DISCUSSION

Pulmonary edema can be defined as an increase in lung fluid caused by extravasation of fluid from the pulmonary vasculature into the interstitium and alveoli of the lungs. The buildup of fluid leads to progressive deterioration of alveolar gas exchange and resulting hypoxia. Pulmonary edema is generally classified as non-cardiogenic and cardiogenic.[30,31]

Non-cardiogenic pulmonary edema is called also acute respiratory distress syndrome (ARDS). It is characterized by diffuse alveolar damage, marked increased permeability of the alveolar-capillary membrane, and accumulation of protein-rich fluid in the alveolar air sacs. [116,117]

The presenting features of acute cardiogenic and noncardiogenic pulmonary edema are similar. Interstitial edema causes dyspnea and tachypnea. Alveolar flooding leads to arterial hypoxemia and may be associated with cough and expectoration of frothy edema fluid. The history should focus on determining the underlying clinical disorder that has led to pulmonary edema.[118]

There are many etiologies of noncardiogenic pulmonary edema.one of them is a complication of renal failure.

Renal failure is characterized by sudden loss of the ability of the kidneys to excrete wastes, concentrate urine, conserve electrolytes, and maintain fluid balance. [1]

It is a frequent clinical problem, particularly in the intensive care unit, where it is associated with a mortality of between 50% and 80% whether occurred acute or chronic onset.[2] More recent prospective studies report an overall incidence of acute renal failure of almost 500 per million per year[3,4] and an incidence of acute renal failure needing dialysis of more than 200 per million per year.[5]

Based on the previous data, the present study was designed to evaluate the role of bedside US chest as a relatively new modality in detection of B line score and DTI to detect E/E` as two noninvasive modalities to evaluate EVLW in acute renal failure. In the matter of fact lung US is used extensively in the ICU [119-121]. Originally it was performed only for the localization of pleural effusions and the placement of chest tube, but over the past few years it has tended to replace chest radiography [74,122].

Successful training of intensive care physicians in lung US can improve the diagnostic approach to various abnormalities and minimize the use of costly, more hazardous diagnostic techniques that require transportation of the patient [123]. Over the past few years, the use of lung US critically ill patients has gained popularity, and has been associated with very good outcomes. Lung US is the fastest, non-invasive, sophisticated diagnostic tool used in the ICU free of complications and with minimal cost [123].

The study was conducted on 60 adult male and female patients admitted to Critical Care Department in Alexandria Main University Hospital with preliminary diagnosis of NCPE due to acute renal failure in need for urgent hemodialysis, ultrasound chest done before and one hour after hemodialysis for all patients to evaluate B-lines score and DTI

done before and one hour after dialysis for all patients to measure E/E` and calculate PCWP indirectly.

Patients were classified according to US chest (B lines score) findings into three groups (mild congestion <14, moderate congestion14-30, severe congestion >30)

Group I: mild congestion 7 patients (11%).

Group II: moderate congestion 14 patients (23.3%).

Group III: severe congestion 39 patients (65%).

Regarding demographic data: this study included 25 male and 35 female patients, their age ranged from 33.0 to 67.0 years (Table 7) (Figure 20).

Regarding chest x ray: In the current study CXR diagnosed congestion before dialysis in 45 out of 60 patients (75%) table (18).

This agreed with the study performed by Lichtenstein et al,[124] in 2004, They stated that bedside chest radiography had a diagnostic accuracy of 47% for pleural effusion, 75% for alveolar consolidation, and 72% for alveolar interstitial syndrome, While, chest ultrasonography had a diagnostic accuracy of 93% for pleural effusion, 97% for alveolar consolidation, and 95% for alveolar interstitial syndrome. They eventually, concluded that chest ultrasonography is better than auscultation and bedside chest radiography for diagnosing pleural effusion, alveolar consolidation, and alveolar interstitial syndrome and for assessing the extent of lung injury. While, bedside CXR was a poor predictor of the extent of lung injury compared with chest ultrasonography.

The same finding were proved by study performed by Agmy et al,[125] in 2010, showed that chest sonography is highly sensitive, specific, and reproducible for diagnosing the main lung pathologic entities in critically ill patients at ICU and can be considered an attractive alternative to bedside chest radiography and chest computed tomography as bedside CXR had a diagnostic accuracy of 50, 70% and 65% for pleural effusion, consolidation and alveolar-interstitial syndrome respectively. Chest U/S had a diagnostic accuracy of 100%, 95% and 95% for pleural effusion, consolidation and alveolar-interstitial syndrome respectively.

In agreement with our study, study performed by Martindale et al,[126] in 2013, reported that residents were able to more accurately identify pulmonary edema with lung ultrasound than with chest radiograph. Even physicians with minimal exposure to lung ultrasound may be able to correctly recognize pulmonary edema on lung ultrasound.

One hour after hemodialysis CXR diagnosed congestion in 21 out of 60 cases (41.7%) table (18). Delay between the resolution of clinical symptoms and the development of radiographic findings of congestion has led clinicians to search for better diagnostic tools. The goal has been to identify tools that can provide more immediate feedback when monitoring a patient's clinical course.

CXRs are only performed on patients in the supine position. The film cassette is placed posterior to the thorax and the X-ray beam originates anterior onto the chest at a distance that is less than satisfactory. In fact, when the x-ray beam does not focus

tangentially on the diaphragm dome and the mediastinal structures, a correct diagnosis of the "silhouette sign" may not be achieved. These circumstances may result in diagnostic errors regarding pleural effusions, parenchymal consolidation, and alveolar-interstitial syndrome.[57,127]

Regarding US chest : in our study US chest diagnosed pulmonary edema through the ROC curve with E/E`, US chest and CT chest "gold standard" area under the receiver operating characteristic curve (AUC) to predict improving of NPE by US chest was 0.977 with a significant p value =0,001. US chest had diagnosed improving of PE with cutoff =3 had sensitivity of 94%, specificity of 90%, PPV of 97.92%, NPV of 75% and with accuracy 93.33%.

This agreed with the study performed by Gardelli et al,[127] in 2012, showed that chest U/S is a promising technique as a mean of diagnosis and can be employed in the monitoring of consolidative pathology until its complete resolution, which avoids the use of x-rays. As when 3 or more "B lines" are seen, interstitial edema can be diagnosed with 97% sensitivity and 95% specificity and their number reflects the extent of pulmonary edema.

The same finding were proved by study performed by Agricola et al,[77] in 2005, documented that the presence and the number of comet-tail images provide reliable information on interstitial pulmonary edema and considered bedside U/S is a useful diagnostic tool for assessing cardiac function and pulmonary congestion.

Volpicelli et al,[128] in 2006, showed the usefulness of chest ultrasound in the detection of AIS. The comet tail B line is a lung ultrasound sign reasonably accurate for diagnosing diffuse alveolar interstitial involvement in dyspneic patients in the Emergency Department (ED). This artifact showed a sensitivity of 85.7% and a specificity of 97.7% in recognition of radiologic AIS with a positive predictive value of 93.0% and a negative predictive value of 95.1%. Also, Volpicelli et al,[129] in 2013, confirmed that lung US is an easy-to-use, low-cost technology that allows accurate noninvasive bedside assessment of pulmonary interstitial fluid.

Lichtenstein et al,[130] in 2008 found that chest U/S provided diagnosis of 90.5% of patients presented with acute respiratory failure and said that chest ultrasound is nearly equivalent to CT in detecting most disorders. For pulmonary edema, the B profile had 95% specificity and 97% sensitivity.

Xirouchaki et al,[53] in 2011, reported that chest ultrasound has a diagnostic accuracy of 92–100% in identifying common pathologic conditions which is much better than CXR and may therefore be considered as an alternative to thoracic CT. The sensitivity, specificity, and diagnostic accuracy of chest ultrasound were 100, 78, and 95% for consolidation, 94, 93, and 94% for interstitial syndrome, 75, 93, and 92% for pneumothorax, and 100, 100, and 100% for pleural effusion, respectively.

Wafaa et al,[131] in 2014, showed the total concordance (TC) of chest U/S in comparison to CT chest as the gold standard in diagnosing consolidation, pneumothorax, pulmonary edema & pleural effusion was 96.7%, 98.9%, 97.8% & 97.8% respectively. So, as considering the benefits of chest ultrasound versus the multiple drawbacks of CT chest,

like it needed a special request, the dose of radiation and the major problem of patient transfer makes chest U/S a reasonable substitution.

Recently, in 2014, Lichtenstein et al,[132] reported that all of the four major pulmonary pathologies found using CT as the "gold standard" were diagnosed by chest ultrasound with sensitivity and specificity ranging from 90% to 100%, allowing ultrasound to be considered as a reasonable bedside "gold standard" in the critically ill.

Comparing the three studied groups as regards B line score, we found that 7 patients in class of mild B lines score, 14 patients in moderate B lines score and 39 patients in severe B lines score before dialysis table (9), figure (22). After dialysis all 7 patients in mild group became free from B lines, 12 patients from moderate group changed their class of lung congestion post dialysis and moved to mild group while the other 2 patients remained in their class of moderate lung congestion, 29 patients from severe group changed their class of lung congestion to mild group and 10 patients became in moderate group so number of patients in mild group became 41 patients, while number of patients in moderate group became 12, no patients in severe group after dialysis table (11),figure (23).

This agreed with study performed by Dimitrie et al,[133] in 2013 reported that lung congestion was classified as absent to mild (≤15 lung comets) in 67 patients (67.7%), moderate (16–30 lung comets) in 19 patients (19.8%) and severe (>30 lung comets) in the remaining 12 patients (12.5%). After dialysis, there were 87 (90.6%) patients with absent or mild lung congestion, 4 (4.2%) with moderate and 5 (5.2%) with severe lung congestion. Seven of the patients with >30 lung comets before dialysis changed their class of lung congestion post-dialysis (four moved to the absent or mild, while three to the moderate lung congestion class).

Nicola et al,[134] in 2014 reported that there was a significant reduction in the number of B-lines (3.13 vs 1.41) after hemodialysis and this reduction in B lines correlated with fluid loss due to hemodialysis, confirming that lung US can identify even modest variations in EVLW. Post dialysis B lines number correlates with residual weight assessed with bioimpedance suggesting a role of US in managing hemodialysis patients.

Francesca et al,[135] in 2010 reported that lung water reduced after dialysis, but 23 patients (31%) still had pulmonary congestion of moderate to severe degree. Lung comets score significantly reduced ($p < 0.001$) after dialysis. The mean and the median number of pre-dialysis lung comets (lung comets score) were 33 and 18, respectively. Lung comets score was <14 in 28 cases, 14 to 30 in 26 cases, and >30 in 21 cases. Overall, 47 of 75 patients (63%) had moderate to severe pulmonary congestion (i.e., a lung comets score ≥14) before dialysis. Effect of dialysis on lung comets the proportion of patients with moderate to severe pulmonary congestion fell from 47 (63%) to 23 (31%). In the 7 patients with pre-existing pulmonary disease, the decrease in lung comet score (from 44 [median] to 18, –59%) did not significantly differ ($p = 0.09$) from that in patients without pulmonary disease (from 17 to 9, –47%).

Matteo et al,[136] in 2010 and Nobel et al,[137] in 2009 reported that B-lines reduction at mid- and end-dialysis session. Confirm that lung echography may recognize rapid changes in pulmonary imbibition, supporting its use in monitoring the therapeutic effect of diuretics in patients with pulmonary edema.

Regarding Echo parameters: in our study there was significance reduction in LAD from 45.75 ± 2.05mm to 37.33 ± 0.99mm, LVEDV from 122.87 ± 5.12mm to 110.32 ± 2.96mm after dialysis (p <0.001). This agreed with study performed by Francesca et al,[79] in 2006 showed there was a significant linear correlation between ULCs and left atrial dimension (r=0.294, p<0.0001), left ventricular end-diastolic diameter (r=0.336, p<0.0001).

Abdenasser Drighil et al,[138] in 2008 showed that hemodialysis led to reduction in LV end-diastolic volume (P < 0.0001), end-systolic volume (P < 0.001).

OualiS et al,[139] in 2009 found that hemodialysis led to reduction in LV end-diastolic volume (p=0.001), left atrium area (p<0.0001).

Conventional echocardiographic (ECHO) parameters of left ventricular (LV) systolic and diastolic functions have been shown to be load dependent; however, the impact of pre-load reduction on DTI parameters of LV function is incompletely understood. Some studies have demonstrated pre-load independence, whereas others suggest the opposite. We performed DTI in the four-chamber view, with the mitral annular planes perpendicular to the ultrasound beam. A 5 mm pulsed Doppler sample volume was placed at the lateral aspect of the mitral annulus [96,105] and calculate E/E′ ratio at the lateral mitral annulus. A number of recent studies have noted that in patients with normal EFs, lateral tissue Doppler signals (E/é) have the best correlations with LV filling pressures and invasive indices of LV stiffness. These studies favor the use of lateral tissue Doppler signals in this population.[108,109]

Doppler tissue imaging (DTI) has been proposed as a tool for the evaluation of diastolic function. Controversy exists regarding whether DTI measurements are influenced by preload. Changes in the circulating volume associated with hemodialysis result in preload reduction. To determine the influence of preload reduction on DTI and standard pulsed-Doppler transmitral diastolic velocities, 60 patients without overt heart disease were studied by DTI and standard pulsed Doppler before and after hemodialysis.

As regards early diastolic mitral inflow (E) there was significance reduction (P <0.001*) mean of E changed by dialysis from 100.45 ± 8.58 to 80.53 ± 5.20, mean late diastolic mitral inflow (A) changed from 113.20 ± 6.56 to 93.88 ± 5.29 (P <0.001*), E/A ratio changed from 0.89 ± 0.04 to 0.86 ± 0.03 (P <0.001*), there was significant reduction in early diastolic mitral annulus on lateral side (E`) 8.37 ± 0.75 to 6.99 ± 0.47, E/E′ ratio changed significantly after dialysis from 14.46 ± 1.71 to 9.67 ± 0.83.

This agreed with study performed by Abdenasser Drighil et al,[138] in 2008 showed that hemodialysis led to reduction of peak early (E wave) transmitral flow velocity (P = 0.0001), and the ratio of early to late Doppler velocities of diastolic mitral inflow (P = 0.021). For the LV, early diastolic (E`) TDI velocities and the ratio of early to late TDI diastolic velocities (E`/A`) only on the septal side of the mitral annulus decreased significantly after HD ($P$ = 0.0001 and $P$ = 0.009, respectively). In a subgroup of seven patients who sustained significantly larger fluid volume loses following HD, E` at the lateral side of mitral annulus also decreased suggesting a greater resistance of the lateral annulus to preload changes, greater volumes of fluid removed (2850 ± 1210 vs. 2600 ± 960 cc, P = 0.03). The Δ% in E' at the lateral mitral annulus correlated positively with FVR

adjusted for pre-HD weight. Finally the *E*/*E′* ratio at the lateral side of mitral annulus decreased significantly (*P* = 0.003) after HD.

Chan et al,[112] in 2012 founded that LVEF measured pre- and post-HD were not different. After HD, there were changes in the peak E velocity, E/A ratio. Tissue velocities measured at the septal and lateral mitral annulus were also affected by HD. E/E′ ratio, expressing the ratio between the peak early diastolic mitral inflow (E) and the tissue velocity (E′), decreased significantly after HD.

Fabio Galetta et al,[113] in 2006 showed that LV diastolic function deteriorated significantly after single hemodialysis session as (peak E, 75.4 ± 11.2 vs. 58.8 ± 12.5 cm/s) P < 0.01, E` (septum: 8.3 ± 1.6 vs. 6.3 ± 1.7 cm/s; lateral wall: 10.2 ± 2.4 vs. 7.1 ± 1.9 cm/s, P < 0.001), These reversible changes could be considered as a cardiac stunning that seems to be related to the ultrafiltration rate and then to the interdialysis weight gain. These findings suggest that low ultrafiltration volume and/or limited interdialytic weight gain are cardioprotective measures in hemodialysis patients.

Dincer et al,[114] in 2002 showed that mitral inflow velocitie (E wave) and mitral annulus tissue doppler velocities (E') from the septal, lateral, anterior, posterolateral and inferior sides of the mitral annulus were measured immediately before and after hemodialysis. Mitral inflow E decreased significantly (p < 0.001) after hemodialysis. Mitral annulus E' wave velocities obtained from five different sides of the annulus also changed significantly (p < 0.001 for all). The decrease in E wave and E' velocities in tissue Doppler measurements were correlated with the amount of fluid extracted. Concluded that mitral annular velocities obtained by tissue Doppler are preload dependent parameters for the evaluation of LV diastolic function.

Oguzhan et al,[115] in 2005 showed that peak velocity of early diastolic mitral flow decreased from 100 +/- 30 to 85 +/- 34 cm/s (P < 0.001) after hemodialysis. Hemodialysis elicited marked reduction in early diastolic lateral mitral annular and midlateral myocardial velocities (6.9 +/- 3.2 to 6.3 +/- 2.9 cm/s, P < 0.04 and 6.7 +/- 0.3 to 5.5 +/- 2 cm/s, P < 0.001, respectively). Early diastolic, septal mitral annular, and midseptal myocardial velocities were also significantly decreased (5.8 +/- 2.8 to 4.6 +/- 2 cm/s, P < 0.006 and 6.2 +/- 2 to 5.1 +/- 1 cm/s, P < 0.008, respectively)

OualiS et al,[139] in 2009 found that hemodialysis led to reduction in LV end-diastolic volume (p=0.001), left atrium area (p<0.0001), peak early (E wave) transmitral flow velocity (p=0.005). Regarding TDI measures, velocities were not affected by preload reduction. Only the early diastolic velocities on the septal side of the mitral annulus decreased significantly (p=0.001) after hemodialysis.

Philippe et al,[140] in 2007 showed that preload reduction induced by ultrafiltration significantly decreased E-wave maximal velocities, TDI E' velocity decreased with preload reduction when recorded at the septal portion of the mitral annulus (7.1 +/- 2.5 cm/s versus 5.9 +/- 1.7 cm/s; P = 0.0003), whereas TDI E' velocities recorded at the lateral aspect of the mitral ring remained unaffected by haemodialysis (8.9 +/- 3.1 cm/s versus 8.3 +/- 2.6 cm/s; P = 0.37). The volume of ultrafiltration was 3.0 ± 1.1 Liters.

Graham et al,[141] in 1995 12 in patients with normal LV systolic function, found no significant reduction in E′ after HD at either the lateral or the septal mitral annulus. In their study, the average volume of fluid removed by HD was only 1600 cc compared with our study 2500 cc removed by ultrafiltration.

Our results agree with Abdel Naser et al,[138] found that significant reduction in in E′ after HD lateral and septal mitral annulus. In their study, the average volume of fluid removed by HD was with 2700 cc, Agmon et al,[142] who in a cohort of patients, with high prevalence of coronary heart disease (69%) and heart failure (15%), found that E′ velocities at both the septal and lateral sides of mitral annulus were load-dependent when the average fluid volume removed (FVR) was 3100 cc. Also, Hung et al,[143] demonstrated that TDI indices of LV diastolic function changed depending on the extent of loading alterations. Furthermore, in a study performed in dogs, Firstenberg et al,[144] found that large changes in preload resulted in reductions in E′.

Recently, in 2014, Leila et al,[145] showed that HD led to reduction in LV end-diastolic volume which changed from 132.7 ± 47.2 to 112.6 ± 40.1 (P <0.001), left atrium area changed from 41.8± 7.5 to 39.3± 8 (P <0.001), peak early (E-wave) trans-mitral flow velocity changed from 95.9± 25.4 to 81.7± 23.2(P <0.001), peak late Doppler velocity changed from 90.6± 24.9 to 86.8± 23.2(P <0.001) the ratio of early to late Doppler velocities of diastolic mitral inflow changed from 1.1± 0.5 to 1± 0.4(P <0.001). Early diastolic mitral annular on lateral side (E') TDI velocities changed from 14.7±4.8 to 13.7±4.2 (P <0.001) while E/E` changed by dialysis from 7.11±1.55to 5.21±1.64, fluid volume removed by HD was 1640 ± 730 cc. Suggesting that TDI diastolic parameters are pre-load dependent.

In all these studies, in spite of the heterogeneous nature of the patient population, the only variable that changed significantly from one study to the next was the amount of volume removed. Therefore, our findings suggest that TDI diastolic parameters are preload-dependent, even in the presence of delayed relaxation or normal systolic LV function, and that this dependency correlates directly and mainly with the volume of fluid removed. Small reductions in preload may not unmask this dependency. Hence, we believe that discrepancies among existing studies may be due more to the amount of volume removed than to the populations studied.

The reason for the difference in preload dependency between the lateral and septal aspects of mitral annulus may be related to a greater sensitivity of the septal side of the mitral valve to right ventricle compliance changes compared with the lateral wall of stiff ventricle.

Through the ROC curve E/E` and US chest “bedside gold standard” main final diagnosis NCPE due to ARF before hemodialysis the area under the receiver operating characteristics curve (AUC) to predict diagnosis of pulmonary edema by E/E` was 0.966 with a significant p value =0.001

As it’s shown, E/E` had diagnosed NCPE by cutoff 12.5 had sensitivity of 94.34%, specificity of 85.71%, positive predictive value of 98.04%, negative predictive value of 66.67% and with 93.33 % accuracy.

Through the ROC curve E/E`, US chest and CT chest "gold standard" main final diagnosis NCPE due to ARF after hemodialysis the area under the receiver operating characteristics curve (AUC) to predict improving of NPE by E/E` was 0.937 with a significant p value =0.001.

As it's shown, E/E` had diagnosed improving of NCPE with cutoff 9 had sensitivity of 94%, specificity of 80%, PPV of 95.92%, NPV of 72.73% and with accuracy 91.67%.

Our study is limited in various ways: relatively small number (N = 60). Nevertheless, we carefully controlled for age, underlying disease, and HD conditions. Our study group included only patients in sinus rhythm. The performance of this method in the presence of nonsinus rhythms is currently unknown. Most of the changes we observed were highly significant with the exception that EF is insensitive to small or moderate levels of preload reduction. In addition, we could not control the volume of dialysate removed because we did not consider it ethical to hold the FVR constant. Instead, we followed a standard protocol to dialyze until each patient reached his/her dry weight. The changes observed in this study may reflect the load sensitivity of Echo parameters in young and relatively healthy patients and may not be directly applicable to patients with significant co-morbid conditions and more severe structural heart disease. The echocardiographer who made the measurements and calculations could not be blinded to the pre- or post-HD condition. Even though the echocardiographer was not blinded to the pre- or post-HD condition, the results should not be affected because he was blinded to the patient's identity.

There is no studies documenting what level of proficiency is necessary for a reliable U/S diagnosis, U/S operator was not blind to the clinical presentation of the patients. Interpretation of sonographic signs is operator dependant unlike that of CXR and CT images.

In addition, chest US limitations include its difficulty to use it in obese patients with thick chest wall, patients having subcutaneous emphysema, the probe may contribute to the dissemination of multi-resistant strains in the ICU and increase the incidence of nosocomial infections, its low availability in remote areas, presence of drain or dressings can interfere with of the probe. Also, usually dorsal lung segments of upper lobes, located behind the scapula, are the only regions that cannot be explored by chest ultrasound. Finally, ICU patients often lie in non optimal positions which limit exploration of certain lung areas.

SUMMARY

A wide variety of pulmonary disorders are associated with renal insufficiency. Pulmonary edema is probably the most common and among the most serious complications of uremia. Pulmonary edema can be defined as an increase in lung fluid caused by extravasation of fluid from the pulmonary vasculature into the interstitium and alveoli of the lungs. The buildup of fluid leads to progressive deterioration of alveolar gas exchange and resulting hypoxia. Pulmonary edema is generally classified as non-cardiogenic and cardiogenic. [44,45]

The commonly used techniques for chest imaging are the ordinary CXR and CT chest as the gold standard. Although, CXR remains the most frequently used method for chest imaging providing an easily accessible, cheap modality but it's neither cost effective nor beneficial reaching a definitive diagnosis. Also, thoracic CT is expensive, need a special request, requires patient transportation to a CT unit, which can be risky and requires cardio-respiratory monitoring as well as medical assistance. In addition, the risk of over-exposure to ionizing radiation is not to be underestimated.

While, CUS was not appreciated by the medical community till recently, although, having the benefits of being rapid, accurate, available, bedside, non expensive, noninvasive and without the risk of radiation or intravenous contrast agents. It can be used in both stable and unstable patients and during pregnancy, does not require too much time to prepare, or introduce greater risk to the patient. It may also be performed parallel to physical examination, resuscitation and stabilization. Which makes chest ultrasound a reasonable bedside gold standard especially for critically ill difficult to transfer patients.

Our aim of the study was to evaluate the role of chest ultrasonography and doppler tissue imaging in diagnosis of extravascular lung water in patients with acute renal failure need hemodialysis using thoracic computed tomography (CT) as gold standard

This study included 60 patients admitted to Emergency Department and Department of Critical Care presented with preliminary diagnosis of acute renal failure in need for urgent hemodialysis.

All patients included in the study were subjected on admission to formal written consent from patients' next of kin, demographic data, complete history taking, monitoring of the vital signs, arterial blood gases and measuring of hypoxic index, Chest examination and auscultation, routine laboratory investigations and electrocardiogram (ECG) on admission and when needed. Chest x-ray: portable A-P view on admission and one hour after dialysis.

Two ultrasounds performed for each patient. The first scan done before dialysis on the patient's arrival at the hemodialysis unit. The second scan within 1hour of the end of dialysis. DTI performed for all patients before and one hour after dialysis to determine left ventricle ejection fraction (LVEF), left ventricle end diastolic volume (LVEDV), left atrial diameter (LAD), mitral inflow velocity, early diastolic velocity of mitral annular motion (E').

Measurement of sensitivity, specificity and diagnostic accuracy for each method was calculated and then statistical analysis was done.

Our study documented that chest U/S is very useful bed side diagnostic tool providing immediate diagnosis EVLW. The total concordance (TC) of chest U/S in comparison to CT chest as the gold standard with cutoff 3 BLS had sensitivity of 94%, specificity of 90%, positive predictive value 97.92%, negative predictive value of 75% and with accuracy 93.33%.

E/E` had diagnosed improving of pulmonary edema with cutoff 9 had sensitivity of 94%, specificity of 80%, positive predictive value of 95.92%, negative predictive value of 72.73% and with accuracy 91.67%, E/E` had diagnosed pulmonary edema with cutoff 12.5 had sensitivity of 94.34%, specificity of 85.71%, positive predictive value of 98.04%, negative predictive value of 66.67% and with 93.33% accuracy

So we can conclude that lung ultrasound is a bedside, reliable, dynamic, rapid, non-invasive technique which makes chest U/S a reasonable alternative to CT chest.

Doppler echocardiography is a highly promising means of assessing the EVLW.