University Heart Journal
Vol. 19, No. 1, January 2023

ORIGINAL ARTICLE

Correlation Between B line in Lung Ultrasound and Plasma NT-proBNP Level in Patients with Acute Heart Failure

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Abstract:

Background: Acute heart failure (AHF) is a major cause of morbidity and mortality worldwide. Although this is a common cause of dyspnoea, its diagnosis still represents a challenge. Lung ultrasound (LUS) is an emerging point-of-care diagnostic tool. Objective: The aim of the study was to assess the Correlation between B line in lung ultrasound and plasma NT-proBNP level in patients with acute heart failure & thus to assess the predictive value of B line in patients with suspected acute heart failure. Materials and Method: Cross-sectional observational study conducted in cardiology department of BSMMU from October 2020 to September 2021. Study procedure: 36 patients presenting with of shortness of breath or heart failure diagnosis were enrolled meeting inclusion and exclusion criteria. The number of B-lines by Lung Ultrasound was measured. Correlation between number of B-lines on lung ultrasonography and NT-proBNP level were analyzed. Results: There is a positive correlation between the number of B-lines and the NT-proBNP levels (r=0.55, p< 0.01) in acute heart failure patients. Conclusion: Patients presenting with acute shortness of breath with raised NT-proBNP level, B line detection &quantification by lung ultrasound can be used as a tool for a faster diagnosis and decision-making on lung congestion in acute heart failure.

Keywords: Acute heart failure, N-terminal pro-B-type natriuretic peptide, B line, Lung Ultrasound.

University Heart Journal 2023; 19(1): 15-19
DOI:https://doi.org/10.3329/uhj.v19i1.69820

Introduction:

Acute Decompensated Heart Failure (ADHF) is defined as an acute worsening of cardiac failure symptoms and is represented through signs of dyspnea, peripheral oedema and lethargy. Even after the extensive improvement and modernization in the management strategies and treatment modalities for acute heart failure, the condition still remains one of the major causes of morbidity and mortality across the globe.[1]

The leading reason for hospitalization to the cardiology department and death in the cases of acute heart failure has been found to be pulmonary congestion.[2]

Diagnosing heart failure is often a challenge due to it's non-specific physical presentations.[3]

Early diagnosis of heart failure is helpful for reducing morbidity and mortality and improving patient's post-treatment life quality as well.[4]

The routinely used chest X-ray and Electrocardiogram (ECG) are legitimately specific in identifying certain presentations like cardiomegaly or T-wave abnormality respectively; they lack the sensitivity to exclude the development of heart failure.[5] The amino-terminal portion of the B-type natriuretic peptide (NT-proBNP) has emerged as a strong neuro-hormonal predictor for heart failure, the utility of its serum testing remains debatable.[6]

Thus, definitive diagnosis is hugely reliant on the radio-imaging techniques.Echocardiography with Doppler examination remains the gold standard for thediagnosis of a heart patient. However, it is not always possible to have a quick andextensive echo testing, in acute condition or even after hours. Additionally, echo maynot be indicated for the patients presenting to the cardiology department with acute pulmonary edema or undifferentiated dyspnea,

Received: 10 October, 2022 **Accepted:** 14 December, 2022

but who have chronic heart failureand established echocardiographic detection of poor left ventricular function.[7] Lung ultrasound can provide sufficient data to verify or preclude thediagnosis of ADHF. Recent advancement in radiology and cardiology are supporting the newly emerged technique of lung ultrasound through B-line evaluation as an easy, non-invasive and reliable technique for identifying extravascular lung water and thus diagnose acute heart failure.[7,8]

A normal lung is filled with air and therefore when the ultrasound beam is targeted on the lung, no visible images are obtained. The air in lungs do not allow for any acoustic mismatch which can reflect the beam [(9)]. Only pleura of a normal lung can be visualized, using lung ultrasound, which appears as a hyperechoic horizontal line moving synchronously with respiration. The parallel lines are called A line in lung ultrasound (Figure 1).[9]

In case of Extravascular Lung Water (EVLW), sub pleural interlobular septa are thickened by edema which can be detected by the ultrasound beams.[7] These reflected ultrasound beams create comet-tail reverberation artifact known as B-lines or ultrasound lung comets[(8)]. The B-lines appear as hyperechoic image arising from the pleural line and extending up to the bottom of the screen. These discrete, standing laser-like images move synchronously with respiration in real time. Number of B-lines increase with increasing EVLW and decreasing air content. Multiple B-lines on a sonograph are suggestive of lung interstitial syndrome.[8]

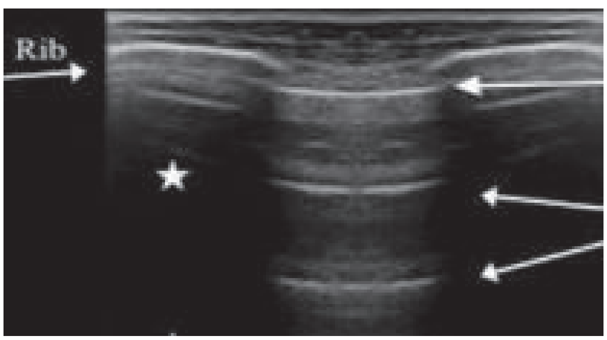

Fig.-1: *A line found in normal lung ultrasound*

Protocol for lung ultrasound to diagnose heart failure: “Lung comet score” are used to define lung ultrasound positivity. Lung ultrasound technique focuses on the scanning of anterior and lateral chest walls at fixed locations.[10] The scanning locations are defined at parasternal, mid-clavicular, anterior axillary and middle axillary lines, from the second to the fifth intercostal space on the right chest and from the second to the fourth intercostal space on the left chest, for a total of 28 scan sites [(11)]. The additional benefit of lung comet scores is that they can be grouped into grades of severity as shown in following table.[12]

Table-I

Lung comet scoring (B Line scoring)

Lung Comet Score	Severity
5-14	Mild
15-29	Moderate
≥30	Severe

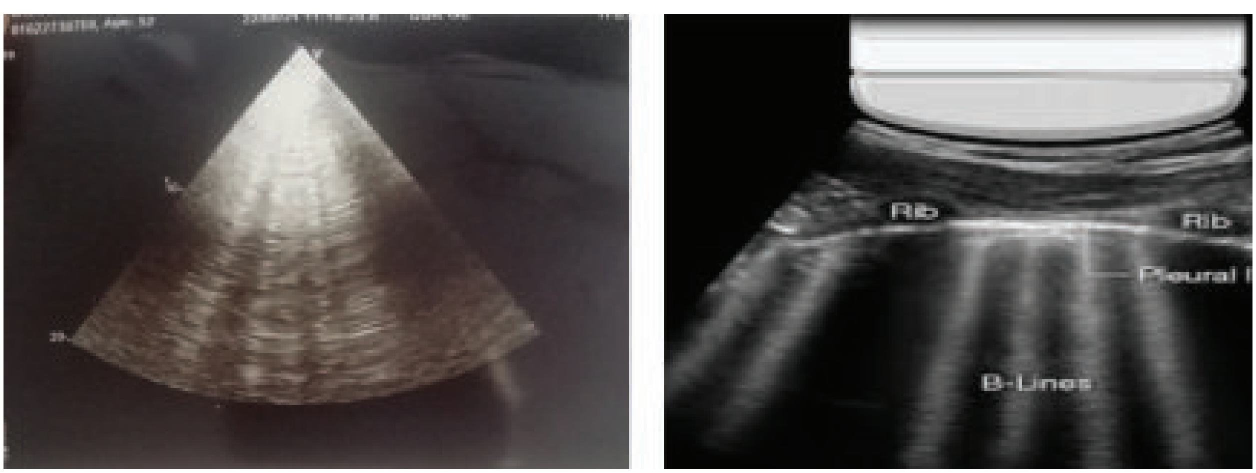

Fig.-2: *B line found in lung ultrasound*

Diagnostic, Prognostic and Therapeutic Implications

AHF accounts for a significant number of emergency department visits in our country, andeven when cardiac peptides are incorporated into the clinical work-up of acute dyspnea, the misclassification rate remains at 14% to 29%. As shown by a recent meta-analysis recruiting 1,914 patients,[13] the B profile identifies the cardiogenic origin of dyspnea with 85% sensitivity and 92% specificity, superior to pleural effusion and TTE, and comparable to cardiac natriuretic peptides.[13]

The B profile is useful to track dynamic changes in pulmonary congestion in response to treatment.[10,14]

Over the past two decades, lung ultrasound (LUS) has emerged as a rapid and reliable tool that can be used in the bedside evaluation of patients with acute dyspnoea. Several observational studies and a recent meta-analysis have suggested that LUS has higherdiagnostic accuracy for acute Decompensated Heart Failre (ADHF) than standard clinical work-up, CXR, and natriuretic peptides[(15)]. Astudy showed that, detection of B-lines by LUS, expression of increased lung density and often secondary to increased water content has been shown to be useful in diagnosing ADHF in patients presenting with acute dyspnea.[8,16]

Methodology

The study was a cross-sectional observational study to correlate between B line detected by lung ultrasound with plasma NT-proBNP level in patients with acute heart failure.

Study Procedure:

All patients admitted with symptoms of acute heart failure in department of cardiology, Bangabandhu Sheikh Mujib Medical University (BSMMU) were initially approached and were selected as case on the basis of inclusion and exclusion criteria. The symptoms of patients were graded according to New York Heart Association (NYHA) classification. Patients whose NT-proBNP were found to be raised, had been selected as cases. Assessment of Left ventricular ejection fraction (LVEF) along with Lung ultrasound were performed at the same setting.

The number of B-lines were calculated. More than three B lines per inter costal space on at least 2 zones on each side of the chest was regarded as positive findings.

Data processing and data Analysis:

Statistical analyses were planned and reviewed by the investigators and guide. After editing data analysis was carried out by using the Statistical Package for Social Science (SPSS) version 25.0 windows software. Descriptive statistics were performed for continuous data and expressed as mean ±SD (Standard Deviation). Categorical data were expressed as frequency and percentages. Pearson's correlation was calculated to measure relation between continuous variables.

Observation and Results

Table-I

Distribution of study population by NYHA (New York Heart Association)clinical class (n=36)

Variable	Class	Frequency (n)	Percentage
NYHA	IIIIV	0531	13,8886.12

Table II

Investigation variables among study population (n=36)

Variable	Minimum	Maximum	Mean	SD
NTproBNP (pg/ml)	1373.0	30000.0	4975.9	4614.9
LVEF(%)	26.0	70.0	41.9	10.6
B-line (Number)	12.0	36.0	20.3	6,2
Hb (gm/dl)	8.9	13.4	11.6	1.53
HbA1c (%)	5.7	10.5	7.34	1.45

NT-proBNP (N terminal proBNP); LVEF (Left Ventricular Ejection Fraction); Hb (Hemoglobin); HbA1 (Hemoglobin A1c); SD (Standard Deviation).

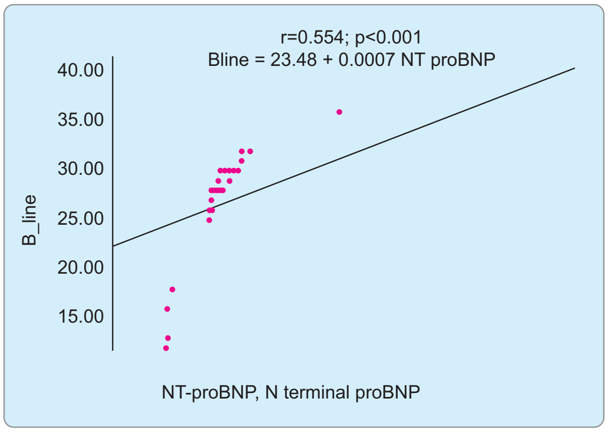

Fig.-3: *Scatter diagram of NT-proBNP and Bline*

P value was calculated from Pearson's correlation.

Scatter diagram for NT-proBNP and B Line shows positive correlation. The Pearson's Correlation is 0.554 which indicates average positive correlation between NT-proBNP and B Line and it is significant at 1% level of significance. Linear regression indicates that because of NTproBNP, number of B line is increased 0.0007.

Scatter diagram was presented to show relation between NYHA and B Line. Simple linear regression was performed to see the impact of independent variables (NT-proBNP, NYHA class and Left ventricular ejection fraction) on the dependent variable (number of B lines).

Discussion :

In our study, we found that the NYHA clinical heart failure classification, NT-proBNP levels, and the number of B-lines on lung ultrasound were highly compatible for the diagnosis of acute heart failure in patients aged who presented to the cardiac emergency department complaining of shortness of breath.

We found that there was a significant difference between the number of B-lines and the NT-proBNP level; that is, NT-proBNP levels increased as the number of B lines increased (p <0.001). Murthy et al. reported a similar relationship between these parameters[17]. There are different interpretations regarding the number of B-lines in the literature. Generally, the presence of e"30 B-lines in all areas indicates an increase in mortality; in a study[18], showed that NYHA stage 4 had more B line than stage 3. On the other hand, a lower number of B-lines is known to be associated with a lower mortality rate.

Morbidity can be estimated using early lung ultrasonography.[19] The validity of ultrasound is significant in the diagnosis of acute decompensated heart failure in patients presenting with dyspnea. Similarly, in a study [20] that investigated clinical findings, chest radiography, and cardiopulmonary ultrasonography, revealing that the sensitivity, specificity, NPV, and PPV for cardiopulmonary ultrasound were better than all other conditions.

Regarding the laboratory values, the mean NT-proBNP level was 5245.9 pg/mL (1373– 30000 pg/mL) in our study. According to a previous study, the mean NT-proBNP level of patients with acute decompensation was 5682 pg/mL (1728-11.020 pg/mL).[21]

According to the results of our study, the number of B-lines on lung ultrasound was highly correlated with the NYHA clinical stage and blood NT-proBNP level.

Conclusion:

This study found that there was a significant positive correlation between B-lines the NT-proBNP level in patients with acute heart failure. Further study can be done to see the relationship of B Line with treatment response in acute heart failure patients.

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