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Original Research Article

Evaluation of lung ultrasound with clinical congestion score in diagnosis and clinical outcome of patients with acute left ventricular failure prospective study

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ABSTRACT

Background: Congestive cardiac failure (CCF) is often a worldwide phenomenon and usually affects millions of people years and is accompanied with high mortality. The present study is undertaken to evaluate the usefulness of Lung Ultrasound Scan in diagnosis and to identify its role as a marker of clinical outcome in patients with Acute LVF.
Methods: A prospective analytical study was undertaken among the patients diagnosed as acute left ventricular failure who were admitted in tertiary care hospital. About 45 patients were enrolled by convenient sampling. The severity of acute LVF will be assessed using Clinical Congestion Score (CCS) and Lung Ultrasound Scan (LUS) based degree of congestion within 6 hours of admission, day 01 of admission and 24 hours before discharge.
Results: The mean clinical congestion score was 5.36 at the time of admission. The Kerley B line at the time of admission was 15.93. The mean Kerley B line was 20.41 in the patients with clinical congestion score of more than 3.The mean Kerley B score after 24 hours of discharge was 19.69 and 5.69 during discharge among the patients with severe LV dysfunction. The mean Kerley B line score was higher at the time of admission which was statistically significant at the time of admission and within 24 hours after admission in patients with readmission.
Conclusions: The mean clinical congestion scores and Kerley B lines were higher during the admission which rapidly decreased before discharge. There was a positive correlation between the Clinical congestion scores and Kerley B lines.

Keywords: Acute heart failure, Clinical Congestion score, Hospital stay, Lung ultrasound, Kerley B. lines

INTRODUCTION

Congestive cardiac failure (CCF) is often a worldwide phenomenon and usually affects millions of people years and is accompanied with high mortality.[1] The heart failure is a burgeoning problem across the world with more than 20 million of the people usually affected. The overall prevalence of the heart failure in adult population in developed countries is 2%.[2] The causes and demographic pattern of the patients suffering with the heart failure varies from one geographic region to another. Hypertension, rheumatic heart disease (RHD) and idiopathic cardiomyopathies are the main causes of heart failure especially in younger age group patients when compared with the developed countries.[3,4]

Clinical diagnosis of heart failure is the mainstay as there is no definitive diagnostic test available for heart failure and is mainly based on careful history and physical examination and supported by ancillary test including chest radiograph, electrocardiogram and echo cardiography.[5] Traditionally, the clinical assessment in assessing the pulmonary congestion in admitted patients lacks sensitivity and specificity.[6] The gold standard for

determining cardiac congestion is by assessing the right and left atrial pressures by measuring pulmonary capillary wedge pressure through cardiac catherization. However, this test is invasive, expensive, time consuming, and carry risk and are not typically performed in patients admitted with acute LVF.[7,8]

Although advances have been in the management of heart failure patients yet the post discharge mortality and readmission rates have continued to be high. A predictor for frequent hospitalization and high mortality among patients with heart failure is due to accumulation of fluid in the lung's alveolar and interstitial space. Early diagnosis of congestion in pulmonary vasculature may prevent re-hospitalization.[9] The present study is undertaken to evaluate the usefulness of Lung Ultrasound Scan in diagnosis and to identify its role as a marker of clinical outcome in patients with Acute LVF.

METHODS

A prospective analytical study was undertaken among the patients with acute onset breathlessness diagnosed as acute left ventricular failure, clinically and confirmed by 2D-Echocardiography, who were admitted in Medical Intensive Care Unit / Critical Care Medicine at a tertiary care hospital in Pondicherry were considered as study participants. Clearance from institutional ethics committee was obtained before including the patients in to the study. A bilingual, written, informed consent was obtained from all the patients. Duration of the study was for 18 months, which includes a follow of 3months for each patient. The sample size was calculated considering the prevalence of Heart failure to be 1% in Indian population as per the study done by Seth et al and sample size was calculated as 45.

Inclusion criteria

- Patients of both the sexes with Echocardiography documented Left ventricular systolic dysfunction and or diastolic dysfunction.
- Age group of 18-60 years.

Exclusion criteria

- Right Ventricular Failure
- Renal insufficiency
- Patients who are unable to undergo LUS within first 6 hours of admission
- Those with other causes of breathlessness like pneumonia, pulmonary embolism, pneumothorax and pleural effusion.

The study participants were enrolled till the desired sample size is achieved.

Patients diagnosed to have Acute LVF, after obtaining a written consent were enrolled in the study. The severity of acute LVF was assessed using Clinical Congestion Score (CCS) and Lung Ultrasound Scan (LUS) based degree of congestion within 6 hours of admission, day 01 of admission and 24 hours before admission. All the patients underwent standard treatment as per AHA/ACC guidelines. In addition to LUS patients were subjected to routine investigations, Chest X ray, cardiac markers as and when required.

A repeat Echocardiography was done if the patient develops cardiogenic shock, to rule out mechanical complications. Parameters like duration of hospital stay, hospital readmission and mortality over 90 days were studied in all patients as a marker of clinical outcome by comparing CCS with LUS. Details pertaining to personal details of the study participants were kept confidential.

The data entry was made in Microsoft Excel sheet and the results were analyzed using Statistical Package for Social Services (SPSS version 20).

The categorical variables were analysed by using Frequencies and percentages. The Quantitative variables were presented as measures of central tendency and dispersion. Chi square test was used as test of significance for categorical variables. A p value of less than 0.05 was considered as statistically significant.

RESULTS

The mean Kerley B lines was higher among the patients was higher in the patients who were admitted for more than 10 days during at the time of admission, within 24 hours after admission and 24 hours before discharge as described in table 1.

Table1: Distribution of the study group according to duration of hospital stay and kerley B line.

Duration of hospital stay	Kerly B line		
	At admission	Within 24 hours after admission	24 hours before discharge
1-3 days	8.5±4.9	5.5±6.36	2.0±1.41
4-6 days	10.82±6.39	7.54±4.34	1.72±2.1
7-10 days	18.08±14.85	14.33±14.04	3.0±4.72
More than 10 days	27.22±15.11	21.67±12.83	4.67±5.02
F value	5.992	4.972	1.452
p value, Sig	0.005, Sig	0.005, Sig	0.242, NS

The mean Kerley B lines was higher in patients with 2 times admission at the time admission, within 24 hours after admission and 24 hours before discharge which was statistically significant as described in table 2. The pearson correlation coefficient between the CCS scores

and Kerley B line score was 0.921 which was statistically significant as described in table 3.

This indicates that, there is positive and significant correlation between clinical congestion score and Kerley B line score at the time of admission.

Table 2: Distribution of the study group according to no of readmissions and kerley B lines.

No of Readmissions	Kerly B line		
	At admission	Within 24 hours after admission	24 hours before discharge
1	5.0	1.0	1.0
2	36.0±15.05	31.0±15.79	7.25±6.18
Nil	14.2±10.73	10.47±8.69	2.25±3.17
F value	7.51	9.429	3.889
p value, Sig	0.002, Sig	0.005, Sig	0.028, Sig

DISCUSSION

Congestive cardiac failure (CCF) is often a worldwide phenomenon and affects millions of people. The congestive cardiac failure is often a complex syndrome characterized by the shortness of breath, fatigue, congestion and cachexia and symptoms related to inadequate tissue perfusion, fluid retention and neurohormonal activation. CHF remains as a serious problem even after improvement in the therapy.[1] Heart failure usually affects more than 20 million of the people and overall prevalence in developed countries is 2%. The prevalence of heart failure follows an exponential pattern, rising with age and affecting 6-10% of the people over the age of 65 years.[2] Clinical diagnosis of heart failure is the mainstay as there is no definitive diagnostic test available for heart failure and is mainly based on careful history and physical examination and supported by ancillary test including chest radiograph, electrocardiogram and echo cardiography.[5]

Table 3: Correlation between CCS and kerley B lines at the time of admission.

Correlations			
		CCS on the day of time of admission	LUS SCORE at the time of admission (within 6 hours)
CCS on the day of time of admission	Pearson Correlation	1	0.921**
	Sig. (2-tailed)		0.000
	N	45	45
LUS SCORE at the time of admission (within 6 hours)	Pearson Correlation	0.921**	1
	Sig. (2-tailed)	0.000	
	N	45	45
**. Correlation is significant at the 0.01 level (2-tailed)			

**. Correlation is significant at the 0.01 level (2-tailed).

The evidence available shows that, ultrasound of the thorax may show extra vascular lung water present in patients with CHF. Artefacts known as "Lung Rockets," or "B-lines," which represent interstitial fluid seen on the periphery of the pleura have been associated with CHF.[9] Lung ultrasonography has emerged as a rapid, non-invasive, bedside tool for the diagnosis and risk assessment of pulmonary congestion in Acute LVF.[10] The present study is undertaken to evaluate the usefulness of Lung Ultrasound Scan in diagnosis and to identify its role as a marker of clinical outcome in patients with Acute LVF.

Age group

The mean age of the study subjects in this study was 57.8 years. More than half of the study subjects belonged to 61-65 years age group. In a study by Miglioranza et al, the mean age of all the patients was 53 years which is lesser than this study, The patients with B lines of more than 15 were aged 55 years and less than 15 were aged 50 years.[11] In a study by Coiro et al, the mean age of the patients was 72.1 years, 71.23 years in patients with no primary outcome and 74.33% in patients with primary outcome.[12] In a study by Prosen et al, the mean age of acute HF related dyspnea was 70.9 years.[13] In a study by Platz et al, the mean age of the patients with more than or equal to 3 B lines was 73 years.[14]

Sex

Males outnumbered females in this study. In a study by Miglioranza et al, about 61% of all the patients with heart failure were males.[11] In a study, Coiro et al also observed similar results.[12] In a study by Prosen et al, about 73% of the patients with acute HF related dyspnea were males.[13] In a study by Platz et al, about 71% of the patients were males.[14]

BMI

About 44.4% of the study subjects had normal BMI in this study and only 37.8% of the study subjects had

overweight. Miglioranza et al noted that, the BMI was 28.[11]

Aetiology

Majority of the study subjects in this study had CAD followed hypertensive disorders as aetiology. A study by Miglioranza et al reported that, Dilated cardiomyopathy was reported in 54% of the patients followed by post ischemic heart failure was reported in 27% of the cases, hypertension in 10% of the cases, myocarditis in 4% of the cases, toxicity in 3% and arrhythmia in 1% of the cases.[11] In a study by Coiro et al, the ischemic etiology was found in 31.6% of the cases and volvular heart disease was found in 21.6% of the cases.[12] In a study by Prosen et al, most of the patients had previous arrhythmia and AMI.[13]

Co morbidity

Diabetes mellitus and hypertension were the most common co morbidity in this study. In a study by Miglioranza et al, hypertension was found in 53% of the cases, dyslipidemia in 44% of the cases, coronary artery disease in 30% of the cases and COPD was found in 2% of the cases.[11]A similar study by Platz et al had noticed that, hypertension was noted in 73%, diabetes mellitus in 53%, atrial fibrillation in 64% of the patients with Kerly B line of more than 3.[13]

Clinical congestion score

The mean clinical congestion score was 5.36 at the time of admission, after first day of admission was 4.24 and 0.84 at the time of discharge. In a study by Miglioranza et al, the mean clinical congestion score was 57.7.[11]

Kerley B line

The Kerley B lines at the time of admission was 15.93, after first day of admission was 12.09 and at the time of discharge was 2.7. The number of Kerley B lines was 4, 5, 6 and 7 was found in 21.4% of the cases with clinical congestion score of less than 3 at the time of admission. At the time of admission about 51.1% of the cases had Kerley B line score of 1, followed by 0 in 17.8% of the cases. About 42.2% of the study subjects had a Kerley B line score of 1 followed by 0 in 35.6% of the cases. At the time of discharge, about 84.4% of the cases had Kerley B line score of 0. The mean B lines in a study by Miglioranza et al was 36.6.[11] Coiro et al had observed that, the mean Kerly B lines was 8.5 ranging from 5-34.[12] A study by Platz et al had shown that, the median B lines in the patients with acute heart failure was 5 among the patients with B lines of more than 3.[14]

Correlation between CCS and Kerley B lines

The mean Kerley B line was 20.41 in the patients with clinical congestion score of more than 3. The mean Kerley B line among the patients with clinical congestion score of 17.87 among more than 17.87 within 1 day of admission. The mean Kerley B lines score at the time of discharge among the patients with CCS of more than 3 was 16.0. The pearson correlation coefficient between the CCS scores and Kerley B line score was statistically significant at the time of admission, after 1 day of admission and at the time of discharge which was statistically significant. In a study by Miglioranza et al, the mean CCS was 66.7 for the patients with B lines of more than or equal to 15 and 38.7 among the patients with B lines of less than 15.[11]

Kerley B score in comparison with severity of LV dysfunction

The mean Kerley B score after 24 hours of discharge was 19.69 and 5.69 during discharge among the patients with severe LV dysfunction. The Kerley B line score decreased after admission which was statistically significant. The mean clinical congestion score decreased in all the types of LV dysfunction which was statistically significant. The studies were not available to compare these results.

Kerley B line with readmission

The mean Kerley B line score was higher at the time of admission which was statistically significant at the time of admission and within 24 hours after admission in patients with readmission. No studies were available to compare these findings.

Duration of hospital stay with CCS

The mean clinical congestion score was higher in the patients who were admitted for more than 10 days during admission, within 24 hours after admission and before discharge which was statistically significant. The studies were not available to compare these results.

Duration of hospital stay with Kerley B line

The mean Kerley B lines was higher among the patients was higher in the patients who were admitted for more than 10 days during at the time of admission, within 24 hours after admission and 24 hours before discharge. None of the studies were available to compare these results.

Readmission

About 2.2% were admitted for 1 time and 8.95 were admitted for 2 times. Coiro et al had observed that, about 75% of the cases were readmitted for heart failure.[12]

Clinical congestion score for readmission

The clinical congestion score was higher for the patients with 2 times of readmission at the time of admission,

within 24 hours after admission and 24 hours before discharge which was statistically significant. The studies were not available to compare these findings.

Duration of hospital stay

About 48.9% of the patients were admitted for 4 – 6 days in this study. In a study by Coiro et al, the length of hospital stay was 6.9 days.[12]

Clinical congestion score with severity of LV dysfunction

The mean clinical congestion score was higher in patients with mild LV dysfunction at the time of admission, in patients with severe LV dysfunction within 24 hours after admission and in both mild and moderate LV dysfunction cases at the 24 hours before discharge. Studies were not available to compare these results.

Kerley B line in patients with readmission with severity of LV dysfunction

In cases of readmission the mean Kerley B line was higher in severe LV dysfunction which was statistically significant at the time admission and within 24 hours after admission. No studies compared these results.

CCS and Kerley B line in patients with readmission

The mean Kerley B line was higher in patients with 2 times admission at the time admission, within 24 hours after admission and 24 hours before discharge which was statistically significant. The mean CCS and Kerley B line was 8.8 and 29.8 in patients with readmission which was decreased on the day of discharge. The mean CCS and Kerley B line was higher at the time of admission and decreased on the day of discharge in patients with 1 readmission. During first time of readmission, the mean CCS and Kerley B line was 3.75 which was decreased on the of discharge, During second time readmission, the mean CCS was 3.25 and Kerley B line was 3.75 in the patients on admission. These scores decreased gradually to 1 and 1.5 respectively on the day of discharge. In a study by Platz et al, about 75% of the patients with more than 3 B lines had admission past 6 months.[14]

CONCLUSION

This study was mainly undertaken to study usefulness of the Lung Ultrasound Scan in diagnosis and to identify its role as a marker of clinical outcome in patients with Acute LVF. Coronary artery disease was the main cause for the acute heart failure. Diabetes mellitus and hypertension were the most common co morbidity in this study. The mean clinical congestion scores and Kerley B lines were higher during the admission which rapidly decreased before discharge. There was a perfect positive correlation between the Clinical congestion scores and Kerley B lines. The severe LV dysfunction also had higher clinical congestion score and kerley B lines. The clinical congestion score and kerley B lines were higher during the readmission which rapidly decreased during the time of discharge. But this study is not without limitations. The pro BNp which is an important marker was not assessed and compared. But this study was able to bring out many facts about the usefulness of clinical congestion scores and Kerley B lines in the diagnosis of acute heart failure.

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