BJMHR
British Journal of Medical and Health Research
Journal home page: www.bjmhr.com

Utility of Bedside Lung Ultrasound in Emergency (BLUE) protocol for the evaluation of patients presenting with dyspnoea in Emergency Department.

Harshad Wankhade[1*], Vishwa Chauhan[1], Atul K. Saxena[1]
1. Medical College Baroda.

ABSTRACT

The aim of this study was to find out the utility of Bedside Lung Ultrasound (BLUE) PROTOCOL in diagnosing the pathology of acute respiratory failure in patients presented to the emergency department. This is observational study was conducted in emergency department. We performed BLUE PROTOCOL on patients admitted in Emergency department with acute respiratory failure. All the patients above the age of 12 years were included. Results obtained by the BLUE PROTOCOL and final diagnosis done by the clinical experts were compaired. Rare ,uncertain diagnosis or multiple diagnosis were excluded. diffuse B lines with lung sliding indicating pulmonary edema can be diagnosed with sensitivity of 93% and specificity of 97%. Normal profile plus deep venous thrombosis indicates pulmonary embolism with sensitivity of 80% and specificity of 97%. Pneumothorax shows absent lung sliding plus A lines plus lung point can be diagnosed with sensitivity of 66% and specificity of 100%. B' profile, A/B profile, C profile, A profile plus PLAPS indicates pneumonia whose sensitivity in diagnosis is 95% and specificity 97%. COPD and Asthma seen as A line plus lung sliding have sensitivity of 90% and specificity 100%. BLUE PROTOCOL had diagnostic accuracy of 90.5% in patients of acute respiratory failure. Faster results is the essence of BLUE PROTOCOL.

Keywords: Lung ultrasound, BLUE PROTOCOL, Pulmonary embolism

*Corresponding Author Email: harshad113@gmail.com
Received 18 May 2017, Accepted 27 May 2017

Please cite this article as: Wankhade H *et al*., Utility of Bedside Lung Ultrasound in Emergency (BLUE) protocol for the evaluation of patients presenting with dyspnoea in Emergency Department. British Journal of Medical and Health Research 2017.

INTRODUCTION

Current guideline do not recommend Lung Ultrasound as investigation of choice for CT Scan or bedside chest x-ray in acute respiratory failure. In critically ill patient bedside chest X ray and clinical examination are inadequate in diagnosing the pathology behind acute respiratory failure (Jardin Fand et al). Bed side Lung Ultrasound remains easily available and handy tool for diagnosing the cause for acute respiratory failure in non-ambulatory patients. It has shown high accuracy in identifying most common causes of acute respiratory failure. (Dénier A Presse Med 1946, 22:307–308). It is easily to perform by physician with minimal training (Slasky BS and et al).

The BLUE-protocol, is a fast protocol not requiring more than 5 minutes. If performed in suitable fashion the results can be easily reached. Hereby we are comparing the BLUE PROTOCOL results and the final diagnosis done by clinical experts at the time of discharge of the patients. Uncertain diagnosis, multiple diagnosis and rare cases were excluded.

MATERIALS AND METHOD

This was a cross sectional observational study conducted in 67 adult patients with acute respiratory failure presented to the Emergency Department over the period one year. Acute respiratory failure was defined based on the classical clinical and biological criteria.

BLUE PROTOCOL was performed by emergency physician without interrupting management protocol within 20 minutes of arrival to the emergency room and lasted less than 5 minutes. All the patients included in this study were with acute respiratory failure having age more than 12 years. Treating clinical experts were blinded to the ultrasound results. The diagnosis was established in hospitalized patients at the time of discharge with different competent and relevant tests by treating clinical experts. Comparison done in between in them.

Patients excluded-

2 No definite diagnosis.

1 Several diagnosis.

1 Rare diagnosis.

BLUE PROTOCOL

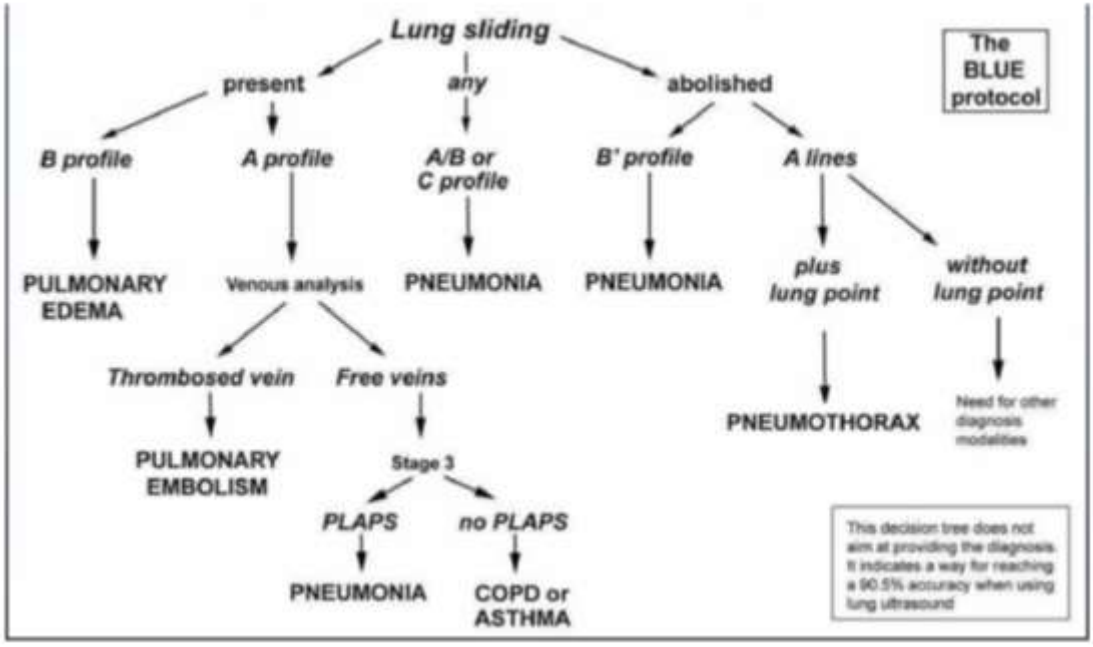

Figure 1: Blue Protocol

A-line: Sonographic hyperechoic reverberations artefacts of the pleural line lies parallel to each other.

B-line: Hyperechoic vertical sonographic artefact arises strictly from the inferior aspect of the pleural line and extends to the edge of the screen without fading, resembling lung rocket in lift off state. B-lines obscure A-lines and move with lung sliding.

Lung point: This is the cyclic appearance of aerated lung (lung sliding, A or B- lines) creeping into and then out of view with each respiratory cycle in dynamic fashion.

Lung sliding: Shimmering of the pleural line in association with respiration in dynamic fashion.

The A-profile associates anterior lung-sliding with A-lines.

The A'-profile is an A-profile with abolished lung-sliding.

The B -profile associates anterior lung-sliding with lung-rockets.

The B'-profile is a B-profile with abolished lung-sliding.

The C-profile indicates anterior lung consolidation, regardless of size and number. A thickened, irregular pleural line is an equivalent.

The A/B profile is a half A-profile at one lung, a half B-profile at another.

The PLAPS-profile designates Postero-Lateral Alveolar and/or Pleural Syndrome[5]

Signs Observed

Pneumothorax: A' profile with lung point.

Pulmonary edema - The B profile (anterior interstitial syndrome with lung sliding).

Pneumonia

The B' profile (lung sliding abolished),

The A/B profile (asymmetric anterior interstitial syndrome),

The C profile (anterior consolidation)

The A profile plus PLAPS.

Pulmonary embolism-The A profile plus venous thrombosis.

COPD/Asthma- A normal profile.

These results correspond to physiopathologic patterns, particularly echoed by ultrasound artefacts.

STUDY

Figure 2 and figure 3 shows areas of investigations to perform ultrasound.

METHOD OF STUDY-

Appearances of different pathology on ultrasound-

Figure 4: shows Pneumothorax.

Figure 5 shows Pleural effusion and alveolar consolidation (PLAPS)

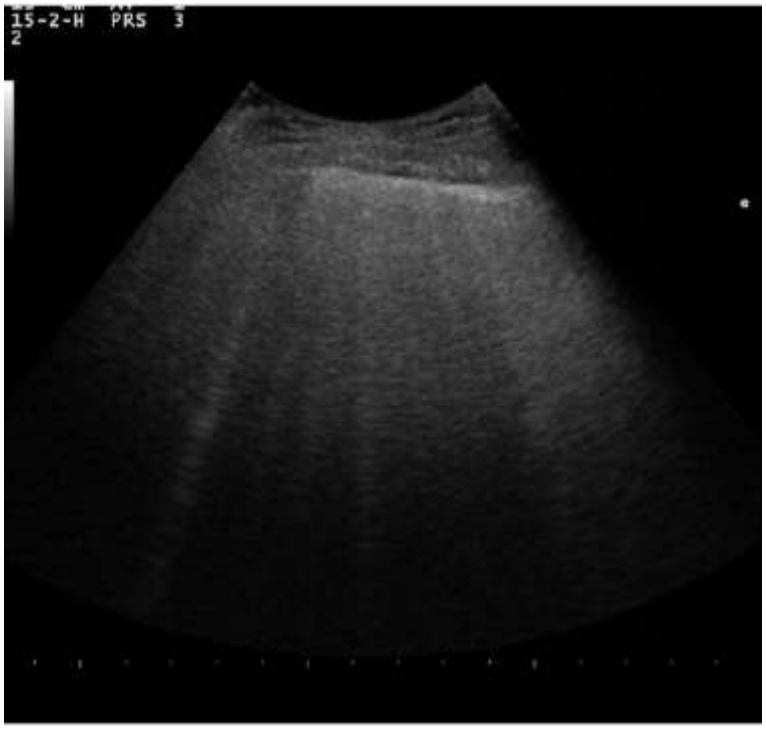

Figure 6: shows Interstitial syndrome

METHOD OF PERFORMING BLUE PROTOCOL

Ultrasound was performed with 3-5 MHz probe. Patients were investigated in a semirecumbant position, or were investigated in supine position if intubated. Scans were longitudinal. The pleural line sought between two rib shadows, indicate the pleural layers. The normal lung displays lung sliding, a movement in rhythm with respiration at the pleural line, indicating sliding of the visceral pleura against the parietal pleura. Objective signs were access as defined by the BLUE Protocol. Deep venous thrombosis was sought using the same probe. Visualization of anatomic echoic intraluminal thrombosis or absence of compressibity and absence or decrease of colour flow on Doppler was considered as a positive finding. An examination combined an anterior approach of analysing artefacts, lung sliding alveolar consolidation. A lateral subposterior search for posterolateral alveolar and or pleural syndrome (PLAPS), and venous analysis. The signs observed in each disease were methodologically collected, then the ultrasound data by BLUE PROTOCOL were compared with the diagnosis established by the clinician.

RESULTS AND DISCUSSION

This study included 67 patients with a definite diagnosis: 48 men and 19 women (mean age, 54 years; range, 12 to 88 years; SD of 14 years). 4 cases subsequently excluded.

Table 1: Diagnosis by Clinical Evaluation

For all patients (n= 67)	History, clinical examination, radiography and CT read by radiologists, favourable clinical progression under treatment.
Pulmonary Edema (n =15)	Echo-cardiography, and other functional tests
Pneumonia (n =20)	Infectious profile, radiologic abnormalities, microorganism isolated (blood culture, invasive lab tests), recovery with antibiotics.
Decompensated chronic respiratory disease (referred to as COPD) and acute asthma (n =20)	Exacerbation of chronic respiratory disease without pneumonia, pneumothorax, pulmonary edema, pleurisy, or pulmonary embolism. COPD was confirmed by standard functional tests.
Acute asthma	History, responds to bronchodilator treatment
Pulmonary embolism (n = 5)	Helical CT
Pneumothorax (n =3)	Chest X Ray and CT if necessary.
Excluded patients (n=4)	Rare causes (n =1) tracheal stenosis No final diagnosis (n =2) Unknown diagnosis at the end of hospitalization, progression preventing conclusions Several final diagnoses (n =1) pulmonary edema plus COPD

Table 2: Diagnosis by Blue Protocol

Diagnosis	A profile +PLAPS	normal profile &A'PROFILE without PLAPS	B profile	B' profile	C profile	A/B profile	Lung point
Pulmonary Edema	1	-	14	-	-	-	-
COPD+Asthma	1	18	1	-	-	-	-
Pulmonary Emobolism	2	2	-	-	1	-	-
Pnemothorax	-	1	-	-	-	-	2
Pneumonia	9	-	1	2	5	3	-

Table 3: Comparison of BLUE PROTOCOL diagnosis with clinical diagnosis

	Clinician Diagnosis	Diagnosis by BLUE PROTOCOL
Pulmonary Edema	15	14
COPD + Asthma	20	18
Pulmonary Embolism	5	4
Pneumothorax	3	2
Pneumonia	20	19

Table 4: Result by Blue Protocol

Mechanism of Dyspnea	Profile of BLUE protocol	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Acute Hemodynamic Pulmonary Edema	B Profile	93%(14/15)	97% (47/48)	93% (14/15)	97%(47/48)
COPD in Exacerbation or Severe Acute Asthma	Normal Profile	90%(18/20)	100%(43/43)	94% (18/19)	95%(40/42)
Pulmonary Embolism	A Profile (with deep venous thrombosis)	80% (4/5)	97%(57/58)	80%(4/5)	98%(57/58)
Pneumothorax	A' Profile (with lung Point)	66%(2/3)	100%(60/60)	100% (2/2)	98%(60/61)
Pneumonia	The Four Profile	95%(19/20)	97% (42/43)	95% (19/20)	97%(42/43)

DISCUSSION:

BLUE PROTOCOL has good sensitivity in diagnosing the underlying main causes of dyspnea. This protocol immediately provides diagnosis of dyspnea in 90.5% (57/63) of cases. Multiple diffuse B lines with lung sliding indicating pulmonary edema can be diagnosed with sensitivity of 93% and specificity of 97%. Normal profile plus deep venous thrombosis indicates pulmonary embolism with sensitivity of 80% and specificity of 97%. Pneumothorax shows absent lung sliding plus A lines plus lung point can be diagnosed with sensitivity of 66% and specificity of 100%. Anterior alveolar consolidations, anterior diffused B lines with abolished lung sliding, anterior asymmetric interstitial patterns posterior consolidations or pleural effusion without anterior diffuse B lines indicates pneumonia whose sensitivity in diagnosis is 95% and specificity 97%. COPD and Asthma seen as A line plus lung sliding have sensitivity of 90% and specificity 100%. Pnemuothorax profile (A' profile and lung point) has 100% specificity hence it can be confidently diagnosed. B profile suggest acute hemodynamic pulmonary edema with 93% sensitivity and 97% specificity. Pulmonary embolism associated with venous thrombosis has 80% sensitivity and 97% specificity. BLUE PROTOCOL can differentiate between pneumonia and pulmonary oedema.

BLUE PROTOCOL provides direct approach to dyspnea (Weinberger SE and et al). It saves times in decision making and decreases the need for the CT scan which is costly and has a risk of radiation exposure (Desai SR, Hansel DM). Lung ultrasound is nearly equivalent to CT in detecting most disorders, and can be repeated at will and at bedside and provides additional information (Lichtenstein D Springer; 1992). Curvilinear probe used in this study has advantage of whole body scanning when needed along with diagnosing respiratory failure. Lung ultrasound generates standardized, reproducible patterns explaining the high interobserver agreement. Feasibility is high. Lung ultrasound may appear complex at first sight but simply requires a change of thinking .once the process has been learned, a step by step use will make it routine. When your patient is blue, promptly perform the BLUE PROTOCOL.

Because of simplified ultrasound approach erroneous results possible in: “decompensated COPD” associated with the B profile or PLAPS, or “pulmonary edema” without the B profile (Lichtenstein D, Mezière G). Problem also lies in distinguishing pulmonary edema and interstitial pneumonia or embolism without thrombosis. In clinical practice cardiac analysis completes approach to dyspnea.

CONCLUSION

BLUE Protocol immediately provided diagnosis of major causes of acute respiratory failure

in 90.5% of patients of acute respiratory failure. We suggest that the bedside use of ultrasound methods in this setting could pave the way for development of new clinically relevant integrative diagnostic methods and models. This will facilitate additional saving time, faster relief and more accurate clinical decision making.

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