*Original Article*

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# To Access The Potential of Point of Care Ultrasound to Differentiate Various Causes of Dyspnea In Emergency Department

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**Abstract**

*Background:* Management of the patients presented with dyspnea can be challenging in emergency department(ED), because differentiating underlying cause can be difficult and time consuming. Point of care ultrasound(POCUS) examination in early evaluation of critical patients have been reported to be helpful in rapid diagnosis of causes of dyspnea which in turn helps in early Resuscitation.

*Aim:* We performed this study to assess utility of POCUS in differentiating causes of dyspnea & compared with final diagnosis at the time of discharge/death.

*Settings and design:* This was a single centre prospective diagnostic study to assess utility of POCUS in dyspnea. It was approved by ethical committee.

*Materials and methods:* The study was conducted at ED of tertiary care government hospital in Central Gujarat from December 2018 to November 2019. All patients presenting with dyspnea to ED were included after written informed consent. Patients' age < 12 years, Patients not willing for admission, and Patient who took discharge against medical advice /absconded/died before establishing final diagnosis were excluded. Provisional diagnosis made through POCUS was compared with the final diagnosis made by the consultants of respective clinical departments during course of their hospitalization.

*Statistical analysis and results:* 146 patients with dyspnea presenting to ED were included in prospective observational study. True and False positives, sensitivity and specificity were calculated from the analysis of data. Reliability index was calculated on the basis of above data.

**Conclusion:* This study showed good efficacy of POCUS in differentiating causes of dyspnea when compared with final medical diagnosis. Thus POCUS helps in early resuscitation and management.

**Keywords:** Ultrasound; Dyspnea; Emergency Department; POCUS; POCUS bundles.

## Introduction

Dyspnea is a common symptom with which patients presented to emergency department. Management of the patient presented with dyspnea can be one of the most challenging issues in emergency department because early identification of underlying cause of dyspnea has always been a difficult and time consuming task. Dyspnea is a prominent symptom of heart failure also, differentiating heart failure from pulmonary causes of dyspnea is an important and frequently difficult task. Treatment and prognosis differ and

embarking down the wrong pathway of treatment can have adverse consequences.[1]

Physical findings of different causes of dyspnea can easily overlap each other and difficult to appreciate in noisy emergency department.Instead of only relying on clinical examination, bedside ultrasound now allows direct visualization of pathology or abnormal physiological states. Specific goal directed point of care ultrasound examinations in early evaluation of critical patients have been reported to be helpful in rapid diagnosis of causes of dyspnea which in term help early management of dyspneic patient thus improve outcome.

Over the last few years, in addition to the BLUE (Bedside Lung Ultrasound in Emergency)study published in 2008, there have been a number of new resuscitation ultrasound studies done to more accurately diagnose the patient presented with dyspnea and to more rapidly develop an improved care plan in the initial stages of medical care. But all of the studies including BLUE protocol falls short in diagnosing comprehensive parameters life threatening cardiac causes of dyspnoea. We tried to incorporate lung ultrasound, EHCO views and venous ultrasound to differentiate the causes of dyspnea by forming bundles of different signs observed in ultrasound.

We performed this study to assess utility of point of care ultrasound (POCUS) in differentiating causes of dyspnea & correlate with final diagnosis at the time of discharge/death.

## Methods

### *Study design and POCUS exam*

Approval of local ethical committee and written informed consent from patients were obtained. A total of 146 patients (with sensitivity of new test 80%, precision 10%, desire confidence level 99% and risk 1%, numbers of disease needed are minimum 107) with dyspnea presenting to emergency department were prospectively included in the study. Patient's age < 12 years, Patient was not willing for admission, Patient who took discharge against medical advice or absconded before establishing final diagnosis and patients who died before establishing final diagnosis were excluded from the study. the performer of POCUS received a certified reputed 3 days vigorous training on EM SONO as well as observed assisted and performed 15 POCUS per day under expert guidance for 6 months before starting this study. Duration of study was from December 2018 to August 2019.

When a dyspneic patient was presented to emergency department the initial clinical evaluation and diagnosis were performed by the physician responsible for patient care. The patient was positioned supine or semi recumbent for evaluation of anterior and lateral chest, cardiac evaluation and evaluation of lower limb large veins. The patient was positioned lateral decubitus or minimally tilted for evaluation of posterior chest.

POCUS was performed within 20 minutes of admission. Curvilinear probe (2-7 MHz) was used for examining deeper structures and Linear probe (7-12 MHz) was used for examining superficial structures. The final diagnosis made by team of physicians before patients were discharged was considered the gold standard.

For evaluation of the lung, curvilinear probe (2-7 MHz) and linear probe (7-12 MHz) were used as and when required. The probe was placed longitudinally over intercostal space with pointer of probe towards cranially. Each half of the chest into six zones anterior upper zone, anterior lower zone, lateral axilla zone, lateral lower zone, posterior upper zone and posterior lower zone. (Table 1,2)

**Table 1:** Boundaries and zones for lung evaluation.

| Chest | Zone | Boundaries |
|---|---|---|
| **Anterior** | Anterior upper | Upper: clavicle; Lower: 4th rib; Medial: sternal edge; Lateral: defined by LUS image of lung |
| | Anterior lower | Upper: 4th rib; Lower: variable depending body habitus and defined by appearance of abdominal contents(liver or spleen); Medial: sternal edge; Lateral: anterior axillary line |
| **Lateral** | Lateral axilla | Upper: defined by LUS image of lung; Lower: axis of 4th rib; Anterior: anterior axillary line; Posterior: posterior axillary line |
| | Lateral lower | Upper: axis of 4th rib; Lower: variable depending body habitus and defined by appearance of abdominal contents(liver or spleen); Anterior: anterior axillary line; Posterior: posterior axillary line |
| **Posterior** | Posterior upper | Upper: defined by LUS image of lung; Lower: level of the inferior angle of the scapula; Medial: thoracic spine; Lateral: medial border of scapula |
| | Posterior lower | Upper: level of the inferior angle of the scapula; Lower: variable depending body habitus and defined by appearance of abdominal contents(liver or spleen); Medial: thoracic spine; Lateral: posterior axillary line |

Right half of the chest was examined followed by left half of chest. First anterior upper and anterior lower zones were examined from above to downward in mid-clavicular line till appearance of abdominal contents (liver or spleen) followed by

lateral axilla and lateral lower zones from above to downwards in mid axillary line till appearance of abdominal contents (liver or spleen) followed by posterior upper and posterior lower zones from above to downward in para-vertebral plane till appearance of abdominal contents (liver or spleen). If any positive finding was noted then whole zone was evaluated in detail and that particular half of lung was considered positive.

**Table 2:** Lung Assessment.

| | Right side | | Left side | |
|---|---|---|---|---|
| **Bat Sign** | + | - | + | - |
| **Lung Sliding** | + | Decreased - | + | Decreased - |
| **Seashore sign** | + | - | + | - |
| **A lines** | + | - | + | - |
| **Barcode sign** | + | - | + | - |
| **Lung Point** | + | - | + | - |
| **E lines** | + | - | + | - |
| **B7 lines** | + | - | + | - |
| **B3 lines** | + | - | + | - |
| **Dynamic air bronchogram** | + | - | + | - |
| **Shred sign** | + | - | + | - |
| **Pleural effusion** | + | - | + | - |
| **Quad sign** | + | - | + | - |
| **Sinusoid sign** | + | - | + | - |
| **Static air bronchogram** | + | - | + | - |
| **Lung pulse** | + | - | + | - |

For Cardiac Assessment, Parasternal long and short axis view just left of sternum, 3rd and 4th intercostal space was elicited using curvilinear probe to see for global LV contractility and D sign precisely. Apical 4 chamber view was elicited just below the nipple using curvilinear probe (2-7 MHz) with pointer in 2 O'clock direction to see McConnell sign and RV strain precisely. Sub-xiphoid view was elicited just below xiphoid process using curvilinear probe (2-7 MHz)aimed towards left scapula with pointer towards right side to see pericardial effusion and RA RV diastolic collapse precisely.(Table 3)

**Table 3:** Cardiac Assessment.

| | | |
|---|---|---|
| **McConnell sign** | + | - |
| **RV strain** | + | - |
| **D sign** | + | - |
| **Pericardial effusion** | + | - |
| **RA diastolic collapse** | + | - |
| **RV diastolic collapse** | + | - |
| **LV Contractility** | Good | Poor |

For assessment of Lower Limb Large Veins linear probe (7-12 MHz) was used to evaluate lower limb large veins right side was examined followed by left. The sequence of exam was femoral vein just below the inguinal ligament for venous direct pressure collapse and visible thrombus followed by popliteal vein in popliteal fossa for the same. Deep venous thrombosis was considered present if visible thrombus and/or incomplete venous direct pressure collapse in one or more large veins of lower limb was observed. (Table 4)

**Table 4:** Lower limb large veins assessment.

| | | Right side | | Left side | |
|---|---|---|---|---|---|
| Venous direct pressure collapse | Femoral vein | Complete | Incomplete | Complete | Incomplete |
| | Popliteal vein | Complete | Incomplete | Complete | Incomplete |
| Venous thrombus | Femoral vein | + | - | + | - |
| | Popliteal vein | + | - | + | - |

After completion of lung, cardiac and lower limb large vein assessment, provisional diagnosis was made according to POCUS bundles as shown in the table. (Table 5)

**Table 5:** POCUS bundles.

| | |
|---|---|
| **Normal** | Bat sign +/-, Pleural line +<br>Lung sliding +<br>A lines +<br>Isolated B lines +/-<br>M-mode:-Sea shore sign + |
| **Subcutaneous Emphysema** | E lines +<br>Bat sign - |
| **Asthma / COPD** | A lines +<br>Bat sign +<br>B lines +<br>Decrease lung sliding(hyper inflated lung) +/-<br>RV stain +/-<br>D sign +/-<br>Deep venous thrombosis - |
| **Pulmonary Embolism** | McConnell sign +<br>RV strain +<br>D sign +<br>Deep venous thrombosis +<br>Sub pleural wedge shape Tissue like pattern +/-<br>Focal/based pleural effusion +/- |
| **Pneumothorax** | Bat sign +<br>Lung sliding -<br>Lung pulse-<br>B lines -<br>A lines +<br>lung point +/-<br>M-mode:- Barcode sign + |
| **Pneumonia** | B lines- B3/B7 +<br>Shred sign<br>Dynamic air bronchogram +/-<br>Adynamic air bronchogram +/-<br>lung pulse +/-<br>Pleural effusion +/- |
| **Cardiogenic Pulmonary edema** | Poor LV contractibility +<br>B lines (mainly B7) + |

Table Continued ....

| | |
|---|---|
| **Cardiac tamponade** | Pericardial effusion + RA/RV diastolic collapse + |
| **Mixed pathology** | Signs of 2 or more from above diagnosis |

The final diagnosis was established by the consultants of respective clinical departments based on standard management protocols according to standard text books which was considered gold standard. Data entry was done in Microsoft excel and analysed in Api info 07 software. Appropriate statistical tests were applied. (Table 6, 7)

The POCUS examination was done in 3 steps: (1) Lung assessment, (2) Cardiac assessment, and (3) Assessment of lower limb large veins. After completion of all the three steps a provisional diagnosis was made and this was then compared with final diagnosis which was established by the consultants of respective clinical departments based on standard management protocols according to standard text books. In this study, a total of 146 patients with dyspnea presenting to Department of Emergency Medicine, SSG hospital Baroda were enrolled, among them 60.27% were males and 39.73% were females. In this study mean time duration of POCUS examination was around 15 minutes.

*For pneumonia*

70 patients in this study were diagnosed as pneumonia by POCUS examination. 63 of them were diagnosed as pneumonia at the final diagnosis after all investigation done by the standard protocol, 5 of them were diagnosed as mixed diagnosis, and 2 other were rare diagnosis (1. lung cancer with gross pleural effusion, 2. aneurysm of descending thoracic aorta with atelectasis of left mid lung) by final diagnosis. Total 146 patients were enrolled, 63 of them were true positive, 7 of them were false positive, 2 of them were false negative, and 74 of them were true negative for pneumonia. This study has sensitivity of 96.92%, specificity of 91.36%, positive predictive value of 90.00%, and negative predictive of 97.37% for diagnosing the pneumonia. The study performed by Felippe Leopoldo, et al. 39 reviewed that among the 37 enrolled patients, 17 patients were diagnosed as pneumonia. Lung ultrasound (LUS) diagnosis was compared with the final clinical diagnosis made by the ICU team before patients were

**Table 6:** Prevalence.

| Probable diagnosis by POCUS | Final diagnosis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pneu-monia | COPD/ Asthma | Pneumo-thorax | Pulmonary embolism | Subcutaneous emphysema | Cardiogenic pulmonary edema | Cardiac tamponade | Mixed diagnosis | Normal | Other rare diagnosis | Total |
| **Pneumonia** | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 2 | 70 |
| **COPD/Asthma** | 1 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| **Pneumothorax** | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| **Pulmonary embolism** | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| **Subcutaneous emphysema** | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Cardiogenic pulmonary edema** | 0 | 0 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 16 |
| **Cardiac tamponade** | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 6 |
| **Mixed diagnosis** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 20 |
| **Normal** | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 4 |
| **Inconclusive** | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 5 |
| **Total** | 65 | 15 | 4 | 4 | 2 | 19 | 6 | 26 | 3 | 2 | 146 |

**Table 7:** Reliability index.

| Reliability index | Pneumothorax, Pulmonary Embolism, Subcutaneous Emphysema Cardiac Tamponade | Pneumonia | COPD/Asthma | Cardiogenic pulmonary edema | Mixed diagnosis |
|---|---|---|---|---|---|
| **Sensitivity (%)** | 100 | 96.92 | 93.33 | 84.21 | 76.92 |
| **Specificity (%)** | 100 | 91.36 | 99.24 | 100 | 100 |
| **Positive predictive value (%)** | 100 | 90.00 | 93.33 | 100 | 100 |
| **Negative predictive value (%)** | 100 | 97.37 | 99.24 | 97.69 | 95.24 |

discharged from the ICU (gold standard).This study has sensitivity of 88%, specificity of 90%, positive predictive value of 88%, and negative predictive value of 90% for diagnosing the pneumonia. The study performed by Daniel A. Lichtenstein, et al.17 reviewed that among the 260 enrolled patients, 83 patients were diagnosed as pneumonia. This study has sensitivity of 89%, specificity of 94%, positive predictive value of 88%, and negative predictive of 95% for diagnosing the pneumonia. The study performed by AmericoTesta, et al. 32 reviewed that among the 34 enrolled patients, 32 patients were diagnosed as pneumonia. False negatives were found in two of 34 cases, and false positives, in five of 33 cases, this study has sensitivity of 94.1%, specificity of 84.8%, positive predictive value of 86.5%, and negative predictive value of 93.3% for diagnosing the pneumonia. The study performed by EE Unluer, et al. 33 reviewed that among the 112 enrolled patients, 34 patients were diagnosed as pneumonia. This study has sensitivity of 96.4%, specificity of 84.1%, positive predictive value of 79.4%, and negative predictive value of 97.4% for diagnosing the pneumonia. In the present study it was found that 63 patients were true positive, 7 patients were false positive, 2 patients were false negative, 74 patients were true negative, sensitivity was 96.92%, specificity was 91.36%, positive predictive value was 90.00%, and negative predictive value was 97.37% for pneumonia. Which closely resemble the above studies. Thus on analyzing, this study correlates well with the published data. Some variations observed could be due to difference in methodology of studies. In this study, 70 patients were diagnosed as pneumonia by POCUS examination, 7 of them were false positive in which 2 patients were put under the category of rare diagnosis by final diagnosis: (1) lung carcinoma with massive pleural effusion, (2) aneurysm of descending thoracic aorta with atelectasis of left lung, and 5 patients were put under the mixed diagnosis in which we found additional disease with pneumonia in final diagnosis. Out of these 5 mixed diagnosis patients, 2 of them were diagnosed as pneumonia with pulmonary embolism, 2 of them were diagnosed as pneumonia with COPD, and 1 of them was diagnosed as pneumonia with anaemic failure.

*For COPD/Asthma*

15 patients in this study were diagnosed as COPD/Asthma by POCUS examination and 15 patients were diagnosed as COPD/Asthma at final diagnosis after all investigations done by the regular protocol. Total 146 patients were enrolled for this study, 14 of them were true positive, 1 of them was false positive, 1 of them was false negative, and 130 of them were true negative for COPD/Asthma. This study has Sensitivity of 93.33%, Specificity of 99.24%, Positive predictive value of 93.33%, and Negative predictive of 99.24% for diagnosing the COPD/Asthma. The study performed by Daniel A. Lichtenstein, et al.17 reviewed that among the 260 enrolled patients, 83 patients were diagnosed as COPD/Asthma. This study has sensitivity of 89%, specificity of 97%, positive predictive value of 93%, and negative predictive of 95% for diagnosing the COPD/Asthma. The study performed by Felippe Leopoldo, et al.39 reviewed that among the 37 enrolled patients, 4 patients were diagnosed as COPD/Asthma. Lung ultrasound (LUS) diagnosis was compared with the final clinical diagnosis made by the ICU team before patients were discharged from the ICU (gold standard). This study has sensitivity of 67%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 94% for diagnosing the COPD/Asthma. In the present study it was found that 14 patients were true positive, 1 patient was false positive, 1 patient was false negative, 130 patients were true negative, sensitivity was 93.33%, specificity was 99.24%, positive predictive value was 93.33%, and negative predictive value was 99.24% for COPD/Asthma. Which closely resemble the above studies. Thus on analyzing, this study correlates well with the published data. Some variations observed could be due to difference in methodology and sample size of studies.

*For Pneumothorax*

4 patients in this study were diagnosed as pneumothorax by POCUS examination and 4 patients were diagnosed as pneumothorax by final diagnosis after all investigations done by the regular protocol. Total 146 patients were enrolled for this study, 4 of them were true positive, 0 of them were false positive, 0 of them were false negative, and 142 of them were true negative for pneumothorax. This study has Sensitivity of 100%, Specificity of 100%, Positive predictive value of 100%, and Negative predictive of 100% for diagnosing the pneumothorax. The study performed by Daniel A. Lichtenstein, et al.17 reviewed that among the 260 enrolled patients, 9 patients were diagnosed as pneumothorax. This study has sensitivity of 88%, specificity of 100%, positive predictive value of 100%, and negative predictive of 99% for diagnosing the pneumothorax. The study performed by Rania Refaat, et al.34 reviewed that among the 90 enrolled patients, 11 patients

were diagnosed as pneumothorax. This study has sensitivity of 92%, specificity of 100%, positive predictive value of 100%, and negative predictive of 99% for diagnosing the pneumothorax. In the present study it was found that 4 patients were true positive, 0 patient were false positive, 0 patients were false negative, 142 patients were true negative, sensitivity was 100%, specificity was 100%, positive predictive value was 100%, and negative predictive value was 100% for pneumothorax. Which closely resemble the above studies. Thus on analyzing, this study correlates well with the published data. Some variations observed could be due to difference in methodology and sample size of studies.

*For pulmonary embolism*

4 patients in this study were diagnosed as pulmonary embolism by POCUS examination and 4 patients were diagnosed as pulmonary embolism by final diagnosis after all investigations done by the regular protocol. Total 146 patients were enrolled for this study, 4 of them were true positive, 0 of them were false positive, 0 of them were false negative, and 142 of them were true negative for pulmonary embolism. This study has Sensitivity of 100%, Specificity of 100%, Positive predictive value of 100%, and Negative predictive of 100% for diagnosing the pulmonary embolism. The study performed by Daniel A. Lichtenstein, et al.17 reviewed that among the 260 enrolled patients, 21 patients were diagnosed as pulmonary embolism. This study has sensitivity of 81%, specificity of 99%, positive predictive value of 94%, and negative predictive of 98% for diagnosing the pulmonary embolism. In the present study it was found that 4 patients were true positive, 0 patient were false positive, 0 patients were false negative, 142 patients were true negative, sensitivity was 100%, specificity was 100%, positive predictive value was 100%, and negative predictive value was 100% for pulmonary embolism. Which closely resemble the above study. Thus on analyzing, this study correlates well with the published data. Some variations observed could be due to difference in methodology and sample size of studies.

*For cardiogenic pulmonary edema*

16 patients in this study were diagnosed as cardiogenic pulmonary edemaby POCUS examination and 19 patients were diagnosed as cardiogenic pulmonary edemaby final diagnosis after all investigations done by the regular protocol. Total 146 patients were enrolled for this study, 16 of them were true positive, 0 of them were false positive, 3 of them were false negative, and 127 of them were true negative for cardiogenic pulmonary edema. This study has Sensitivity of 84.21%, Specificity of 100%, Positive predictive value of 100%, and Negative predictive of 97.69% for diagnosing the cardiogenic pulmonary edema. The study performed by Daniel A. Lichtenstein, et al. 17 reviewed that among the 260 enrolled patients, 64 patients were diagnosed as cardiogenic pulmonary edema. This study has sensitivity of 97%, specificity of 95%, positive predictive value of 87%, and negative predictive of 99% for diagnosing the cardiogenic pulmonary edema. The study performed by Benoit Bataille, et al.37 reviewed that among the 260 enrolled patients, 64 patients were diagnosed cardiogenic pulmonary edema. This study has sensitivity of 94%, specificity of 94%, positive predictive value of 85%, and negative predictive of 98% for diagnosing the cardiogenic pulmonary edema. In the present study it was found that 16 patients were true positive, 0 patient were false positive, 3 patients were false negative, 127 patients were true negative, sensitivity was 84.21%, specificity was 100%, positive predictive value was 100%, and negative predictive value was 97.69% for cardiogenic pulmonary edema. Which closely resemble the above studies. Thus on analyzing, this study correlates well with the published data. Some variations observed could be due to difference in methodology and sample size of studies.

*For cardiac tamponade*

6 patients in this study were diagnosed as cardiac tamponade by POCUS examination and 6 patients were diagnosed as cardiac tamponade by final diagnosis after all investigations done by the regular protocol. Total 146 patients were enrolled for this study, 6 of them were true positive, 0 of them were false positive, 0 of them were false negative, and 140 of them were true negative for cardiac tamponade. This study has Sensitivity of 100%, Specificity of 100%, Positive predictive value of 100%, and Negative predictive of 100% for diagnosing the cardiac tamponade. The study performed by Sanjay Singh, et al. 42 reviewed that among the 16 enrolled patients, 12 patients were diagnosed as cardiac tamponade. This study has sensitivity of 92%, specificity of 100%, and predictive value of 100% for diagnosing the cardiac tamponade. In the present study it was found that 6 patients were true positive, 0 patient were false positive, 0 patients were false negative, 140 patients were true negative, sensitivity was 100%, specificity was 100%, positive predictive value was 100%, and negative predictive value was 100% for cardiac tamponade. Which closely resemble the above

study. Thus on analyzing, this study correlates well with the published data. Some variations observed could be due to difference in methodology and sample size of studies.

*For Subcutaneous emphysema*

2 patients in this study were diagnosed as subcutaneous emphysema by POCUS examination and 2 patients were diagnosed as subcutaneous emphysema by final diagnosis after all investigations done by the regular protocol. Total 146 patients were enrolled for this study, 2 of them were true positive, 0 of them were false positive, 0 of them were false negative, and 144 of them were true negative for subcutaneous emphysema. This study has Sensitivity of 100%, Specificity of 100%, Positive predictive value of 100%, and Negative predictive of 100% for diagnosing the subcutaneous emphysema. We couldn't find any analytical study for this condition. In our study we only found 2 cases of subcutaneous emphysema, for detailed elaboration about role of POCUS for subcutaneous emphysema larger sample size is needed.

*For mixed diagnosis*

20 patients in this study were diagnosed as mixed diagnosis by POCUS examination and 26 patients were diagnosed as mixed diagnosis by final diagnosis after all investigations done by the regular protocol. Total 146 patients were enrolled for this study, 20 of them were true positive, 0 of them were false positive, 6 of them were false negative, and 120 of them were true negative for mixed diagnosis. This study has Sensitivity of 76.92%, Specificity of 100%, Positive predictive value of 100%, and Negative predictive of 95.24% for diagnosing the mixed diagnosis. We couldn't find any analytical study for this condition. 20 patients which were true positive, there were 8 patients of pneumonia with cardiogenic pulmonary edema, 5 patients of pneumonia with COPD, 4 patients of pneumonia with pneumothorax, 1 patient of COPD with cardiogenic pulmonary edema, 1 patient of cardiac tamponade with pneumonia and 1 patient of pneumothorax with pneumonia and lung abscess. 6 patients which were false negative, there were 2 patients of pneumonia with pulmonary embolism, 2 patients of pneumonia with COPD, 1 patient of COPD with diabetic ketoacidosis and 1 patient of pneumonia with anemic failure. POCUS examination was normal in 4 patients. Out of these, 2 patients were of psychiatric illness, 1 patient was of gastritis, and 1 patient was of COPD.

POCUS examination was inconclusive in 5 patients. Out of these, 3 patients of valvular heart disease with cardiogenic pulmonary edema, 1 patient with pneumonia and 1 patient with COPD with diabetic ketoacidosis.

Of the 2 rare causes of dyspnea, one patient with aneurysm of descending aorta with compressive atelectasis of left lung, there was only static air-bronchogram without any other findings in POCUS examination hence was wrongly diagnosed as pneumonia, and second patient of lung carcinoma with massive pleural effusion, there was pleural effusion with underlying consolidation in POCUS examination hence was wrongly diagnosed as pneumonia.

The limitation of this study was interpretation and performance point of care ultrasound is operator dependent. The sample size in our study was small. So we need to perform this study on a larger scale for relevant numbers. The person performing the POCUS examination was not blinded about clinical findings of patient hence a bias towards the diagnosis could not be eliminated.

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