RADIODIAGNOSIS OF PLEURAL LESIONS WITH USG AND CT SCAN

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ABSTRACT

BACKGROUND

Ultrasound is easy available, less expensive study. It differentiates pleural effusion, consolidation and masses. CT scores in diagnosing early pleural lesions and helps in localising lesions differentiating benign and malignant.

The aim of the study is to-

1. Assess the value of ultrasonography and computed tomography in evaluation of pleural lesions.
2. Determine the sensitivity and specificity of ultrasound and CT in pleural lesions.

MATERIALS AND METHODS

The present study was aimed at assessing the value of ultrasonography and CT in evaluating the pleural lesions. In our study, during the period of 12 months, 100 patients with pleural effusions were evaluated. The most common cause was transudate. Exudates consist of malignant and non-malignant causes.

RESULTS

The study group was defined into two groups- Malignant and non-malignant group based on pleural effusion of transudate and exudate types. CT and ultrasound has success rate of 100% and 85% respectively to identify neoplastic and non-neoplastic disease. Diagnostic accuracy of CT and ultrasound are comparable while CT scores over ultrasound in failed cases. CT has 100% sensitivity and 100% specificity in pleural lesions. CT has more therapeutic value compared to ultrasound.

CONCLUSION

The role of ultrasound and CT are complimentary, give high yield of positive results for pleural mass differentiation; useful for guided procedures like pleural biopsy and pleural drainage. Combined study not only useful for localisation of lesion, but also gives information about the extent of disease and characterising the tissue density by analysis of attenuation coefficient.

KEYWORDS

Ultrasound, MDCT, Pleural Effusion, Transudate and Exudates.

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BACKGROUND

The pleura is derived embryologically from the mesenchyme.[1] It serves an important role in lung function, in that it acts as a cushion for the lungs and allows for smooth movement of the lungs within the chest cavity.[2] A variety of imaging techniques can be used to evaluate the pleura and pleural space. Standard radiographs are the most commonly used, but difficult to differentiate the pleural collection from masses. Ultrasound is an effective, easily performed complimentary to chest radiograph in evaluation of puzzling areas of increased opacity in the chest. Ultrasound may provide useful information that eliminates the need for more invasive/expensive studies. Useful in differentiating pulmonary consolidation from lung masses and pleural lesions, which are main causes of increased opacity on chest radiograph. Ultrasound provides detailed information about nature of pleural fluid. It allows determining whether a fluid is amenable to aspiration. Hence, initial screening with ultrasound to determine whether the lesion is solid or fluid filled[3] helps to limit the differential diagnosis. Chest CT scanning permits imaging of entire pleural space, pulmonary parenchyma and mediastinum simultaneously. CT reveals early stage of pleural abnormalities and contrast-enhanced scan can depict multiple loculation and localising effusion. Differentiate between lung consolidation vs. pleural effusion, cystic from solid lesion, necrotic areas, pleural thickening, nodules, masses or round atelectasis and peripheral lung abscess from lung empyema and tumoral extent helps in identifying benign vs. malignant involvement.

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MATERIALS AND METHODS

The study was conducted in our hospital over a period of January 2015 to December 2015. It was a prospective study. A total of 100 patients with suspected pleural lesions on chest radiography were enrolled for this study. After obtaining relevant history and clinical data, these cases were subjected to ultrasound (real time SS-D 1000 Aloka 5 MHz)

and CT (Siemens 16 slice). Subsequently, the confirmed pleural lesions were subjected to pleurocentesis/ FNAC/biopsy to know the nature of the lesion. A comparative study was done between USG and CT findings. Further, the pleural lesions were correlated with FNAC/biopsy.[4] These observations were analysed and statistical assessments were performed.

List of Pleural Pathologies- Pleural effusion collection of fluid between the visceral and parietal pleura. Pleural effusion is classically divided into transudates and exudates.[5] USG is useful in characterising the nature of effusion. CT is of limited value in distinguishing transudate from exudates[6] depending on attenuation coefficient (higher density indicates exudates).[7] Empyema is infected exudative pleural effusion when loculated. It is in lenticular shape making obtuse angle with chest wall. "Split pleural sign"- where the parietal and visceral pleura are split and show marked enhancement in empyema. CT helps to differentiate effusion from ascites by-

1. Displaced crus sign.[8]
2. Diaphragm sign.[9]
3. Interface sign.[10]
4. Bare area sign.

Focal pleural diseases include pleural thickening and pleural plaques affecting most commonly parietal pleura. It is seen on USG as homogenous echogenic layer adjacent to chest wall and on CT as soft tissue opacity. Pleural plaques ossify, if it is due to asbestosis. Diffuse pleural diseases include fibrothorax, malignant mesothelioma and metastatic carcinoma and lymphoma. Fibrothorax is characterised by pleural thickening more than 8 cm craniocaudally and 5 cm laterally with thickness more than 3 mm malignant mesothelioma, highly malignant locally aggressive tumour of pleura caused due to exposure to asbestos with an average latent period of 35 yrs.[11] CT appearance consists of pleural effusion with thickened irregular nodular pleura encasing the lung and extending into the pleural fissure. Occasionally, only pleural effusion can be identified.[12,13]

Signs which indicate malignant pleural thickening are-

1. Circumferential thickening.
2. Nodularity.
3. Parietal thickening >1 cm.
4. Involvement of mediastinal pleura.

Metastasis to pleura occurs from bronchogenic carcinoma, breast cancer, lymphoma and ovarian and gastric cancer. CT findings include pleural nodule and extensive pleural thickening with contrast enhancement. Lymphoma shows characteristic CT appearance of pleural involvement consists of localised broad-based lymphomatous pleural plaques.

OBSERVATIONS AND RESULTS

Nature of Effusion	Number of Patients	%
Transudate	28	28
Exudate	72	72
Non-malignant	34	47.20
Malignant	38	52.80

Table 1. Nature of Pleural Effusion

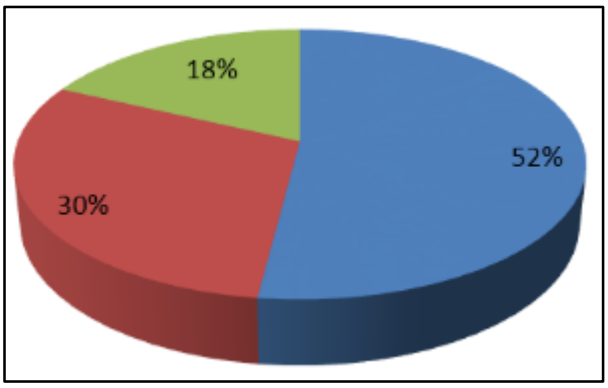

Chart 1. Pie Diagram Showing Degree of Pleural Effusion

52%- Moderate, 30%- Massive, Minimal- 18%.

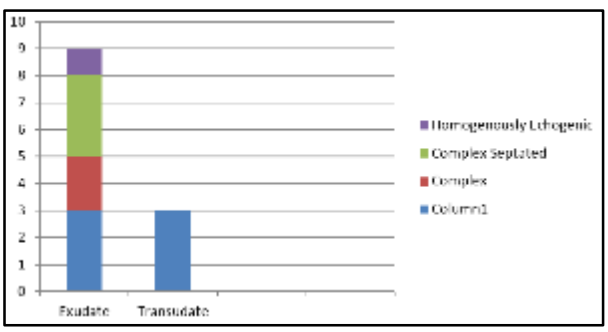

Chart 2. Bar Diagram Representing Sonographic Pattern and Nature of Pleural Effusion

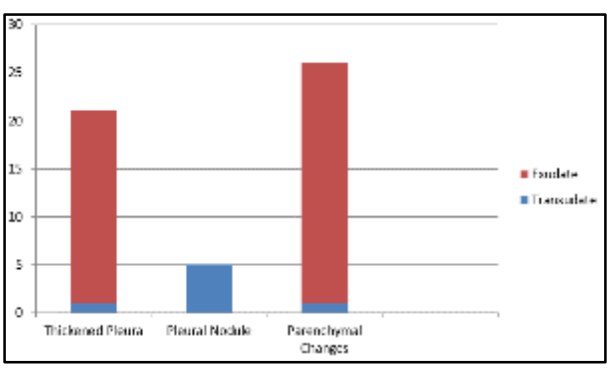

Chart 3. Bar Diagram Showing Nature of Pleural Effusion and Associated Findings

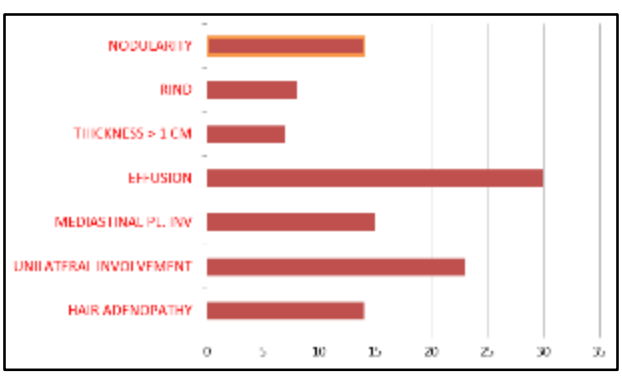

Chart 4. Bar Diagram Showing Characteristics of Diffuse Pleural Diseases

Effusions	Internal Echogenicity			
	Anechoic (n=58)	Complex Non-Septated (n=14)	Complex Septated (n=24)	Homogenously Echogenic (n=4)
Transudate	28 (48.27%)	0	0	0
Exudate				
Non-malignant	12 (20.68%)	8 (57.14%)	12 (50%)	3 (75%)
Malignant	18 (31.03%)	6 (42.85%)	12 (50%)	1 (25%)

Table 2. Showing Sonographic Pattern and Nature of Pleural Effusions

Nature of Effusion	Thickened Pleura (n=23)	Pleural Nodule (n=3)	Parenchymal Changes (n=16)
Transudate	1	0	1
Exudate			
Non-malignant	12	0	11
Malignant	10	3	4

Table 3. Showing Thickened Pleura and Associated Findings

Transudate (n=28)	Numbers	Percentage
a) Congestive heart failure.	12	42
b) Cirrhosis of liver.	8	28.5
c) Hypoalbuminaemia.	5	17.8
d) Others.	3	10.7
Exudate (n=72)		
1. Non-malignant (n=34)		
a) Tuberculosis.	14	46.6
b) Nontuberculous bacterial infections.	8	23.5
c) Empyema.	8	23.5
d) Pancreatitis.	4	11.7

Table 4. Showing Aetiology of Pleural Effusion

Group	Parietal Pleural Thickening	Extra Pleural Fat Thickening	Visceral Pleural Thickening
Exudate (n=72)	44	24	15
Transudate (n=28)	1	1	1

Table 5. Showing CT Findings in 72 Exudates and 28 Transudates

Benign	18	47.4%
Empyema	9	50%
Fibrothorax	7	38.8%
Asbestosis	2	11.2%
Malignant	20	52.6%
Metastasis	16	80%
Mesothelioma	3	15%
Lymphoma	1	5%

Table 6. Showing Diffuse Pleural Disease (n=38)

Characteristic	Mesothelioma (3)	Metastasis (16)	Lymphoma (1)	Asbestosis (2)	Fibrothorax (7)	Empyema (9)
Nodularity	2	9	1	0	2	0
Rind	2	6	0	0	0	0
Thickness >1 cm	2	3	1	0	1	0
Calcifications	0	1	0	2	4	1
Mediastinal pleural involvement	1	9	1	1	1	2
Unilateral involvement	0	10	1	0	4	8
Effusion	3	14	1	1	3	9
Hilar adenopathy	1	7	1	0	3	2

Table 7. Showing Characteristics of Diffuse Pleural Disease

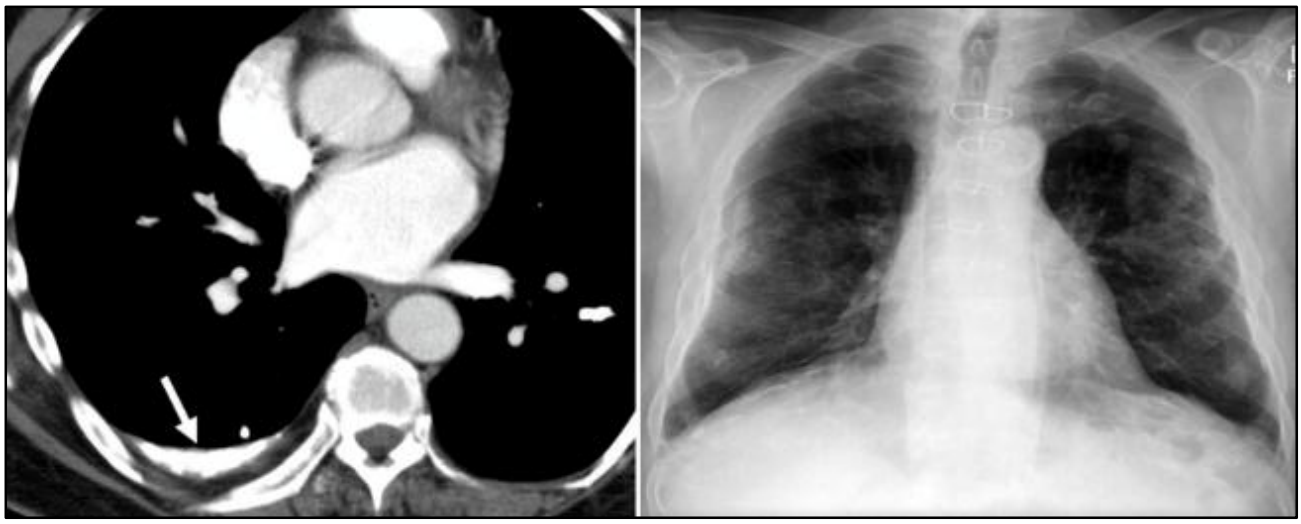

Figure 1. CT Chest and X-Ray Chest Showing Plaque-Like Pleural Calcification

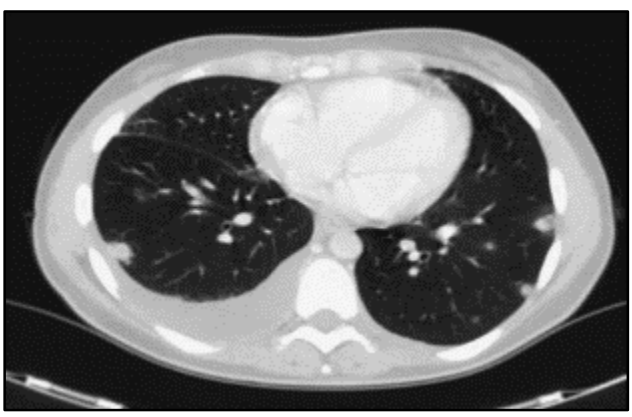

Figure 2. CT Chest Shows Pleural Effusion with Lung Secondaries

DISCUSSION

The current study was undertaken to assess the evaluation of USG and CT in evaluation of pleural lesions. There have been few trials, which have sought to determine the accuracy of USG and CT chest in these cases. Age and sex incidence- In our study on 100 patients, 59 were males (59%) and 41 were females (41%). According to Aquino SL Webb et al 1994, male (68.75%) and females (31.25%); Yang et al 1992, males were (59%) and females were (41%) between the age group of 2-80 yrs. with mean age of 55 yrs. According to Yang et al 1992, mean age was 54 yrs. Aquino SL Webb et al 1994, it was 58 years. Nature of pleural effusion in our study, transudate was 28% and exudates were 72% as compared to Aquino SL Webb et al 1994, transudate was 31.4% and exudates were 68.6%.

Simple vs. Complex Effusions

Based on its sonographic appearance, pleural effusions are categorised as simple or complex. Simple pleural effusions are anechoic and usually transudative. Complex pleural effusions are subcategorised as homogeneously or heterogeneously echogenic with or without septations and are more often exudative.[13]

Effusions with heterogeneous echogenicity with swirling echoes suggest high cellular content that is often associated with malignancy.[14] Fibrinous stranding, septations and loculations also suggest an exudative effusion and are more readily identified and characterised on lung ultrasound than CT scan.[15]

Homogenously echogenic effusions are most often due to haemothorax or empyema.[16] The high cell count of a haemothorax creates a layering effect in costophrenic recesses ("haematocrit sign"). Empyemas develop from complex effusions that organise into collections of pus and usually have a homogeneously echogenic, speckled appearance. Sonographic evidence of septations in the presence of empyema predicts the need for intrapleural fibrinolytic therapy, longer duration of drainage and possible surgical intervention.[17]

Isolated dense loculations may be challenging to differentiate from peripheral lung or pleural lesions, such as abscess or tumour. Solid pleural and peripheral lung lesions are generally hypoechoic and demonstrate absence of flow by colour Doppler ultrasound.

Pleural Thickness

Normal visceral and parietal pleura are opposed and 0.2-0.3 mm thick.[18] Pleural effusions with parietal pleural thickness >10 mm, pleural nodularity and diaphragmatic thickness >7 mm predicted underlying malignancy with high specificity and positive predictive value in one study.[19] As many as 20% of anechoic lesions of the pleura are solid rather than fluid. Colour flow Doppler ultrasound can differentiate small pleural effusions from solid pleural abnormalities with sensitivity and specificity of 89% and 100%, respectively.[20]

Pattern	Present Study	Yang et al 1992
Anechoic	58%	53.75%
Complex non-septated	14%	15.62%
Complex septated	24%	23.75%
Homogenous echogenic	4%	6.87%

Table 8. Sonographic Patterns of Pleural Effusion

Findings	Present Study	Yang et al 1992
Thickened pleura	23%	23.75%
Pleural nodule	3%	3.12%
Parenchymal changes	16%	16.87%

Table 9. Comparison Table Showing Associated Findings in Pleural Effusion

The characteristic findings on CT in our study showed specificities of nodularity (88%), pleural thickening >1 cm (94.4%), rind sign (100%) and mediastinal pleural involvement (88.8%), whereas according to Leung et al 1990 specificities were nodularity (94%), pleural thickening >1 cm (94%), rind sign (100%) and mediastinal pleural involvement (88%).

Percentage	Present Study	Fredrick Abraham et al	Leung et al
Specificity (%)	83.33	83	83
Sensitivity (%)	70.00	72	72

Table 10. Comparison Studies Evaluating CT Characteristics in Malignant Pleural Disease

CONCLUSION

The pattern of ultrasonography helps in differentiating the nature of effusion. In addition to the basic effusion patterns (anechoic, complex, non-septated, complex septated) a pleural effusion can be homogenously echogenic. Transudates are usually anechoic, whereas an anechoic effusion could be either a transudate or an exudate. Pleural effusion with complex septated, complex non-septated or homogenously echogenic patterns are always exudates. The most common sonographic pattern in our study was anechoic, which represented 58%. CT scan revealed very small effusion. For detecting exudative effusion by CT, the sensitivity was 61.11% and specificity was 96.44%. The CT features most helpful in distinguishing malignant from benign pleural disease are pleural rind, nodular pleural thickening, pleural thickening greater than 1 cm and mediastinal pleural involvement. Overall, the sensitivity was 70% and the specificity was 83.33% for detecting malignant pleural disease in our study. Hence, the role of ultrasound and CT are complimentary giving high yield of positive results for pleural mass differentiation useful for guided procedures like pleural biopsy and pleural drainage. Combined study not only useful for localisation of lesion, but also gives information about the extent of disease and characterising the tissue density by analysis of attenuation coefficient.

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