Original Article

Correlation of Fluid Overload and B-Lines Score on Lung Ultrasound among Chronic Kidney Disease Patients with Clinical Hypervolemia

Fluid Overload and B-Lines Score on Lung Ultrasound among Kidney Disease

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ABSTRACT

Objective: To find a correlation between B-line score on lung ultrasound and fluid overload by clinical examination among CKD patients.
Study Design: Cross-sectional study
Place and Duration of Study: This study was conducted at the Department of Nephrology, Sir Ganga Ram Hospital, Lahore from 20th October 2020 to 20th April 2021.
Materials and Methods: Eighty seven patients meeting the inclusion criteria were enrolled. Clinical assessment for hypervolemia was done at the bedside and recorded. Lung ultrasound for B-line scoring was done for patients who fulfilled inclusion criteria. The lateral and anterior chest was checked sonographically from 2nd to 4th intercostal spaces on the left side and right-sided 2nd to 5th intercostal spaces, at parasternal to mid-axillary lines (total 28 scanning sites). At these positions, the visible B-lines were counted, and scoring was done.
Results: The mean age of the patients was 49.85±15.913 years, 46(52.87%) patients were male, and 41(47.13%) patients were females. There was a weak positive relationship identified between the B-line final score and fluid overload on clinical assessment i.e., r=0.356 (p<0.05).
Conclusion: B-lines detected on lung ultrasonography have a weak positive relationship with the severity of volume overload among chronic kidney disease patients.
Key Words: Chronic kidney disease (CKD), Lung ultrasound, Fluid overload, B-Lines score

INTRODUCTION

Chronic kidney disease (CKD) is an abnormality of renal function, defined on basis of irreversibility and persistence for 3 or more months. Chronic kidney disease is now recognized as a major worldwide health problem because of its increasing patient number, worse outcome, and serious complications.[1]

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Along with other complications of the disease, hypervolemia is a big problem that is frequently associated with CKD.[2] Impairment of renal function leads to poor handling of the body's water balance, thus causing fluid overload. This state of hypervolemia not only causes many harmful effects including stiffening of arteries, raised intra-arterial pressure, anaemia, proteinuria, hypertrophied left ventricular, but also proved to be a major risk factor for enhancement of all-cause mortality and morbidity.[3] Therefore, maintaining a euvolemic state is particularly required in nephrology. Various techniques have been utilized for patient volume status assessment. Gold standard techniques are the Isotope dilution technique and neutron activation analysis.[4] However, unfortunately, their use is limited to the research environment and cannot be practiced in the wards. Clinical assessment is a traditional way of evaluating a patient's hydration status but its precision has remained doubtful.[5] Along with other techniques, B-line score (BL score) based on lung ultrasound (L-USG) was probed in different studies and it was proposed that L-USG could be used for assessment of extravascular fluid accumulation in lungs and thus represented overall body fluid status.[6,7]

A study by Zoccali et al[8], on end-stage renal disease (ESRD) patients receiving regular maintenance hemodialysis, showed that pulmonary congestion demonstrated by BL score on L-USG is quite common and often goes unnoticed. It was observed that 45% of the dialyzed individuals had moderate-to-severe congestion, 14% had very severe pulmonary congestion, 71% of patients had significant lung congestion with minimal or without any symptoms.

B-lines are "discrete laser-like vertical hyperechoic artifacts (previously described as comet tails)evolving from the lung pleura and persisting ill L-USG screen ends and move concurrently with lung".[6]B-line/ Comet tail artifacts were mentioned by Ziskin et al[9] in 1982, however, their role in nephrology was first brought in light 2009 when Noble et al., published their findings regarding the correlation of BL score with extravascular lung volume and reduction in their number after reduction in fluid overload.[10]Since then, the study of BL score and their correlation with different modes of hypervolemia assessment has remained under focus.[11] Marino et al[12] demonstrated a significant association of BL score with fluid overload. It is now believed that BL scoring is a helpful technique that is easy to learn, reproducible, and has great potential in the evaluation of volume status.[7]

This research work was designed to find a correlation between BL score on L-USG and fluid overload by clinical examination among CKD patients.

MATERIALS AND METHODS

This cross-sectional study was performed at Nephrology Department, Sir Ganga Ram Hospital, Lahore, from 20th October 2020 to 20th April 2021. Using non-probability convenient sampling, a sample size of 87 was calculated by keeping α error as 5 and β as 10 and expected correlation between BL score and hypervolemia as 0.34.[12] CKD patients of both gender, from 18 to 80 years, having fluid overload were inducted in the research. Patients with normal GFR, CKD patients with clinically euvolemia/hypovolemia, and patients unfit for lung ultrasound were excluded.

After approval from the Institutional Ethical Review Board, 87 cases matching the criteria for inclusion were enrolled. Informed consent was taken from each subject. Clinical examination for hypervolemia was performed at the patient's bedside and hypervolemia severity was recorded. L-USG was done, and BL score was calculated and recorded (BL score: 0, 1, 2, and 3 if B lines were ≤5, 6–15,16–30, and >30 respectively). Lung ultrasound procedure: In presence of a trained radiologist and nephrologist L-USG was performed by a single doctor on each enrolled patient to avoid interobserver variability. The lateral and anterior chest was checked from 2nd to 4th intercostal space on the left side and 2nd to 5th intercostal spaces on the right side, at parasternal to mid-axillary lines, for a total of 28 scanning sites. At each of these sites, the number of BL seen was recorded. This number was used to calculate the BL score.

Data was entered in SPSS version 21.0 and analyzed. Correlation between fluid overload and B-line score was studied by Spearman correlation keeping p-value ≤0.05 as significant.

RESULTS

The mean age was 49.85±15.913 years respectively, 46 (52.87%) patients were male and 41 (47.13%) patients were females. The patient's mean GFR was 29.46±12.17 with minimum and maximum GFR of 9 & 50 respectively. On clinical examination, mild fluid overload was present in 33 (37.93%) patients, moderate fluid overload was present in 41 (47.13%) patients and severe overload was present in 13 (14.94%) patients.

The mean right BL number was 4.97±3.23 while the mean left BL number of the patients was 8.63±5.54. The mean total score was 13.57±7.77.In our study ≤5 number of BL (Score 0)was noted in 17 (19.54%) patients, 6-15 number of BL (Score 1) was noted in 34 (39.08%) patients, 16-30 number of BL (Score 2) was noted in 34 (39.08%) patients and >30 BL (Score 3) were noted in 2 (2.30%) patients. There was a very weak, although positive, and significant relationship existed between the final BL score and fluid overload on clinical assessment i.e., r= 0.356 (p-value = 0.001) as shown in Figure 1.

When data were stratified for the age of patients, a very weak but positive relationship existed between the final BL score and fluid overload for age<50 years i.e., r =0.269 (p>0.05) but for age ≥50 years, it is not so much weak i.e., r = 0.403 (p<0.05) as shown in Figure 2.

When data were stratified for the gender of patients, there was a very weak, but positive relationship found between the final score and fluid overload for females i.e., r = 0.373 (p<0.05) and for males i.e., r = 0.326 (p<0.05) as shown in Figure 3.
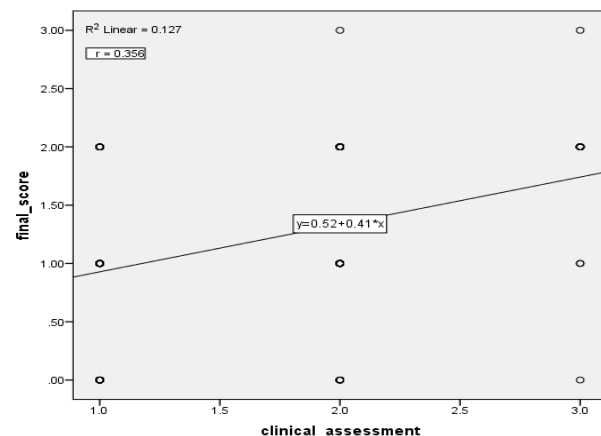

Figure No. 1: Weak but positive correlation between BL score and clinical overload assessment
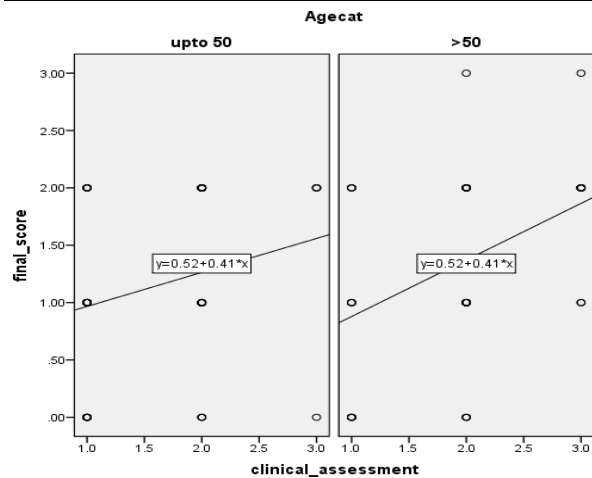
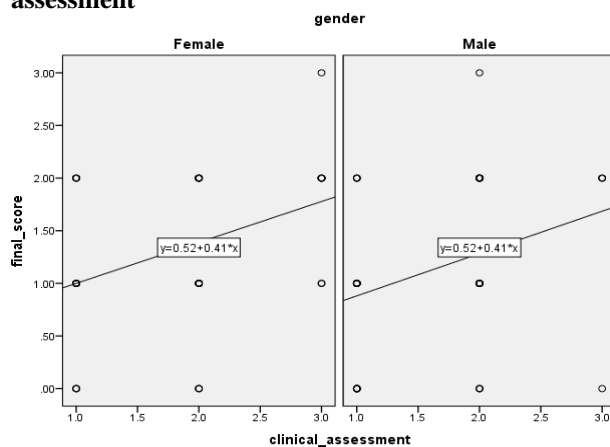**Figure No. 2: Age of patients and weak positive relationship between BL score and clinical overload assessment**

Figure No. 3: gender and weak positive relationship between BL score and clinical overload assessment

DISCUSSION

Accurate assessment of hypervolemia among CKD patients is not only important for ongoing treatment but also exhibits its mortality predictor quality especially at the point when these patients are getting support hemodialysis. Decreasing excessive volume and achieving euvolemic condition have demonstrated fruitful in maintaining normal blood pressure without the utilization of anti-hypertensive drugs in almost 90% of hemodialysis patients. In addition, this too has a critical positive effect on the quality of life of these patients.[13] BL score counting on L-USG has gained popularity as a bedside method of volume status assessment especially in emergency and hemodialysis units, keeping in mind the pitfalls of routine clinical examination for volume status noticeably the interobserver variability. L-USG for volume assessment can easily be learned and can be performed by a resident nephrology doctor obviating the requirement of a trained radiologist. In a study by Gargani et al[14], thirty doctors of general medicine were taught techniques of L-USG and quantification of BL with help of an online teaching curriculum. Their capacity to count B-lines was viewed as exact contrasted with a specialist radiologist ($r = 0.979$, $P < 0.0001$). Even by using different ultrasound probes for L-USG, insignificant interobserver variability has been documented.[15]

Among nephrologists, the B-lines score has gained much attraction because of its strong correlation with volume overloaded states. Among patients presenting with acute dyspnea, the BL score on L-USG showed 97% sensitivity and 95%, specificity[16]. In hemodialysis ESRD patients, removal of excess body water by ultrafiltration demonstrated a decrease in BL number after dialysis.[10] Likewise study published by Trezzi et al[15], showed a BL score reduction having a statistically significant correlation at the end of the dialysis session. Increase in the number of BL in between two dialysis sessions were strongly associated with water accumulation and weight gain whereas disappearance of BL demonstrated water removal by dialysis and weight reduction. Even real-time disappearance of B lines have been evaluated in a study by Noble et al.[10]

Even among patients with acute coronary syndrome having pulmonary edema, <0.5L extravascular lung water can be detected by BL score with a 90% sensitivity of and 89%. Specificity. almost the same sensitivity is present with more than 0.5L extravascular lung water but specificity drops to 86%.[17] In our study there is a very weak, although positive relationship found between the final score and clinical assessment i.e. r=0.356 (p<0.05).

In the future, further studies should be done with a larger sample size to further explore the correlation between fluid overload and B-line score, especially among hemodialysis patients.

CONCLUSION

B-lines detected on lung ultrasonography have a weak positive relationship with the severity of volume overload among CKD patients.

Author's Contribution:

Concept & Design of Study:	Muhammad Muzaffar Habib
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Revisiting Critically:	Muhammad Muzaffar Habib, Shahid Anwar, Sajad Ahmad
Final Approval of version:	Muhammad Muzaffar Habib

Conflict of Interest: The study has no conflict of interest to declare by any author.

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