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## Efficacy of ultrasonography in diagnosis of pleural effusion

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### Abstract

**Background:** Pleural effusion is due to excessive accumulation of pleural fluid in the pleural space that exceeds the physiological amount. Pleura effusion imaging technique will play important role in diagnosis and subsequent management of the disease. Ultra sound (US) is a non radiation technique and it can be used in immediate application at the point of care.

**Methods:** A Prospective study. Study, containing 60 pleural effusion cases. Demographic data was collected followed by history regarding current health status, history of medication, alcoholism and Active smoking. In all the subjects, chest radiography posteroanterior data was obtained. Conventional CT of the chest was performed and ultrasound scan was recorded for each participant.

**Results:** In the present study encysted effusions, pleural thicknees, pleural mass and consolidation are less diagnosed by chest x-ray compared with ultrasound. The number of pleural effusions, encysted effusions, pleural thicknees, pleural mass and consolidation are equally diagnosed by ultrasound and computed tomography. The number of unilateral and bilateral are equally diagnosed by ultrasound and computed tomography.

**Conclusion:** Present study finding suggested that ultrasound is an easy accessible method for detection of pleural effusion and it is very helpful in detection of encysted effusions, pleural thickness, pleural mass and pleural nodules. Ultrasound will not only helpful in diagnosis of pleural effusion it will also useful in the management of pleural effusions.

**Keywords:** Pleural effusion, computed tomography, ultrasonography, chest radiography

### Introduction

Pleural effusion is due to excessive accumulation of pleural fluid in the pleural space that exceeds the physiological amount. Pleural effusion occurred due to alteration of hydrostatic forces, osmotic forces and impairment of lymphatic drainage <sup>[1]</sup>. Pleural effusion can be either transudative or exudative effusions. Transudative pleural effusions are usually bilateral due to systemic conditions whereas excudative effusions are unilateral and due to localized disorders <sup>[2]</sup>. Pleural effusions have a wide range of differential diagnosis, systemic approach is necessary to investigation.

Pleura effusion imaging technique will play important role in diagnosis and subsequent management of the disease. The primary suggested routine radiological investigation for identification of pleural effusion is Chest radiography but it fails in the determination of pleural thickness, fibrosis and septations within the effusion <sup>[3]</sup>. The computed tomography (CT) is very helpful in the finding of pleura abnormalities even in the earlier stage it is useful in difference of pleural from parenchymal lung disease <sup>[4]</sup>. It is helpful in the determination of exact location of pleural disease and certain conditions it will allows to characterization of tissue density within a lesion. Ultra sound (US) is a non radiation technique and it can be used in immediate application at the point of care and it is also very important role in assessment of the respiratory system with short examination time <sup>[5]</sup>.

Ultra sound can be used for the identification of nature of pleural effusion, pleural thickness and pleural density. It Provide differentiate pleural from parenchymal lesions, pleural septations, Parenchyma obscured by pleural effusion and other plural disorders <sup>[6]</sup>. It helps in differential diagnosis of parenchymal diseases like atelectasis, consolidation and tumors. It is useful in identification of chest wall tumor mass and clarification of subphrenic and subpulmonary fluid accumulations <sup>[7]</sup>. Ultra sound allows the detection of minimal amount of

pleural locular fluid and easily differentiation of pleural locular fluid and thickened pleura and provides more accurate position of thoracocentesis even in the less volume. Ultrasound guided pleural fluid aspirations will improves the success rate of aspiration, which may be around 97% [8]. Ultrasound is enormously helpful in guiding of pleural biopsies. Focal pleural disorders can be identified with ultrasound and biopsies can be collected from the area of the interest [9]. Previous studies also revealed that image guiding pleural biopsies and thoracocentesis decreases the complications [10]. The present study was taken to understand the role of ultrasound in the diagnosis and management of pleural effusion in comparison with CT.

**Materials and Methods**

**Type of study**

Prospective study.

**Study Population**

Study population are patients who attend the Department of Radiology with clinical and radiological evidence of pleural effusion.

**Selection Criteria**

**Inclusion criteria:** Patients with evidence of pleural effusion age group 30 to 70 were taken for the study.

**Exclusion Criteria**

Known Subjects with critical illness and younger individuals are excluded from the study. Individuals who did not provide inform constant were excluded

**Study design**

The study consists of 60 pleural effusion individuals Informed consent was taken from the patients. Demographic data was collected followed by history regarding current health status, history of medication, alcoholism and Active smoking. A questionnaire was given to all participants and detailed clinical examination was performed. In all the subjects, chest radiography posteroanterior data was obtained. Conventional CT of the chest was performed with multidetector CT scanner. Ultrasound scan was recorded for each participant with sector curved array transducer of 3.5-5 MHz. Ultra sound scan was performed both sides of chest starts from costophrenic angle upwards and dorsal to ventral.

The transducer was placed intercostally with perpendicular position. Each patient arm was raised and crossed behind the head to extend the inter costal space. The probe was placed in different position to provide three dimensional image. Abdominal approach was adopted the diaphragm looks brighter and curving echogenic line. Above the diaphragm lung is located with filled air. The diaphragm and lung curved surface interface act as a specular reflector and produce a mirror images of liver or spleen above the diaphragm. The ultrasound is a hallmark of pleural fluid and provides echo free zone between the parietal and visceral pleura [11].

Ultrasound was used to know the undiagnosed pleural

densities. We used ultrasound for detection of various sonographic patterns and find out nature of effusion either exudates or transudates. Based on appearance of pleural effusions it was identified in different pattern that are (a) no echogenic density within the effusion (anechoic pattern) (b) visible bright spots as echogenic density within the effusion (Complex nonsepatated patteren) (c) prominent fibrous septations with the effusion (complex septated pattern) (d) echogenic spot densitits evenly distributed within the effusions (Homogenously echogenic pattern) [12]. Ultrasound was also used for differentiates subpulmonary effusion from subphrenic fluid. It is also used for identification of encysted effusion from free effusions, detections pleural tumors, pleural thickness, hydropneumothorax and assesses the invasion of tumors to pleura and the chest wall [13]. Ultrasound utilized for selecting of puncture site for thoracocentesis for biochemical analysis and also for the pleural biopsy [14].

**Statistical analysis**

Data will be expressed in Mean and Standard deviation (mean ±SD). Chi square test was used for comparison of means. The statistical significance was determined at 5% (p< 0.05) level.

**Results**

The present study was conducted at Maharajah’s Institute of medical sciences, Vizianagaram, Andhra Pradesh, India. A total of 60 pleural effussions subjects were included.

**Table 1:** Demographic Profile of Pleural effusion cases

	<b>Pleural effusion cases</b>
<b>Number</b>	60
Age (mean±SD) years	45.12±12.18
Sex (males %)	79
(females %)	21
<b>Smoking status</b>	
(Non smokers %)	45
(Smoker %)	55

Table 1 shows the mean age of the adult group was 45.12years±12.18. The majority of subjects were male 79% and the smokers are 55% in the present study

**Table 2:** Distribution of pleural effusion cases based to clinical data

<b>Presenting symptoms</b>	<b>Pleural effusion cases (n=60)</b>
Dyspnea	58 (97%)
Chest pain	48 (80%)
Fever	41 (68.3%)
Cough	29 (48.3%)
Hemoptysis	3 (5%)
Loss of weight	5 (8.3%)

Table 2 shows most of the subjects have dyspnea (97%), chest pain (80%) and fever (68.3%) The number of subjects showing symptoms of hemoptysis and loss of weight were much less.

**Table 3:** Distribution of pleural effusion cases based on causes of pleural effusion

	<b>Pleural effusion cases (n=60)</b>
Exudatives	56 (93.3%)
Empyema	22 (36.7%)
Parapneumonic	8 (13.3%)

Tuberculosis	12 (20%)
Malignant	7 (11.7%)
Pulmonary embolism	5 (8.3%)
Non specific inflammation	2 (3.3%)
Transudative	4 (6.7%)
Congestive heart failure	2 (3.3%)
Liver failure	1 (1.7%)
Kidney failure	1(1.7%)

Table 3 shows most of the subjects have exudative effusions (93.3%), in which 36.7% are individuals have empyema. The number of subjects with transudative effusions is 6.7%.

**Table 4:** Distribution of cases according to types of pleural and pulmonary lesions detected by means of ultrasound versus chest radiography

	Ultrasound N (%)	Chest radiography N (%)	p value
Total number of pleural effusions detected	60 (100)	58 (97)	NS
Encysted effusion	17 (28.3)	3 (5)	<0.005
Hydropneumothorax	2 (3.3)	2 (3.3)	NS
Pleural thickening	18 (30)	0 (0.0)	<0.001
Pleural mass	3(5)	0 (0.0)	<0.05
Consolidation	19 (31.7)	3 (5)	<0.005
Pulmonary nodules	1 (1.7)	3(5)	<0.05

Table 4 shows that encysted effusions, pleural thicknees, pleural mass and consolidation are less diagnosed by chest radiography compared with ultrasound.

**Table 5:** Distribution of cases according to types of pleural and pulmonary lesions detected by means of ultrasound versus computed tomography

	Ultra sound N (%)	Computed tomography N (%)	p value
Total number of pleural effusions detected	60 (100)	60 (100)	NS
Encysted effusion	17 (28.3)	17 (28.3)	NS
Hydropneumothorax	2 (3.3)	2 (3.3)	NS
Pleural thickening	18 (30)	18 (30)	NS
Pleural mass	3(5)	3(5)	NS
Consolidation	19 (31.7)	19 (31.7)	NS
Pulmonary nodules	1 (1.7)	4(5)	<0.005

Table 5 shows that number of pleural effusions, encysted effusions, pleural thicknees, pleural mass and consolidation are equally diagnosed by ultrasound and computed tomography.

**Table 6:** Comparison between pleural effusion characteristics in ultrasound and computed tomography

	Ultra sound N (%)	computed tomography N (%)	p value
Unilateral (n=52)			NS
Detected	52 (100)	52 (100)	
Not detected	0 (0.0)	0 (0.0)	
Bilateral (n=8)			NS
Detected	8 (100)	8 (100)	
Not detected	0 (0.0)	0 (0.0)	
Loculation (n=18)			<0.001
Detected	11(61.1)	18 (100)	
Not detected	7 (38.9)	0 (0.0)	
Septation (n=15)			<0.001
Detected	15 (100)	4 (26.7)	
Not detected	0 (0.0)	11 (73.3)	

Table 6 shows that unilateral and bilateral are equally diagnosed by ultrasound and computed tomography.

**Discussion**

In the present study, we evaluated pleura effusion ultrasound. This study comprised of 60 pleural effusion individuals. Ultrasound is a powerful tool for physicians to managing pleural effusion and pleural pathology and clarifies nature of effusion, densities and thickness of pleura. In the present study ultrasund demonstrated significant detection of pleural effusion that is 100% which is higher than the chest radiography (97%). Previous studies also reported that ultrasound replace chest radiography for diagnosis of acute dyspnea and concluded that ultrasound detected more numbers cases than chest radiography [15]. Motogna *et al.*, also reported ultrasound showed higher significant detection of pleural effusion compared with chest radiography [16].

Previous studies also reported that ultrasound detected 70% of cases pleural thickness but chest radiography detected only 10% [17]. Helala *et al.* study showed that ultrasound detects pleural thickness more accurate than chest radiography [18]. In our study ultrasound and computed tomography detected equal number of pleural thickness that means ultrasound detected 100% of cases with pleural thickness that are detected by the computed tomography whereas chest radiography not detected any one case with pleural thickness.

The current study shown pleural mass detected by ultrasound has statistically significant when compared with chest radiography. The ultrasound and computed tomography detected equal number of plural masses and chest radiography not detected any cases. Ultrasound detected pleural effusion even small subpulmonic effusion. Helala *et al.* shown that ultrasound is better for detecting pleural effusion then compared with computed tomography in ill ICU patients [18]. The previous study shown that ultrasound and computed tomography were well correlated in detecting pleural effusion and there is no statistically difference between this to group [19].

In this study ultrasound and computed tomography shown equal number of encysted effusion. Kurian *et al.* shown that ultrasound detected 86% whereas computed tomography detected 100% encysted effusions in the evaluation of pneumonic complication by parapneumoonic effusions [20]. Youssef *et al.* shown that ultrasound was more accurate than computed tomography in detection of encysted effusions [19]. From the present study, it was concluded that chest radiography is a nonsensitive imaging technique for diagnosis of pleural thickness, pleural mass and pleural nodules. Previous studies also reported that chest radiography has limited utility in pleural effusion [21]. Ultrasound is a simple and easy accessible method for detection of pleural effusion and it is very helpful in detection of encysted effusions, pleural thickness, pleural mass and pleural nodules. Ultrasound will not only helpful

in diagnosis of pleural effusion it will also useful in management of pleural effusions

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### Declarations

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**Conflict of interest:** None declared

**Ethical approval:** The study was approved by the Institutional Ethics Committee

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