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A prospective cohort study on the role of an abbreviated ultrasonography in the diagnosis of acute dyspnea at first point of contact in a tertiary care centre.

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ABSTRACT

Introduction: Point of care ultrasonography (PoCUS) is a revolutionary tool, aimed at improving patient outcomes in the acutely sick patient. Acute severe dyspnea is a frequently encountered complaint in the emergency department that requires quick assessment and intervention. We aimed to [5] compare the accuracy of diagnosis established by the physician before and after an abbreviated triple Scan ultrasonography at first point of contact with the final diagnosis.

Methods: In this prospective observational study at a tertiary care centre,100 consecutive patients presenting with acute dyspnea and without any previously recognized condition known to cause dyspnea or recent trauma were recruited and subjected to standard evaluation and care, underwent [10] triplescan (TS) an algorithm based diagnostic evaluation for dyspnea, which includes lung, heart and Inferiorvenacava ultrasonography, Cohens Kappa Coefficient was used to estimate concordance with final diagnosis.

Results: The mean age of the study population was 51.58±18.21years. Acute heart failure was the most common diagnosis (25%, n=25/100) encountered in this study population. TS had higher [15] concordance(k=0.9525) with final diagnosis than with emergency physician's diagnosis(k=0.3776) at First point of contact. The concordance was higher for TS in all conditions except pneumothorax where both were equal. The diagnostic value of clinical diagnosis improved with use of TS.

Conclusion: TS improved the accuracy of diagnosis compared to clinical evaluation alone and thus serves as a highly efficient form of extended clinical examination in the emergency setting.

Keywords: dyspnea; emergency medicine; ultrasound

INTRODUCTION

Acute dyspnea is the most common presenting symptom in the emergency department (ED). Emergency physicians (EPs) need to rapidly and accurately formulate a diagnosis to make an early and appropriate therapeutic intervention, especially in critically ill patients, in whom a rapid stabilization is crucial to reduce morbidity and mortality.[5]

Dyspnea is the main symptom of many diseases, and rapidly discriminating the underlying pathological condition is often difficult for the EP. An appropriate medical history and a thorough physical examination can direct the diagnostic suspicion, but they need to be integrated with laboratory and radiological tests for accurate diagnosis which is time consuming leading to diagnostic delays [1-3].

Chest radiography(CXR) and Chest computed tomography(CCT) form the basis of initial evaluation of dyspneic patients, where the latter is considered the gold standard for differential diagnosis of dyspnea[4,]however they expensive and not feasible in unstable patients. Chest radiograph and its interpretation in the acutely ill patient, on the other hand has considerable inter-reader variation and often leads to missed/misinterpreted diagnosis[5,6].Moreover,results of advanced diagnostic imaging (computed tomography, consultative echocardiography) and blood tests are often not available during

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The critical initial minutes of care. Thus, the emergency physicians (EP) are often forced to initiate treatment before the aetiology of dyspnea can be clearly defined.

Point-of-care ultrasonography(PoCUS) is emerging as a powerful tool for rapid diagnostic evaluation of Patients presenting with undifferentiated dyspnea in the ED. They provide anatomical and functional data on the clinical condition of a dyspneic patient,thereby enabling accurate diagnosis and treatment[7-9]

PoCUS is defined as a goal-directed, bedside ultrasound examination performed by a healthcare provider to answer a specific diagnostic question or to guide performance of an invasive procedure. Its utility in the form of lung ultrasonography and echocardiography in the differential diagnosis of acute dyspnea due to cardiac and respiratory failure have been described in various studies[10-13]

In addition, assessment of the the Inferior Vena Cava (IVC) diameter and its variations during respiratory activity allow an indirect estimation of right atrial pressure and an assessment of volume status, giving useful information to guide fluid therapy[14,15].

On this basis integration of lung, heart and IVC ultrasonography(US) by PoCUS could lead to a rapid diagnosis and therefore to a targeted and early treatment of patients with acute dyspnea in ED. We have developed and refined a rapid multi-organ exam, dubbed ―triple scan (TS), composed of abbreviated echocardiography, lung ultrasound (US) and IVC examination, which can easily be performed by EPs at the bedside of an acutely dyspneic patient. We thus aimed to compare the accuracy of the treating EP's diagnostic impression before and after the Triple scan with the final diagnosis.Our secondary objective was to evaluate the diagnostic accuracy of Triple Scan for each differential, in acutely dyspneic patients presenting to the ED.

METHODOLOGY

Study Design: prospective observational study.

Study duration: The present study was conducted for a period of 18months from November 2016- May 2018.

Study setting: The study was conducted In the Department of Emergency Medicine at a tertiary care hospital in South India

Source of Data: Adult patients coming to the Emergency Department with acute dyspnea were

Included in the study.

Inclusion criteria:

- Age>18 years
- Chief complaint of acute dyspnea
- Respiratory rate>20breaths per minute
- Pulseoximetry<94%at roomair

Exclusion criteria:

- Respiratory distress associated with trauma
- When patients were clearly able to tell the treating physician what was causing their dyspnea

(recurrent asthma, known heart failure etc.)

Method of collection of data:

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One hundred consecutive patients, satisfying study criteria were included in the study. Their demographic data and baseline clinical history including presenting symptoms,vitals,other clinical findings and provisional clinical diagnosis were recorded on a pre-structured proforma. All of the

patients were subjected toTriple Scan ultrasonography as per the following algorithm. Figure/Table1

Parameters Assessed:

- Echocardiography:A standard parasternal longaxis view and additional parasternal short, subxiphoid, and/or apical four chamber views as needed were performed, to assess-

a) Gross ventricular ejection fraction,categorized as either normal,poor, or hyperdynamic;

b) Presence or absence of pericardial effusion;

c) Presence or absence of right ventricular enlargement(estimated right ventricular chamber size equal or greater than left ventricular chamber size).

- Lung ultrasound:Using bilateral lung windows(representing four lung zones), lateral chest and anterior lung fields, to assess-

a. Presence of A lines or B lines and their predominance,

b. Presence or absence of pleural effusions

c. Presence or absence of pleural sliding on 2D and M-mode

- Inferior venacava: A subxiphoid or right lateral view of the IVC approximately 2 cm proximal to hepatic vein confluence, to assess

a) IVC collapse during inspiration , the IVC was thus categorized using gross visual estimation, as-

i. Plethoric(lessthan15%collapse),

ii. Flat(>90%collapse)or

iii. Normal(15%-90%collapse),

- The diagnostic impression thus arrived was categorized as follows

1. Heart Failure,

2. COPD/asthma,

3. Pneumonia,

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4. Acute respiratory distress syndrome(ARDS),
5. Pleural effusion,
6. Pericardial effusion,
7. Pneumothorax,
8. Pulmonary embolism.
9. Others[diagnosis other than the eight above].

- The patients were subjected to investigations as per standard of care practiced at the institution.

The final diagnosis thus obtained were recorded from review of medical records performed by

Physicians blinded to the results of Triple Scan.

- All data were recorded on a pre-structured proforma.

- Institutional ethical committee approval was obtained for the study and written and informed consent was obtained from all participants of the study.

Statistical analysis:

Data thus recorded was extrapolated on to Microsoft excel data sheet and statistical analysis was

performed using Statistical analysis was done using SPSS software version 22 (IBMSPSS Statistics,

Somers NY,USA).Categorical data was represented in the form of Frequencies and proportions.Chi- square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation.Agraphical presentation of data was undertaken for salient features.Ap value of less than 0.05 was considered to be significant. Cohens kappa coefficient was utilised to

compare the concordance of diagnosis obtained by emergency physician before and after TS with the

Final diagnosis.

Sample size estimation:

Based on a similar study by Daniel Mantuanietal[16],where the sensitivity of triple scan was 64.7% in the diagnosis of COPD/Asthma compared to final diagnosis, the minimum number of subjects estimated was 88 at 95% Confidence level with absolute precision of 5, further considering an on- Response rate of 10%,a minimum of(88+8.8=96.8≈100)100 participants were considered for the study.

RESULTS

During the study period, 100 consecutive patients who presented to the emergency department, satisfying study criteria were included for the study. Males formed the majority [60%] in the study population while females accounted for the remaining 40%.The mean age of the study population was

51.58±18.21years. Those aged 51 to 60 years formed the majority(n=24/100,24%).The baseline

characteristics of the study population is depicted in Figure/ Table 2 and the results of blood workup performed are outlined in Figure / Table 3. The clinical diagnosis established by the physician at first point of contact, the diagnosis after TS and the final diagnosis obtained after complete evaluation is described in Figure/Table4.The sonographic findings observed on triple scan are tabulated in Figure/

Table 5.

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Primary objective: TS had higher concordance(k=0.9525)with final diagnosis than with emergency physician's diagnosis (k=0.3776) at first point of contact.

Secondary objective: TS had higher concordance than EPs diagnosis with final diagnosis among all the differential diagnoses encountered in this study for acute dyspnea,the same is outlined elaborately in Figure/Table6.

DISCUSSION

This prospective cohort study assessed the diagnostic performance of Triple Scan ultrasonography in evaluating patients presenting with acute undifferentiated dyspnea as the primary complaint to the Emergency Department. 100 consecutive patients were enrolled, the most common cause of acute dyspnea in this cohort was HF(25%),followed by COPD/asthma(19%)and pneumonia(16%).The Overall diagnostic accuracy of the emergency physician's impression improvedwithTS,from71%to 98% in HF, 83 to 99% in COPD/ asthma and 80 to 97% in case of pneumonia.

The sensitivity and specificity of TS in identifying HFwas 96%,and 98.67%,respectively. In a Similar study by Kajimotoetal[17] the sensitivity and specificity of PoCUS in diagnosing HF was found to be 94% and 91% ,like wise Russelletal[18]in their study reported a sensitivity and specificity of 83% And 83% respectively.The diagnosis of heart failure was established with high sensitivity in similar studies, compared that of EPs initial clinical impression, in addition, TS also had a high negative Predictive value,98.67% in our study.On this pretext, it can be considered with high reliability,that the absence of an USG pattern of diffuse interstitial syndrome and reduced ejection fraction would rule out HF as the main cause of dyspnea.

COPD/asthma accounted for the cause of dyspnea in 19% of cases in our study,TS exhibited a sensitivity of 100% and specificity of 98.77%, essentially being a diagnosis of exclusion,it was comparable to that of EPs diagnosis. Other studies exhibited sensitivities of 88.5% and 82.8% and specificities of 91.6% and 95.5% [19,20],the lower sensitivity is likely due to the presence of co-existing etiologies for dyspnea.

Pirrozietal[19] in their study we found that COPD/asthma and pneumonia were roughly as common as HF in acutely dyspneic patients, and that TS improved the treating physician's accuracy of diagnosis, Similar to that in our study for the same conditions.

The high diagnostic accuracy for pneumonia(sensitivity-93.75%,specificity-97.62%)as compared to final diagnosis, is rather compelling, to consider USG as a standalone tool, to spare the patient of exposure to radiation encountered in routine chest radiographs and computed tomographies. The findings of our study suggest that TS can point clinicians towards a correct diagnosis of pneumonia

Early in the evaluation of the dyspneic patient, when it might otherwise be missed because the patient is initially afebrile, or wheezing, or assumed to have ADHF, or when the portable chest radiograph lacks an obvious infiltrate.

The positive predictive value of TS was highest for pulmonary embolism, anaphylactic shock and pericardial effusion compared to other diagnosis in our study.

In similar studies by Guttikondaetal[20]and Zanobettietal[21],where a USG based diagnostic strategy for acute dyspnea was utilised, there was high concordance with final diagnosis in both studies, k=0.805 and 0.71 respectively. Heart failure being the most common etiology diagnosed in both studies, these findings are similar to that obtained in our study. It is important to note that the improvementing diagnostic accuracy observed in our study was achieved Using a highly abbreviated TS exam that was performed with in minutes of arrival of the patient to the ED.Not only is such an abbreviated protocol feasible during initial resuscitation of the sickest dyspneic patients, but it is likely to be more generalizable to non-expert sonographers.

The limitations of our study, includes its relatively low sample size, data on patient's final clinical out come was not available for all cases,no control group was employed to compare utility of TS in patient management.

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CONCLUSION

Triple scan in the acutely dyspneic patient would serve as a useful and time saving tool in ensuring accurate diagnosis, precise treatment and thereby improved patient outcomes. It can efficiently differentiate cardiac dyspnea from non-cardiac. TS significantly improved accuracy of diagnosis compared to clinical evaluation alone and thus serves as a highly efficient form of extended clinical Examination in the emergency setting.

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Conflicts of interest
No conflicts of interest

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References

1. MulrowCD, LuceyCR,FarnettLE. Discriminating causes of dyspnea through clinical examination. J Gen Intern Med. 1993;8(7):383-92.
2. Schmitt BP, Kushner MS, Wiener SL. The diagnostic usefulness of the history of the patient with dyspnea. J Gen Intern Med. 1986;1(6):386-93.
3. NielsenLS,SvanegaardJ,WiggersP,EgebladH.The yield of a diagnostic hospital dyspnoea Clinic for the primary health care section. J Intern Med. 2001;250(5):422-8.
4. Ivatury RR, Sugerman HJ. Chest radiograph or computed tomography in the intensive care unit? Crit Care Med. 2000;28(4):1234-5.
5. GreenbaumDM, MarschallKE.The value of routine daily chest x-rays in intubated patients in the medical intensive care unit. Crit Care Med. 1982;10(1):29-30.
6. LichtensteinD,GoldsteinI,MourgeonE,CluzelP,GrenierP,RoubyJ-J.Comparative diagnostic performances of auscultation, chest radiography, and lung ultrasonography in acute respiratory distress syndrome. Anesthesiology. 2004; 100:915.
7. JehleD,DavisE,EvansT,HarchelroadF,MartinM,ZaiserK,etal.
8. Emergency department sonography by emergency physicians. Am J Emerg Med. 1989;7(6):605- 11.
9. Plummer D. WhoseTurf isit, anyway? Diagnostic ultrasonography in the emergency department. Acad Emerg Med. 2000;7(2):186-7.
10. LichtensteinD,AxlerO.Intensive use of general ultrasound in the intensive care unit. Prospective study of 150 consecutive patients. Intensive Care Med. 1993;19(6):353-5.
11. ReissigA,Copetti R,Mathis G,MempelC, Schuler A, ZechnerP,et al.Lungultrasoundin the diagnosis and follow-up of community-acquired pneumonia: a prospective, multicenter, diagnostic accuracy study. Chest. 2012;142(4):965-72.
12. ZanobettiM,PoggioniC,PiniR. Can chest ultrasonography replace standard chest radiography for evaluation of acute dyspnea in the ED? Chest. 2011;139(5):1140-7.
13. Mueller X, Stauffer JC, Jaussi A, Goy JJ, Kappenberger L. Subjective visual echocardiographic estimate of left ventricular ejection fraction asan alternative to conventional echocardiographic methods: comparison with contrast angiography. Clin Cardiol. 1991;14(11):898-902.
14. Nazerian P, Vanni S, Zanobetti M, Polidori G, Pepe G, Federico R, et al Diagnostic accuracy of emergency Doppler echocardiographyfor identification of acute left ventricular heart failure in patients with acute dyspnea: comparison with Boston criteria and N-terminal prohormone brain natriuretic peptide. Acad Emerg Med. 2010;17(1):18-26.

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1. Stawicki SP, Braslow BM, Panebianco NL, Kirkpatrick JK, Gracias VH,Hayden GE, et al. Intensivist use of hand-carried ultrasonography to measure IVC collapsibility in estimating intravascular volume status: correlations with CVP. J Am Coll Surg. 2009;209(1):55-61.

2. FeisselM,MichardF,FallerJP,TeboulJL.The respiratory variation in inferior venacava diameter as a guide to fluid therapy. Intensive Care Med. 2004;30(9):1834-7.

3. Mantuani D, Frazee BW, FahimiJ, NagdevA. Point-of-Care Multi-Organ Ultrasound Improves Diagnostic Accuracy in Adults Presenting to the Emergency Department with Acute Dyspnea.Western Journal of Emergency Medicine. 2016;17(1):46-53.

4. KajimotoK,MadeenK,NakayamaT,TsudoH,Kuroda1TandAbeT Cardio vascular Ultrasound 2012;10:49.

5. RussellFM,EhrmanRR,Cosby K,AnsariA,Tseeng S,ChristainE, etal. Diagnosingacute heart failure in patients with undifferentiated dyspnea: a lung and cardiac ultrasound (LuCUS) protocol. Acad Emerg Med. 2015; 22:182–91.

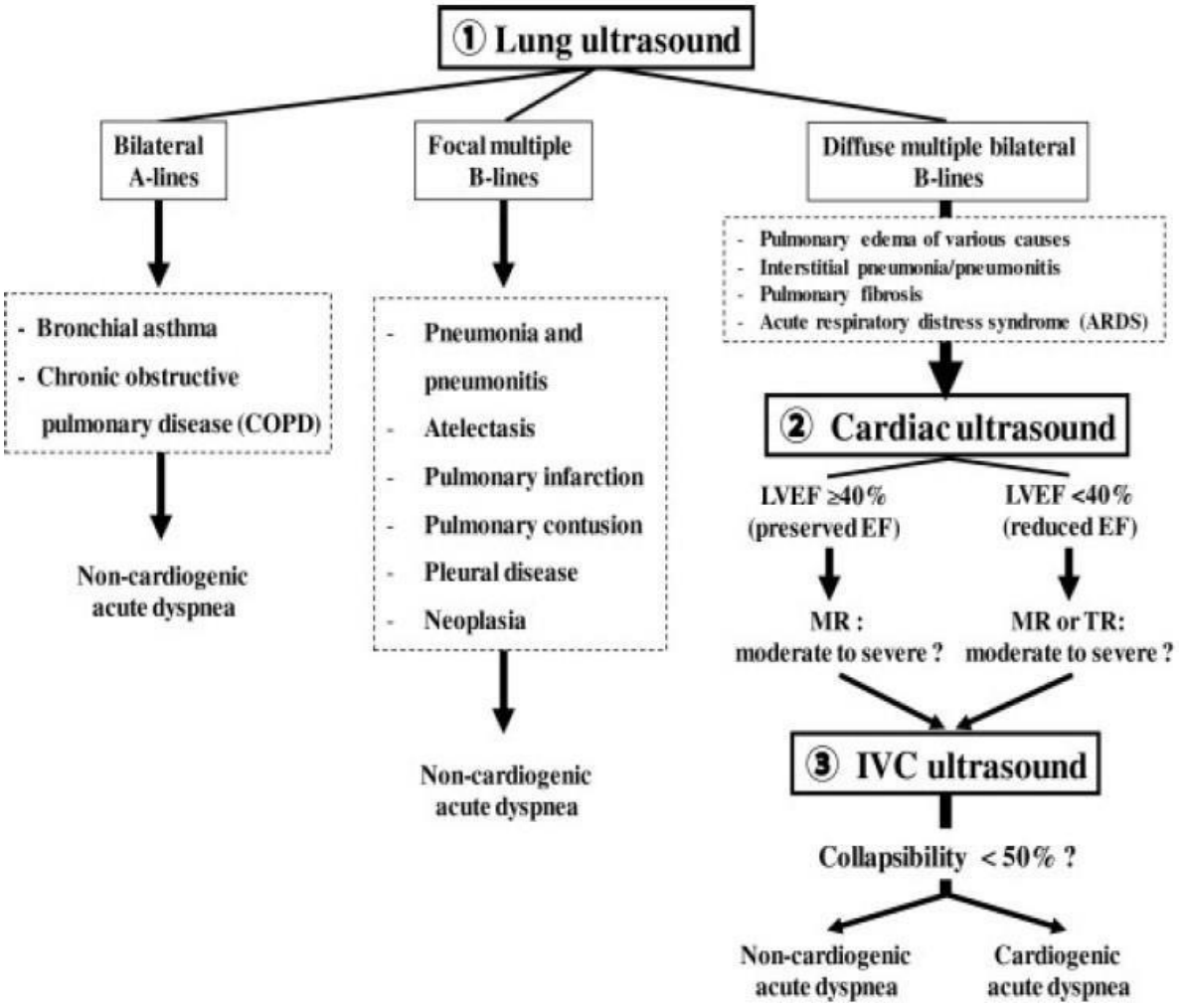
6. PirozziC,NumisFG,PaganoA,MelilloP,CopettiRandSchiraldiF.GCriticalUltrasoundJournal 2014;6:

7. GuttikondaSNR,&VadapalliK.Approachtoundifferentiateddyspneainemergencydepartment: aids in rapid clinical decision-making. International Journal of Emergency Medicine 2018;11(1).

8. Zanobetti M, Scorpiniti M, Gigli C, Nazerian P, Vanni S, Innocenti F, et al. Point-of care ultrasonography for evaluation of acute dyspnea in the emergency department, CHEST 2017.

Figure/Tablelegends

Figure/Table1-TripleScan Algorithm



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Figure/Table2Baselinepatient characteristics

Variable		
Age Category	**Frequency**	
30 years	18.0% (n=18)	
31to40years	14.0%(n=14)	
41to50years	11.0%(n=11)	
51to60years	24.0%(n=24)	
61to70years	18.0%(n=18)	
71to80years	13.0%(n=13)	
>80 years	2.0%(n=2)	
Gender	**Frequency**	
Males	60%	
Females	40%	
Symptoms	**Frequency**	
Breathlessness	100.0%	
Chestpain	38.0%	
Orthopnea	27.0%	
Cough	86.0%	
Wheeze	50.0%	
Vitalparameters	**Mean±SD**	
PR(bpm)	108.87±13.38	
SBP(mmHg)	129.30±31.00	
DBP(mmHg)	75.24±17.47	
RR (cpm)	29.63±4.11	
SpO2(%)	86.30±5.69	
BreathSounds	**Present**	**Absent**
Rightside	93%	7%
Leftside	97%	3%
Breathsounds-added sounds	**Right**	**Left**
Noaddedsounds	14.0%	18.0%
Crepitation's	35.0%	33.0%
Rhonchi	22.0%	22.0%
Rhonchi+ Crepitation's	25.0%	23.0%
Crepitation's+Rhonchi	4.0%	4.0%
Cardiac Auscultation	**Frequency**	
Normal	81%	
Abnormal	9%	

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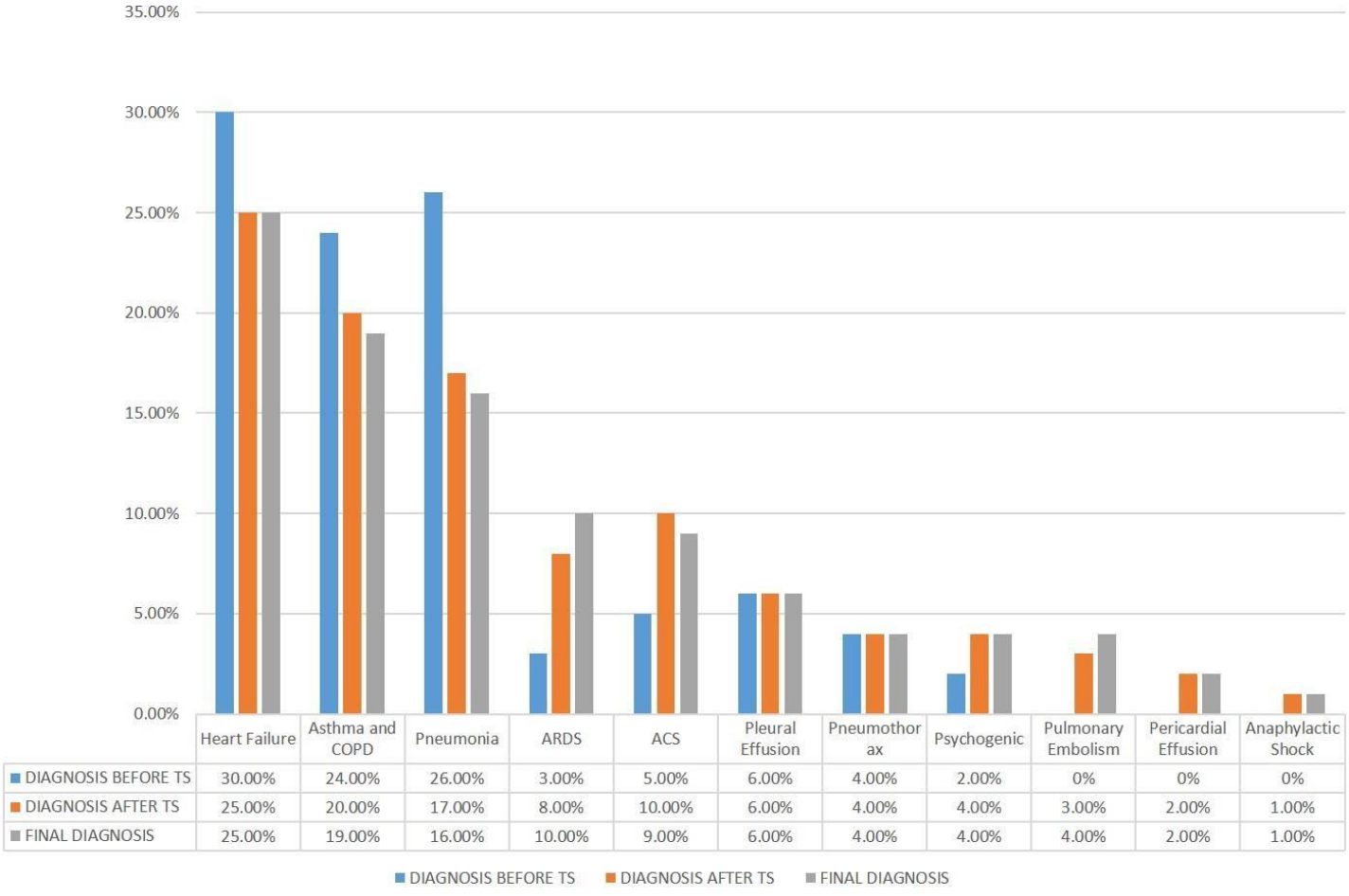
Figure/Table3BaselineinvestigationsperformedattheED

Investigations	Mean±SD
Haemoglobin	12.05±2.35
TotalleucocyteCount Platelet	14208.37±6354.69
Urea Creatinine CK MB	2.25±0.96
Troponin-I BNP	44.26±21.63
DDimer	1.27±0.55
	22.25±20.69
	1.88±4.14
	1165.89±1053.47
	1638.80±1067.21

CK-MB-CreatineKinase-MB; BNP-BrainNatriureticPeptide;

Figure/Table4-Comparisonof diagnosismadeatdifferentpointsinthetimeline



	Heart Failure	Asthma and COPD	Pneumonia	ARDS	ACS	Pleural Effusion	Pneumothorax	Psychogenic	Pulmonary Embolism	Pericardial Effusion	Anaphylactic Shock
DIAGNOSIS BEFORE TS	30.00%	24.00%	26.00%	3.00%	5.00%	6.00%	4.00%	2.00%	0%	0%	0%
DIAGNOSIS AFTER TS	25.00%	20.00%	17.00%	8.00%	10.00%	6.00%	4.00%	4.00%	3.00%	2.00%	1.00%
FINAL DIAGNOSIS	25.00%	19.00%	16.00%	10.00%	9.00%	6.00%	4.00%	4.00%	4.00%	2.00%	1.00%

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Figure/Table5FrequencyoffindingsobservedonTripleScan

FindingonTripleScan	**Frequency**
HyperdynamicLVFunction	47.0%
DecreasedLVSFunction	37.0%
PericardialEffusion	2.0%
ALINES B/L*	20.0%
BLINESB/L	37.0%
BLINES U/L[#]	12.0%
LACKOFPLEURALSLIDING	4.0%
PLETHORICIVC	36.0%
FLATIVC	15.0%

*B/L-Bilateral;[#]U/L-Unilateral;[$]IVC-InferiorVenaCava

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Figure/Table6ComparisonoftheConcordancebetweenclinicaldiagnosisanddiagnosisafter PoCUS

FINAL DIAGNOSIS	ED DIAGNOSIS				POCUS DIAGNOSIS			
	Sensitivity	Specificity	Accuracy	Cohens Kappa	Sensitivity	Specificity	Accuracy	Cohens Kappa
ACS*	22.22%	96.7%	90%	0.2366(0.05-0.4233)	100%	98.9%	99%	0.9419(0.7462-1.138)
ARDS#	30%	100%	93%	0.4355(0.2737-0.5973)	80%	100%	98%	0.878(0.6835-1.073)
Asthmaand COPD$	68.42%	86.42%	83%	0.4982(0.3044-0.6921)	100%	98.77%	99%	0.9682(0.7723-1.164)
Pneumonia	68.75%	82.14%	80%	0.4062(0.219-0.5933)	93.75%	97.62%	97%	0.8911(0.6953-1.087)
HeartFailure	52%	77.33%	71%	0.275(0.08054-0.4695)	96%	98.67%	98%	0.9467(0.7507-1.143)
Pleural Effusion	66.67%	97.87%	96%	0.6454(0.4494-0.8414)	100%	100%	100%	1 (0.804-1.196)
Pneumothorax	100%	100%	100%	1(0.804-1.196)	100%	100%	100%	1 (0.804-1.196)
Psychogenic	50%	100%	98%	0.6575(0.4734-0.8417)	100%	100%	100%	1 (0.804-1.196)
Pulmonary Embolism	0.0%	100%	96%	0.0	75%	100%	99%	0.8521(0.6582-1.046)
Pericardial Effusion	0.0%	100%	98%	0.0	100%	100%	100%	1 (0.804-1.196)
Anaphylactic Shock	0.0%	100%	99%	0.0	100%	100%	100%	1 (0.804-1.196)
Overall				0.3776				0.9525

*ACS-Acute CoronarySyndrome;#Acute RespiratoryDistress Syndrome;$COPD-ChronicObstructivePulmonaryDisease