Effectiveness of Ultrasonography procedure in predicting Nature of Pleural Effusion

Panthee MR*, Khanal R**, Khadka H***, Pandit SP****

*Clinical Professor of Radiology, **Consultant Radiologist, ***Clinical Tutor of Radiology, ****Senior consultant Radiologist

ABSTRACT

INTRODUCTION: Chest ultrasonography (USG) is one of the useful methods for the detection of pleural effusion and other pleural opacities. When the volume of pleural effusion is small, USG allows the detection and localization of fluid, especially when the physical and radiographic means are not helpful. Once the fluid in pleural cavity is detected, it must be confirmed the fluid is an exudate or transudate, and reaching the final diagnosis is necessary for the definitive treatment of the underlying cause. The aim of this study was to assess the sensitivity and specificity of USG in the prediction of nature of pleural fluid is an exudate or transudate.

METHOD: Prospective study of 51 patients with positive radiographic findings suggesting pleural effusion were included in the study. The USG nature of pleural fluid was recorded as clear (prediction as transudates) or complex with some form of echoes or septations (exudates); and USG findings were correlated with final laboratory reports.

RESULT: Ultrasound can predict the nature of pleural fluid is either an exudate or transudate with the sensitivity 97.8% and specificity 100%, and PPV 100% and NPV 83.3%.

CONCLUSION: The study concluded when the complex effusion with floating echoes with or without septations are exudates; and most of the anechoic fluids are transudates where as the clear anechoic fluid may be exudates.

KEY WORDS: pleural effusion, ultrasonography, exudate, transudate, biochemistry.

INTRODUCTION:

Pleural effusion is the collection of fluid in potential pleural space. Condition is manifested by many diseases and is a common presentation all over the world. The most common causes of pleural effusion in adults are heart failure, malignancy, pneumonia, tuberculosis, pulmonary embolism; whereas pneumonia is the commonest cause in children. Pleural effusion is a common manifestation of many diseases and it may result from pleural or nonpleural systemic pathology. Pleural effusion may be exudates or transudates according to their biochemical composition. So it is necessary to determine the nature of effusion, which leads the definitive treatment of the particular case. Primary objective of this study was to assess the nature of pleural fluid is either clear or complex with echoes and predicting the fluid is transudate or exudateate respectively on the basis of USG findings. And in addition, to correlate the USG reports to the final laboratory results.

METHOD

Prospective study of pleural effusions diagnosed or suspected on chest radiographs were included in the study. Patients were referred to department of radiology for reconformation of effusion or guided aspiration. Chest USG was carried out by 3.5 MHz curve or 8 MHz linear transducer before aspiration of pleural fluid. Sonographic pattern of pleural fluid recorded as simple anechoic, complex nonsepted (fluid containing echo particles) and complex septed or moving layers in the fluid. Aspirated fluid was sent for biochemical evaluation. The cases were diagnosed on the basis of the results of biochemical, bacterologic and cytologic evaluation of pleural effusions, and in this study USG findings were correlated with laboratory results in
A small amount of transudative fluid presents in the pleural space in normal situation. Average volume of fluid in normal situation is about 8 ml (0.13 ml per kg body weight). Pleural effusion is the most common presentation of pleural abnormality. On normal condition, production and reabsorption of pleural fluid is an ongoing process. The fluid provides a mechanical coupling and lubrication between the lung and chest wall.

Pleural effusion is the collection of fluid in pleural cavity. It results when the production of fluid is increased or when the reabsorption is impaired. Causes of pleural effusion may be due to increased capillary permeability due to infection or other pathology causing pleural inflammation, blockage of the lymphatic drainage from the pleural cavity, or it may be secondary to the high periphery and pulmonary pressure leading to transudation of fluid from the capillary. Various radiological modalities are useful to diagnose the pleural effusion; they are the conventional chest radiography, ultrasonography (USG) and computerized tomography (CT) etc. Chest radiography is the first method requested for suspected cases of pleural effusion. Shadow pattern of the plain radiographs are rarely specific to a single disease process. Loculated or minimal effusions, and a subpulmonary effusion is frequently difficult to distinguish from elevated diaphragm or consolidation.

USG and CT are useful for conformation when there is small effusion and in doubtful cases. USG differentiates between effusion and pleural thickening where the plain radiography where it is not an effective method. USG is valuable in the guidance for diagnostic or therapeutic procedures like biopsy or aspiration. USG is simple, easy, cheap and effective method without radiation exposure to the patients and it can be done as a bed side procedure. This useful clinical tool is increasingly being performed by chest physicians too. In UK, guidelines have been published with suggestion of training for physicians with an interest in practicing transthoracic USG.

Transthoracic USG is useful in various conditions. Some of them are: for the detection of pleural effusion, especially in minimal or loculated effusions; to distinguish between cystic or solid lesions in opaque hemithorax on chest radiograph; to differentiate...
Subpulmonic effusion from subdiaphragmatic collection; to access the invasion of pleura and chest wall by lung tumor; to assess the lesions in lung parenchyma and guiding percutaneous transthoracic biopsy for pleural or pleural based lesions. According to the biochemical composition pleural effusion are divided into exudates and transudates. Exudates is caused by diseased pleural surfaces (e.g. any pleural infection, pneumonias, tuberculosis, malignancy etc) and transudates by some systemic factors that affect the production and reabsorption of pleural fluid where the pleura are not involved by the primary disease (e.g. congestive cardiac failure, nephritic syndrome, hypoproteninaemias etc). The pleural fluid is termed exudates when it has serum protein greater than 0.5, lactose dehydrogenase greater than 200 IU/liter\(^5\); glucose level less than serum glucose level, pH less than 7.2, RBC count more than 1000 per cubic millimeter or positive Gram’s stain or culture according to the causative pathology. Exudative effusion results due to local pathological process of pleura resulting increased capillary permeability\(^1\). Transudative effusion is secondary to increase in capillary hydrostatic pressure or a decrease in colloid osmotic pressure\(^2\). Common causes of transudative effusion are congestive cardiac failure, hypoprotenemia secondary to cirrhosis or nephritic syndrome\(^3\).

Posterolateral and lateral chest radiographs usually confirm the presence of pleural effusion in most of the patients, but it is not always conclusive. Lateral decubitus view may be helpful to detect small amount of pleural effusion. Large effusion opacify the hemithorax and displace the mediastinal structures to the opposite side and in case of collapse lung by any cause with pleural effusion the mediastinum is shifted towards the side of pleural effusion\(^4\). When there is doubt in pleural effusion, ultrasound or computerized tomography scans are definitive for the detection of fluid in pleural cavity and effusion is easily differentiated from pleural thickening. And transthoracic USG is relatively accurate in differentiating malignant parietal pleural thickening and chronic fibrosis\(^4\). Chest ultrasonography offers a more effective result than conventional radiography for the detection of fluid\(^5\). USG can detect even 20 ml of pleural effusion in comparison to 50-70 ml on chest x-ray\(^6\). The role of real time ultrasonography in detection of small volume of pleural effusion, pleural thickening, pleural metastasis, empyema and pneumothorax is well documented\(^7,8\), and is useful in detecting the nature of pleural masses and localizing loculated effusion before aspiration\(^9\). Transthoracic USG is useful in intensive care unit where a small effusion or a real amount of effusion may be missed when radiographs are taken on supine position\(^10\). The diagnostic yield from pleural biopsy is higher when it is used with some form of image guidance to identify the areas of particular thickening or nodularity of pleural surface\(^11\). Chest ultrasonography is useful for diagnosis of pleural opacities, but its use is limited to pleural fluid detection and image guided procedures\(^12\).

No diagnosis is ever established for approximately 15% of the cases with pleural effusion\(^1\). In such situation the line of management may differ in different geographical regions or countries according to the prevalence of the national prevalence of diseases and clinical work up is more important in such situation. For example, in countries like Nepal, in clinical practice when the pleural fluid reported as an exudative nature and no other supporting evidences for final diagnosis, we usually suspect it may be secondary to tuberculous in origin. The result of this study is statistically significant as other studies\(^1,4\), and in our study; Kappa = 0.89, which means the agreement between USG and pathology finding is high and statistically significant (p<0.001).

**CONCLUSION**

Transthoracic ultrasound is a quick, inexpensive, harmless procedure and no exposure to X-radiation. When the nature of pleural fluid contain echoes with or without septations it can be predicted the fluid is an exudates and when the fluid in anechoic it is usually transudate. USG also provides many useful diagnostic information including detection of small volume of pleural fluid and it is an useful tool to guide percutaneous transthoracic aspiration biopsy of pleural and peripheral lung lesions with high diagnostic yield. In this study, many diseases were not found causing pleural effusion, large studies of pleural effusions will produce a valuable adjunct in the presentation and differentiation of nature of pleural fluid by both ultrasonologically and biochemically. Finally, I acknowledge to all whose references are cited in this document.
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