

# The Utility of Blue Protocol for Lung Ultra Sound in the Diagnosis of Acute Dyspnoea in an Emergency Setting

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## Abstract:

**Background:** lung ultra sound has gained lot of popularity among physicians in recent years .There are studies suggesting that Lung ultrasound has higher sensitivity and specificity in some pulmonary conditions like pneumonia pleural effusion and pulmonary oedema or fibrosis. It is a cheap and portable method of diagnosis . As ultrasound examination of lung involves interpretation of artefacts preset protocols for examination gives ease of training and improves the accuracy.

**Materials and Methods:** In this hospital based prospective observational study, 135 consecutive patients presenting to the emergency department with complaints of acute dyspnea over a period of 6 months were evaluated according to BLUE protocol. Data including demographic profile and a detailed history of patient were obtained. The diagnosis made with the BLUE protocol were compared to the final diagnosis at the time of discharge and statistically analyzed.

**Results:** Among the study population, 62.2% were males and 37.1% were females. Mean age of the population was 63.8±10. The study evaluated 135 patients and 122 had diagnoses according to BLUE Protocol and 13 were found to have pleural effusions. provisional diagnosis by BLUE protocol made as pulmonary oedema , Copd/asthma ,Pneumonia ,Pneumothorax and Pulmonary embolism were in 13.9% ,40.1% ,19.6% ,8.1% and 2.4% respectively.

Final diagnosis made were pulmonary oedema ,Copt/asthma ,Pneumonia ,Pneumothorax and Pulmonary embolism in 13.9% ,36% ,22.9% ,9.0% and 2.4% respectively. Overall accuracy of BLUE Protocol was 81.5%.

**Conclusion:** Blue protocol was found to have an accuracy of 81.5% .Therefore POCUS and blue protocol are very useful reliable ,cheap, radiation free tool which rapidly detects life threatening causes of dyspnea can be added as an adjuvant among the initial investigations of dyspnea.

**KeyWord:** BLUE Protocol, acute dyspnea ,lung ultra sound

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## I. Introduction

Lung ultrasound is a easily accessible non invasive imaging modality that can fast track the clinical evaluation<sup>(1)</sup>. It being radiation free and real time increases its appeal for a clinical practitioner<sup>(2)</sup>. Earlier ultra sound was considered not useful for lung pathology due its low tissue density and due to the presence of an air soft tissue air interface ( at the level of pleura) which virtually reflects back almost all Of the ultra sound waves<sup>(3)</sup>. This causes the production of a large number of artefacts. So it's uses were largely restricted to the pleura and the chest wall<sup>(4,5)</sup>. Later it was understood that we can classify and asses the artifacts and these artefacts can be interpreted to reach a specific diagnosis. This understanding lead to the development of Bedside Lung Ultrasound in Emergencies (BLUE) protocol by Daniel Lichtenstein, a French intensivist which was published in published in 2008. The diagnoses that can be made through BLUE protocol include cardiogenic pulmonary oedema, pneumonia, obstructive lung disease, pulmonary embolism and pneumothorax.

Recently BLUE protocol has received lot of acceptance for evaluation of dyspnea in an intensive care setting.<sup>(1)</sup> Its sensitivity ,specificity and accuracy is well documented.<sup>(1,6-8)</sup> BLUE protocol involves sequential examination 3 points in thorax namely 2 anterior BLUE point Posterior and/or Lateral Alveolar and/or Pleural Syndrome (PLAPS). Point

In the present study we aim at assessing the utility of BLUE protocol in a emergency setting. There is no much studies regarding usefulness of BLUE protocol in emergency setting.

## II. Material And Methods

It is a prospective observational study was conducted in 135 patients presenting to emergency department with complaints of acute dyspnea over a period of 6 months (dec 2021-may 2022) into the casualty of govt. hospital for chest and communicable disease, Visakhapatnam.

**Study design:** Hospital-based prospective observational study

**Study location:** Government Hospital for chest and communicable diseases, at teaching hospital of Andhra medical college, Visakhapatnam, Andhra Pradesh.

**Study Duration:** December 2021 to may 2022

**Sample size:** A total of 135 consecutive patients presenting with acute exacerbation of COPD were enrolled in the study

**Subjects & Selection methods:** The study population was drawn from consecutive patients with Acute dyspnea who visited casualty of Govt Hospital for chest & communicable diseases, Visakhapatnam.

### Inclusion criteria:

1. Patients presenting to the casualty with complaints of acute dyspnea.

### Exclusion criteria: Exclusion criteria:

1. Patients with multiple diagnoses were excluded from the study.
2. Patients with known diagnoses were excluded from the study.
3. Patients with rare diagnosis ( $f \leq 1$ ) were excluded from the study.

### Procedure methodology

All patients presenting to the casualty with complaints of dyspnea were included in the study

All cases were examined according to the "algorithm of blue protocol".

3-5 HZ curvilinear probe for thorax and high frequency phase array probe for deep veins were used in the study each patient the anterior BLUE points were examined initially followed by PLAPS point and deep veins<sup>(7)</sup>. BLUE points can be identified by placing the four fingers (excluding thumb) of the left hand below the clavicle of the patient's right side, and having the tips of the fingers over the sternum, the upper point is located at the base of the second finger and third fingers. By placing the right hand immediately below the left so the forefingers are next to each other, you will find the lower point in the middle of the palm. Repeat the process on the other side to find all four anterior BLUE points

To reach PLAPS point move from the lower BLUE point around the chest wall to approximately the posterior axillary line.

The artefacts identified included<sup>(2)</sup>

- 1) A-profile – anterior lung-sliding with A-lines.
- 2) The A' - A-profile with abolished lung-sliding.
- 3) The B- anterior lung-sliding with lung-rockets.
- 4) The B'-profile is a B-profile with abolished lung-sliding.
- 5) The C-profile indicates anterior lung consolidation, regardless of size and number; thickened, irregular pleural line is an equivalent.
- 6) The A/B profile is A-profile at one lung, a half B-profile at another.

On deep vein examination internal jugular vein, subclavian vein, femoral vein, iliac veins, superior vena cava, and inferior vena cava were examined<sup>(9)</sup>



Figure 1 Patients were initially examined in the anterior blue points followed by the PLAPS point for findings



Figure 2 A- lines

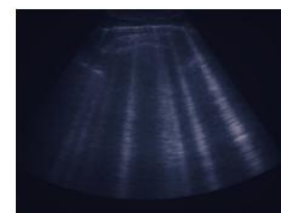


Figure 3 B-lines

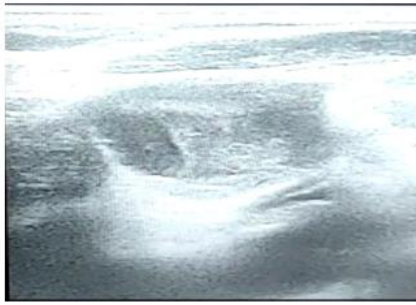


Figure 5 visualisation of deep veins-femoral veins thrombus in situ

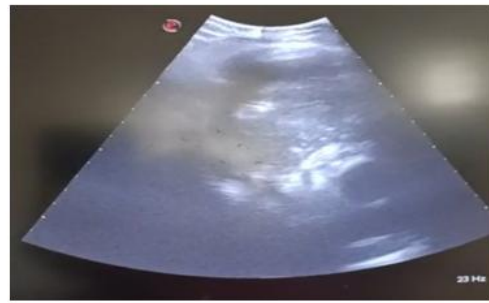


Figure 1 PLAPS Point showing "shred sign" suggestive of consolidation .

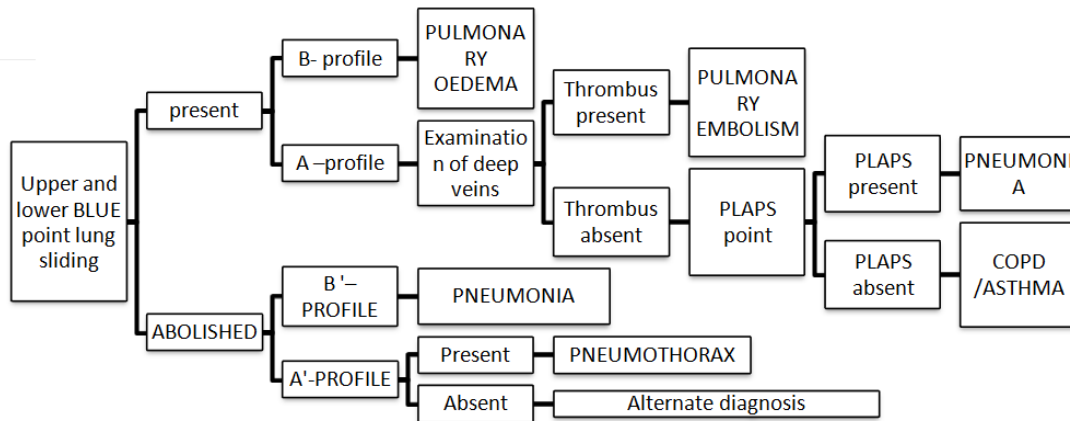


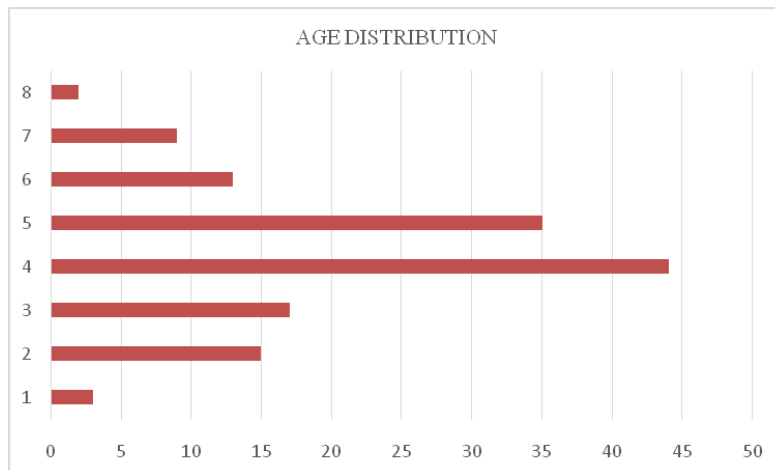
Figure 6 algorithm of BLUE Protocol

**Statistical analysis**

All data were analyzed using the Statistical Package for Social Science for Windows 17.0 (SPSS Inc., Chicago, USA) software. Descriptive variables were expressed as median and interquartile ratios and percentage distributions. The statistical significance level was accepted as P < 0.05. Sensitivity, specificity, and positive and negative predictive values were calculated using a chi-square table design.

**III. Results**

Among the 135 patients included in the study 84 (62.2%) were males and 51 (37.1%) were females; Mean age of the population was 46.8±10



**Table 1 Provisional diagnosis with blue protocol**

PROVISIONAL DIAGNOSIS	PERCENTAGE(%)
PULMONARY OEDEMA	13.9%
COPD/ASTHMA	40.1%
PNEUMONIA	19.6%
PNEUMOTHORAX	8.1%
PULMUNARY EMBOLISM	2.4%

provisional diagnosis by BLUE protocol made as pulmonary oedema , Copd/asthma ,Pneumonia ,Pneumothorax and Pulmonary embolism were in 13.9% ,40.1% ,19.6% ,8.1% and 2.4% respectively.

**Table 2 Final diagnosis of the patients**

FINAL DIAGNOSIS	PERCENTAGE(%)
PULMONARY OEDEMA	13.9%
COPD/ASTHMA	36%
PNEUMONIA	22.9%
PNEUMOTHORAX	9.0%
PULMUNARY EMBOLISM	2.4%

Final diagnosis made were pulmonary oedema ,Copt/asthma ,Pneumonia ,Pneumothorax and Pulmonary embolism in 13.9% ,36% ,22.9% ,9.0% and 2.4% respectively

**Table 3 Positive predictive value and negative predictive value of blue protocol**

diagnosis	PPV	NPV
Pulmonary oedema	93.75%	99.05%
Copt/asthma	85.71%	97.26%
Pneumonia	88.46%	94.79%
Pneumothorax	80%	97.32%
Pulmonary embolism	66.67%	99.15%

**Table 3 Sensitivity and specificity of blue protocol**

diagnosis	Sensitivity	specificity
PULMONARY OEDEMA	93	99
COPD/ASTHMA	66	99.1
PNEUMONIA	95	91.0
PNEUMOTHORAX	82.1	96.8

PULMONARY EMBOLISM	72.7	98.1
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Over all Accuracy of BLUE protocol for the diagnosis of acute dyspnoea was found to be 81.5%. Even though not included in BLUE protocol 9.6% patients were found to have pleural effusion . (accuracy=100%)

Figure 1The ultrasonographic findings of the study patients according to profiles in BLUE protocol algorithm

#### IV. Discussion

The ultra sound is a cheap ,portable , radiation free and real time investigative method .its importance in diagnosing lung pathologies increasingly beingrecognized these days.

BLUE protocol was proposed for the diagnosis of cases of respiratory failure in intensive care unit. Its application in emergency department was also previously evaluated.

There is high over all diagnostic accuracy of 81.5% for diagnosis acute dyspnea in emergency setting was found in the current study. It iscomparable to previous study conducted by dexheimer neo et al which showed accuracy of 84%.<sup>(10)</sup> in lichenstein et al study the total over all accuracy of BLUE protocol was more than 90%<sup>(11)</sup>Table shows the previous studies which were done in this front

diagnosis	Present study		j patel et al		Lichenstein et al		Dexheimer neo et al	
	sensitivity	specificity	sensitivity	specificity	sensitivity	specificity	sensitivity	specificity
Pulmonary oedema	93	99	92.3	100	97	95	85	87
Copd/asthma	66	99.1	85	88.8	89	97	67	100
Pneumonia	95	91.0	94.11	93.93	89	94	88	90
Pneumothorax	82.1	96.8	80	100	88	100		

The current study has more comparable results with results of the study by dexheimer et al as both the studies were conducted in emergency department and ultrasound was done by newly trained physicians under guidance. Another main difference observed was that reduced specificity and sensitivity for diagnosis of obstructive airway disease in both the studies. It can be explained by the fact that the obstructive airway disease is not a peripheral disease process. So the ultrasound is less sensitive for picking up the disease. As there will be an increased proportion of obstructive airway disease in the emergency department compared to ICU .This will reduce the overall accuracy of blue protocol in emergency department compared to ICU.Another probable reason could be the diversity in the diagnoses in an emergency department compared to an ICU which may not be included in the BLUE protocol atypical pneumonias, cardiacdisorders, psychological disorders ,chest wall and neuromuscular disorders

Ultra sound is a radiation free readily accessible modality of diagnosis. It understood from this study that BLUE protocol can be effectively used for diagnosis dyspnea in emergency department also.

#### V. Conclusion

Blue protocol was found to have an accuracy of 81.5% .Therefore point of care ultrasound using blue protocol is a useful reliable ,cheap, radiation free tool which rapidly detects life threatening causes of dyspnea and can be added as an adjuvant among the initial investigations of dyspnea.

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