	Chest radiography	Ultrasonography	USG benefit in Differentiation of effusion type (% higher than CXR)
1.(a)	Free effusion	56 (with 1subpulm.) [89%]	45 (with 3subpulmo.) [47%]	2 sub pulmo. (66.67%)
(b)	Sub pulmonary effusion			
2.	Loculated fluid	7 (11%)	17 (18%)	10(58.83%)
3.	Septate effusion	0	26 (27%)	26(100%)
4.	Thick fluid	0	8 (8%)	8(100%)
5.	No fluid	37	4	4 Thickened pleura
Total effusion		63 (100%)	96 (100%)	

Table also Shows USG is superior in diagnosing pleural effusion than chest x-ray method. Table 4 shows that Ultrasonography is 100% successful in diagnosing and differentiating various types of pleural effusion. Ultrasonography is superior in diagnosing septated effusion in 26 (100%).

DISCUSSION

In this study we observed that the most common cause of pleural effusion was tuberculosis in 70 cases {including 55 (79%) males and 15 (21%) females} followed by non-TB pleural effusion in 26 cases {including 21(81%) males and 5(19%) females}. The majority of cases were males 79% as compared to females 21% in tubercular pleural effusion. We also observed that M: F ratio in Tubercular PE was 3.6:1. The similar observation made by Sharma *et al.* (1997) in their study of 75 cases found a male predominance with M: F ratio being 3.1 :1 among Tubercular PE and 2.4:1 among non-TB groups. In study cases, patients with thickened pleura was 4, including 3 males and 1 female shows M:F ratio was 3:1 in our study and similar observation made by Yilmaz *et al.* (2005). TB pleural effusion is typically unilateral, small to moderate in size as concluded by Valdes *et al.* (1998). Radiological diagnosis was made by taking different x-ray views and after careful examination of x-ray film, opinion from radiologist and respiratory physician taken under consideration to evaluate the value of chest x-ray and expected amount of pleural fluid if present in pleural space. Leuallan and Carr *et al.* (1958) on a

study of 436 patients had described that right sided pleural effusion more common than left sided and findings were statically significant. In our study, pleural effusion was diagnosed by chest x-ray in 63 cases and by ultrasonography 96 cases, out of 100 study cases. Thus ultrasonography is superior in diagnosis of pleural effusion by detecting 33 extra cases. Most of the patients had tuberculous pleural effusion in both Chest x-ray group (43 out of 63 cases) & USG groups (70 Out of 96 cases). An analysis of data obtained, we concluded that chest radiograph had a sensitivity of 66%, specificity 81%, while USG had a sensitivity of 96%, specificity 100% and diagnostic accuracy of 100%. Similar results were observed by, Kamila Sikora *et al.* (Aug 2012) as they demonstrated that ultrasound serves as a more accurate imaging tool than chest radiography for the diagnosis of pleural effusions. They found sensitivity of 65%, a specificity of 81%, and diagnostic accuracy of 69% with chest radiography, while sensitivity of 100%, a specificity of 100%, and a diagnostic accuracy of 100% with ultrasound. Also by D T Ashton Cleary (July 2013); demonstrated high sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy (DA) for USG, whereas Chest X-ray was notably weaker, particularly in terms of sensitivity, NPV and diagnostic accuracy. Ivan volmar (Jan 2010)¹⁴ also found the sensitivity of 100% and a specificity of 99.7%, with sonography. USG is more accurate than conventional radiography in the detection of pleural effusion. Rahman *et al.* in (2010) concluded in their study that the sensitivity of USG in diagnosis of pleural effusion is 99.6%.

Gryminski *et al.* (1976); also observed in their study that Ultrasound could detect pleural fluid in 93% patients where as radiology could detect fluid in 83%. The absence of fluid was established by ultrasound in 89% and by radiologic examination in 61%. Moskowitz *et al.* (1973) demonstrated that minimal free pleural fluid can be diagnosed by the lateral decubitus view, which help in diagnosis.

Conclusion

Finally we concluded from the present study that ultrasonography is superior to chest radiography as follows:-

1. USG is superior in diagnosis of pleural effusion (even of small amount), sub pulmonary, loculated, septated effusion and empyema than chest radiography.
2. We can better differentiate pleural and parenchymal pathology like pleural effusion, pleural thickening, calcification, mass lesion and consolidation by USG guidance. Also USG can better differentiate infra diaphragmatic and supra diaphragmatic lesion
3. The results of the examination are known immediately to the examiner and they are easy to interpret.
4. Ultrasonic examination is comfortable, entirely harmless to the patient and no radiation hazard.

So, it should be a routine method of investigation for better diagnosis of chest pathology especially pleural effusion and for it's therapeutic thoracocentesis.

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