AIM OF THE WORK

To evaluate the role of chest ultrasonography and doppler tissue imaging in diagnosis of extravascular lung water in patients with acute renal failure after hemodialysis to be correlated with clinicolaboratory parameters of patient improvement as regards:

1- Vital signs (blood pressure, heart rate, respiratory rate).

2- Central venous pressure readings.

3- Oxygenation parameters(hypoxic index).

4- Chest x-ray.

5- Laboratory parameters (Bun, K, urea and creatinine).

PATIENTS

This study was carried out on sixty patients of both sexes, who were admitted to the units of the Critical Care Medicine Department in Alexandria Main University hospital who fulfilled diagnostic criteria of acute renal failure in need for urgent hemodialysis.

This study was approved by the Medical Ethics Committee of Alexandria Faculty of Medicine. An informed consent was taken from the first degree patients' relatives before their enrollment in the study.

Exclusion criteria: [97]

1- Patients aged less than 18 years.

2- Pregnant females.

3- Cardiogenic pulmonary edema.

4- Other causes of non cardiogenic pulmonary edema.

5- Abnormal rhythm.

6- Mitral stenosis or prosthetic mitral valve.

METHODS

All patients included in to the study were subjected **on admission** to the followings:

1. Formal written consent from patients' next of kin.
2. Demographic data: age & sex.
3. Complete History taking: including drug history.
4. Complete physical examination including full chest examination.
5. Electrocardiogram (ECG) on admission and when needed.
6. Routine laboratory investigations including: complete blood count, serum creatinine, blood urea, random blood sugar.
7. Arterial blood gas analysis for measurement of PaO2 and hypoxic index (PaO2/FiO2 ratio) on admission and one hour after dialysis.
8. Bun, K, urea and creatinine will be measured before and one hour after dialysis.
9. Vital signs: monitoring of heart rate, systolic arterial blood pressure and diastolic blood pressure and respiratory rate on admission using bed side monitor and monitoring them after dialysis.
10. Chest x-ray: portable A-P view on admission and one hour after dialysis.
11. Ultrasound abdomen.
12. Total fluid volume removed was calculated by the hemodialysis machine.

Ultrasound chest was performed in all patients using ultrasound unit digital ultrasonic imaging system model EMP-2100, Shenzhen emperor electronic.co.ltd, China with macroconvex probe 2.5-5 MHZ to detect density of b-lines on both lung fields.

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.

B-lines were defined as an echogenic, coherent, dynamic, wedge-shaped signal, with a narrow origin in the near field of the image, arising from the pleural line and extending to the edge of the screen.

The scanning protocol consists of scanning in the parasternal, midclavicular, anterior axillary, and mid axillary positions of the second to fifth intercostal spaces on the right side and second to fourth spaces on the left side for a total of 28 positions per complete examination. (Figure 15)

- The normal sonographic appearance of the lung: a longitudinal scan of an intercostal space, with the ribs as topographic reference:

1) The gliding sign is present when the visceral pleura slides on the parietal pleura, excluding pneumothorax. (Figure 13)

2) Horizontal artifacts-the A-lines appear cyclically at an interval that reproduces the distance of the transducer to the pleural line. The gliding sign is not always evident, and the pleural contact and lung movement may be shown in the M mode, this image is called the seashore sign, characterized by horizontal lines ("waves") representing the static chest wall and by a scattered region ("sand"), formed by the dynamic artifacts beyond the pleural line, which would be absent in the case of pneumothorax.(Figure 13)

3) Eventually, a type of vertical artifact—B-lines—(formerly called comet tails) can be found in normal examination.

- The recognition of a few other artifacts must be mastered when looking for B-lines:

- Z-line artifacts are lines that arise from the pleural line and fade away vertically, do not reach the edge of the screen. (Figure 11)

- E-lines are generated by subcutaneous emphysema; they are vertical laser-like lines that reach the edge of the screen but do not arise from the pleural line. (Figure 12)

- An examination was considered normal in the presence of the gliding sign, the presence of fewer than three B-line artifacts in the entire scanned surface.

B-lines were counted and recorded for each time point on a data collection sheet; their sum yields the overall B-line score (BLS) Lung aeration score. On the basis of this score, we will group patients into 3 categories (mild <14 comets; moderate 14 to 30 comets and severe >30 comets).

The BLS will be correlated with the volume removed at postdialysis scan time.

DTI performed for all patients before and one hour after dialysis using echocardiography using Philips HD 11 XE, China to determine left ventricle ejection fraction (LVEF), left ventricle end diastolic volume (LVEDV), left atrial diameter (LAD)

The mitral flow velocities were recorded with pulsed-wave Doppler at the tip of mitral valve from the apical four-chamber view. From the mitral inflow velocity curve the following measurements were obtained: peak mitral inflow velocity at early (E) and late (A) Peak diastole, early diastolic velocity of mitral annular motion on lateral side (E'), calculate ratio (E/E`) (Figure 17, 18)

Use Nagueh formula to calculate PCWP indirectly PCWP =1.24[E/E`] +1.9 it shows that when E/E`<8 is usually associated with normal LV filling pressure PCWP<15 mmHg, when ratio >15 is associated with high filling pressure PCWP>15. Between 8 and 15 there is a grey zone with overlapping of values for filling pressures.

CT chest was used as a gold standard to evaluate the sensitivity, specificity and accuracy of both bedside chest ultrasonography and DTI after dialysis.

All patients assessed for the following outcomes:

1- Hemodynamic stability: Heart rate, blood pressure, respiratory rate.

2- Clinical improvement of dyspnea and respiratory distress.

3- Hypoxic index (PaO2/FIO2).

4- Chest x-ray.

5- Laboratory improvement (Bun, K, creatinine and urea).

Statistical analysis of data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Qualitative data were described using number and percent. Quantitative data were described using Range (minimum and maximum), mean and standard deviation and median. Agreement of the different predictives with the outcome was used and was expressed in sensitivity, specificity, positive predictive value, negative predictive value and accuracy. Receiver operating characteristic curve (ROC) was plotted to analyse a recommended cutoff, the area under the ROC curve denotes the diagnostic performance of the test. Area more than 50% gives acceptable performance and area about 100% is the best performance for the test. Significance of the obtained results was judged at the 5% level.

RESULTS

The current study was carried out on 60 adult patients of both sex; all patients were admitted to the Alexandria Main University Hospital with preliminary diagnosis of 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 Doppler tissue imaging done before and one hour after dialysis for all patients to measure E/E` and calculate PCWP indirectly, Patients were assessed for the following parameters.

1- Hemodynamic stability: Heart rate, Blood pressure, Respiratory rate.

2- X-ray chest.

3- Laboratory improvement (urea, Creatinine, BUN, K).

4- Arterial blood gas analysis for measurement of PaO2 and hypoxic index (PaO2/FiO2 ratio).

5. Demographic data (age & sex):

Table (7) shows the distribution of the studied cases according to the demographic data. This study included 25 male and 35 female patients, their age ranged from 33.0 to 67.0 years (Figure 21).

Table (7): Distribution of the studied cases according to demographic data

Age	No.	%
Min. – Max.	33.0 – 67.0	
Mean ± SD.	48.84 ± 8.46	
Median	50.0	
Sex		
Male	25	41.7
Female	35	58.3

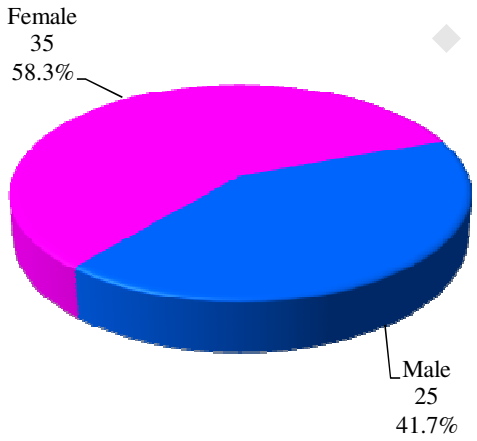

Figure (21): Distribution of studied cases according to sex

2. Medical history:

According to their past medical history 15(25%) patients had diabetes mellitus (DM), 22(36.6%) had hypertension (HTN) and 15 (25%) were smokers (Figure22).

Table (8): Distribution of studied cases according to medical history (n=60)

	No.	%
Hypertension	22	36.6
Diabetes mellitus	15	25.0
Smoker	15	25.0

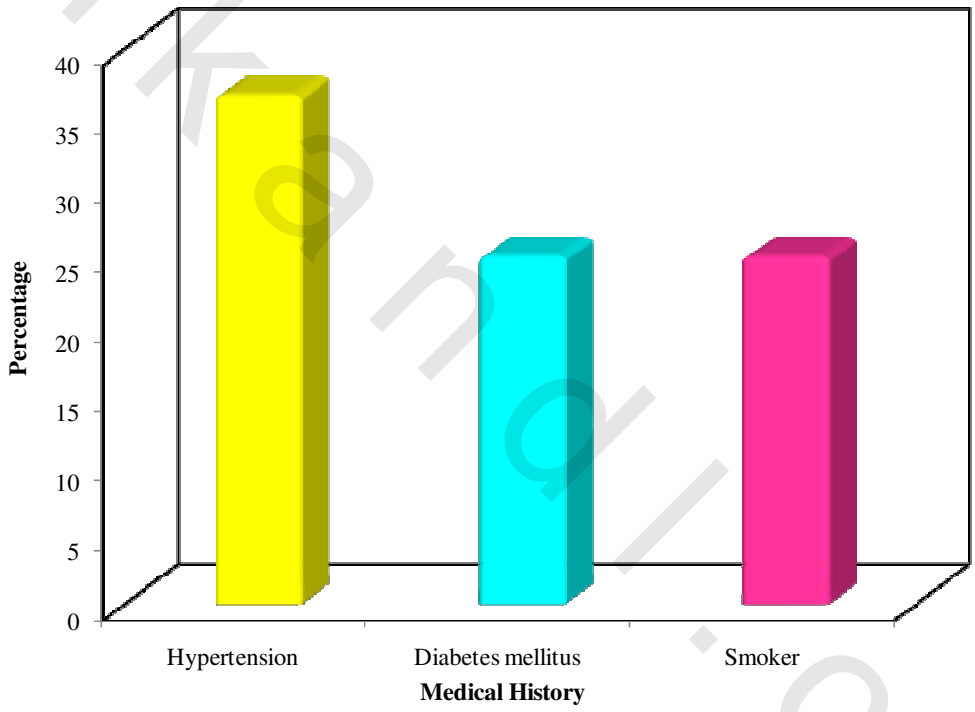

Figure (22): Distribution of studied cases according to medical history

3. Chest ultrasound (U/S) B line score:

Table (9) shows the distribution of the studied cases according to chest ultrasound B line score. 65.0% of the patients presented with severe B line score, 23.33% presented by moderate B line score and 11.66% presented by mild congestion (Figure 23)

Table (9): Distribution of the studied cases according to B line score

B line score	No.	%
Mild 3 - <14	7	11.66
Moderate 14 – 30	14	23.33
Severe >30	39	65.0

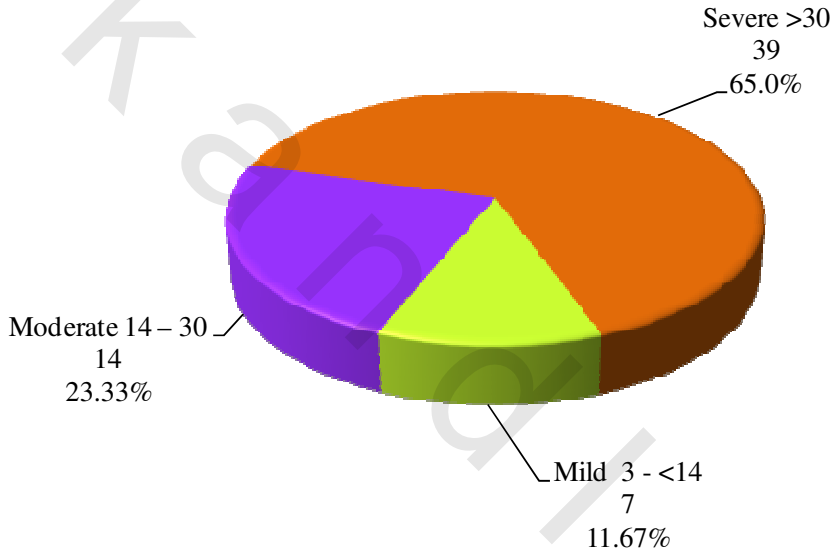

Figure (23): Distribution of studied cases according to B line score

4. Amount of ultrafiltration and time needed for dialysis.

Table (10) shows amount of ultrafiltration and time needed for dialysis for study groups. In group I mean ultrafiltration was 1928.6 ± 345.0 ml, mean ultrafiltration in group II was 2357.1 ± 456.9 cc while in group III was 2500.0 ± 344cc.Time needed for dialysis ranged from 2.0 – 3.0 hours.

Table (10): Distribution of studied cases according to amount of ultrafiltration

	US chest before dialysis			**F**	**P**
	Mild (n = 7) (I)	**Moderate (n = 14) (II)**	**Severe (n = 39) (III)**		
Amount of ultrafiltration					
Min. – Max.	1500.0 - 2500.0	1500.0 - 3000.0	2000.0 - 3000.0		
Mean ± SD.	1928.6 ± 345.0	2357.1 ± 456.9	2500.0 ± 344.1	7.086*	0.002**
Median	2000.0	2500.0	2500.0		
Sig. bet. levels.	I-III**				
Time needed for dialysis					
Min. – Max.	2.0 – 3.0	2.0 – 3.0	2.0 – 3.0		
Mean ± SD.	2.14 ± 0.38	2.21 ± 0.43	2.41 ± 0.50	1.539	0.223
Median	2.0	2.0	2.0		

F: F test (ANOVA), Sig. bet. levels was done using Post Hoc Test (Scheffe)
**: Statistically significant at $p \leq 0.01$

5. Distribution of studied cases after dialysis according to B line score

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(23). After dialysis all 7 patients in mild group became free from B line score, 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(24).

Table (11): Distribution of studied cases after dialysis according to B line score

	US chest after						**Total**	
	Free		**Mild**		**Moderate**			
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
US chest before								
Mild 3- <14	7	11.7	0	0.0	0	0.0	**7**	**11.7**
Moderate 14 – 30	0	0.0	12	20.0	2	3.3	**14**	**23.3**
Severe >30	0	0.0	29	48.3	10	16.7	**39**	**65.0**
Total	**7**	**11.7**	**41**	**68.3**	**12**	**20.0**	**60**	**100.0**

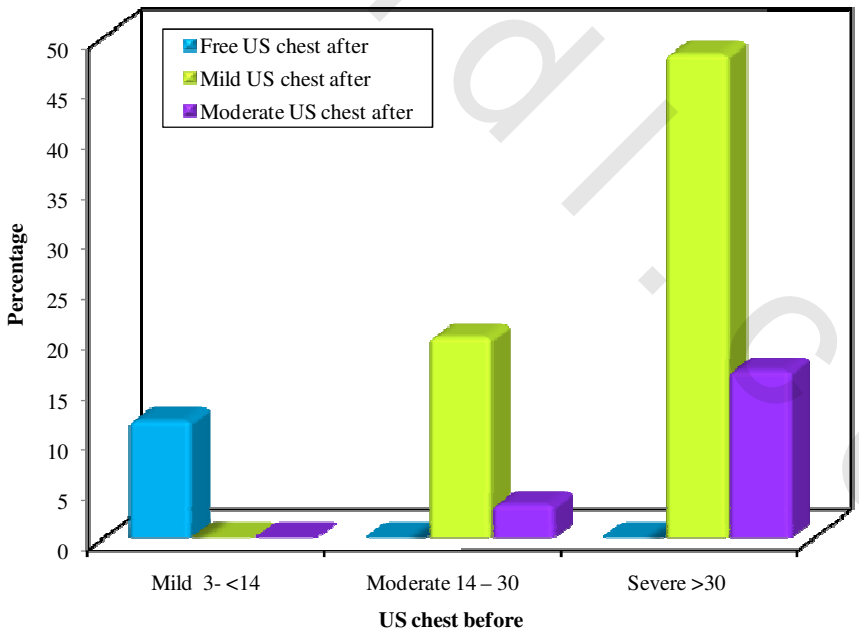

Figure (24): Distribution of studied cases after dialysis according to B line score

6. US chest (BLS) before and after dialysis

Among the studied patients, the mean B line score before dialysis 28.60 ± 10.50 changed to 11.87 ± 2.77 after dialysis.

Table (12): Distribution of studied case according to B line score before and after dialysis.

	Before (n=60)	After (n=53)	Z	p
US chest dialysis				
Min – Max.	6.0 - 42.0	4.0 – 18.0		
Mean ± SD.	28.60 ± 10.50	11.87 ± 2.77	6.340*	<0.001*
Median	34.0	12.0		

Z: Z for Wilcoxon signed ranks test
*: Statistically significant at p ≤ 0.05

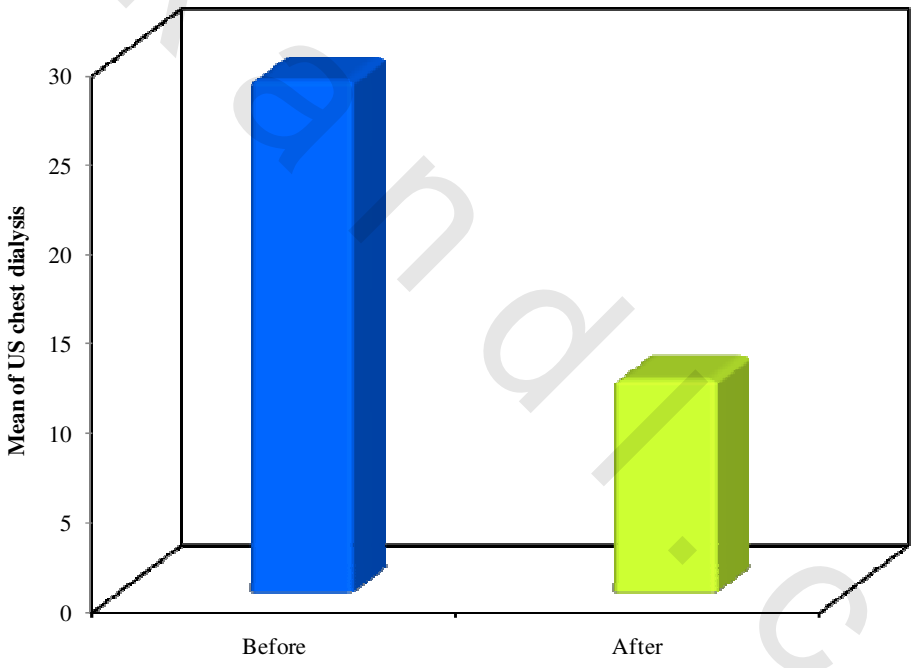

Figure (25): Comparing B line score before and after dialysis

7. Effect of dialysis on vital signs

Among the studied patients, the mean BP before dialysis was 194.25 ± 13.40mmHg changed to 146.0 ± 6.56mmHg after dialysis, mean diastolic BP before dialysis 141.0 ± 13.74mmHg changed to 98.33 ± 5.42mmHg after dialysis, while median HR was 132.50 beat/min changed to 75.0 beat/min. While mean Respiratory rate (RR) was changed from 34.0 breath/min to 20.0 breath/min after dialysis.

Table (13): Distribution of studied cases according to vital signs

	Before (n=60)	**After (n=60)**	**t**	**p**
Systolic blood pressure "BP" (mmHg)				
Min – Max.	150.0 - 230.0	130.0 - 160.0		
Mean ± SD.	194.25 ± 13.40	146.0 ± 6.56	28.507*	<0.001*
Median	190.0	145.0		
Diastolic blood pressure "BP" (mmHg)				
Min – Max.	100.0 - 160.0	90.0 - 110.0		
Mean ± SD.	141.0 ± 13.74	98.33 ± 5.42	25.046*	<0.001*
Median	145.0	100.0		
Heart rate "HR" (beat/min)				
Min – Max.	110.0 - 150.0	60.0 - 100.0		
Mean ± SD.	133.50 ± 8.20	74.17 ± 7.32	11.347*	<0.001*
Median	132.50	75.0		
Respiratory rate "RR" (breath/min.)				
Min – Max.	28.0 – 52.0	18.0 – 24.0		
Mean ± SD.	36.57 ± 7.46	20.95 ± 1.27	15.546*	<0.001*
Median	34.0	20.0		

t: Paired t-test
Z: Z for Wilcoxon signed ranks test
*: Statistically significant at $p \leq 0.05$

8. Effect of dialysis on laboratory investigation

Among the studied patients mean creatinine before dialysis 11.02 ± 1.62 mg/dl changed to 5.93 ± 1.09 mg/dl, mean BUN changed from 131.0 ± 16.81 mg/dl to 64.63 ± 9.91 mg/dl after dialysis, mean Urea before dialysis 282.95 ± 39.30 mg/dl changed to 137.90 ± 18.95 mg/dl, while mean serum potassium changed from 8.0 ± 0.70 mmol/L to 4.48 ± 0.63mmol/L after dialysis.

Table (14): Distribution of studied cases according to laboratory investigation

	Before (n=60)	**After (n=60)**	**Test of Sig.**	**p**
Creatinine (mg/dl)				
Min – Max.	8.40 – 15.0	3.80 – 8.40		
Mean ± SD.	11.02 ± 1.62	5.93 ± 1.09	Z = 6.737*	<0.001*
Median	10.50	5.85		
Blood urea nitrogen (mg/dl)				
Min – Max.	98.0 - 164.0	42.0 - 84.0		
Mean ± SD.	131.0 ± 16.81	64.63 ± 9.91	Z = 6.737*	<0.001*
Median	131.0	64.0		
Serum Urea (mg/dl)				
Min – Max.	200.0 - 380.0	90.0 - 180.0		
Mean ± SD.	282.95 ± 39.30	137.90 ± 18.95	Z = 6.736*	<0.001*
Median	285.0	136.50		
Serum potassium(mmol/L)				
Min – Max.	6.70 - 9.50	3.10 - 5.60		
Mean ± SD.	8.0 ± 0.70	4.48 ± 0.63	t = 32.444*	<0.001*
Median	7.90	4.60		

t: Paired t-test
Z: Z for Wilcoxon signed ranks test
*: Statistically significant at $p \leq 0.05$

9. Effect of dialysis on hypoxic index (HI)

Among the studied cases according to hypoxic index mean HI changed from 112.67 ± 12.74 to 243.67 ± 38.08 after dialysis.

Table (15): Distribution of studied cases according to hypoxic index

	Before (n=60)	After (n=60)	t	p
Hypoxic index				
Min – Max.	90.0 - 140.0	150.0 - 310.0		
Mean ± SD.	112.67 ± 12.74	243.67 ± 38.08	23.620*	<0.001*
Median	110.0	245.0		

t: Paired t-test
*: Statistically significant at $p \leq 0.05$

10. Effect of dialysis on transthoracic Echo parameters:

According to Echo parameters mean left ventricle end diastolic volume (LVEDV) changed from 122.87 ± 5.12 ml to110.32 ± 2.96ml, mean left atrial (LAD)diameter changed from 45.75 ± 2.05mm to 37.33 ± 0.99mm after dialysis, while mean ejection fraction (EF) 60.22 ± 6.10 to 60.20 ± 6.09 % unchanged by dialysis

Table (16): Distribution of studied cases according to transthoracic Echo parameters

	Before (n=60)	After (n=60)	t	p
LVEDV				
Min – Max.	108.0 - 135.0	104.0 – 118.0		
Mean ± SD.	122.87 ± 5.12	110.32 ± 2.96	27.940*	<0.001*
Median	122.50	110.0		
LAD				
Min – Max.	39.0 - 49.0	35.0 – 39.0		
Mean ± SD.	45.75 ± 2.05	37.33 ± 0.99	33.122*	<0.001*
Median	46.0	37.0		
EF				
Min – Max.	53.0 – 71.0	53.0 – 71.0		
Mean ± SD.	60.22 ± 6.10	60.20 ± 6.09	0.799	0.427
Median	59.0	59.0		

t: Paired t-test
*: Statistically significant at $p \leq 0.05$

11. Effect of dialysis on DTI parameters

As regards early diastolic mitral inflow (E) mean of E changed by dialysis from 100.45 ± 8.58 cm/s to 80.53 ± 5.20 cm/s, mean late diastolic (A) changed from 113.20 ± 6.56 cm/s to 93.88 ± 5.29 cm/s, E/A ratio changed from 0.89 ± 0.04 to 0.86 ± 0.03, mean lateral mitral annular velocity (E`) was 8.37 ± 0.75 cm/s changed to 6.99 ± 0.47 cm/s after dialysis, mean E/E` changed from 14.46 ± 1.71 to 9.67 ± 0.83 by dialysis, while mean PCWP changed from 19.83 ± 2.12 mm Hg to 13.89 ± 1.02 after dialysis.

Table (17): Distribution of studied cases according to DTI parameters

	Before (n=60)	**After (n=60)**	**t**	**p**
E				
Min – Max.	80.0 – 110.0	70.0 – 88.0		
Mean ± SD.	100.45 ± 8.58	80.53 ± 5.20	38.557*	<0.001*
Median	102.0	82.0		
A				
Min – Max.	90.0 – 120.0	75.0 – 98.0		
Mean ± SD.	113.20 ± 6.56	93.88 ± 5.29	58.424*	<0.001*
Median	116.0	96.0		
E/A				
Min – Max.	0.79 – 0.95	0.71 – 0.93		
Mean ± SD.	0.89 ± 0.04	0.86 ± 0.03	6.767*	<0.001*
Median	0.89	0.86		
E`				
Min – Max.	6.70 – 9.78	6.05 – 9.40		
Mean ± SD.	8.37 ± 0.75	6.99 ± 0.47	11.150*	<0.001*
Median	8.55	6.92		
E/E`				
Min – Max.	10.0 – 17.20	8.0 – 11.40		
Mean ± SD.	14.46 ± 1.71	9.67 ± 0.83	21.081*	<0.001*
Median	15.05	9.50		
PCWP				
Min – Max.	14.30 – 23.23	11.82 – 16.04		
Mean ± SD.	19.83 ± 2.12	13.89 ± 1.02	21.081*	<0.001*
Median	20.56	13.68		

t: Paired t-test

*: Statistically significant at $p \leq 0.05$

12. Effect of dialysis on CXR

Table (18) shows the distribution of the studied cases according to plain chest radiograph findings, 75% of the patients had pulmonary findings before dialysis while after dialysis 41.7% had pulmonary edema findings.

Table (18): Distribution of studied cases according to CXR findings

	Before (n=60)		After (n=60)		p
	No.	%	No.	%	
CXR dialysis					
-ve	15	25.0	35	58.3	<0.001*
+ve	45	75.0	25	41.7	

χ^2 :McNemar test
*: Statistically significant at $p \leq 0.05$

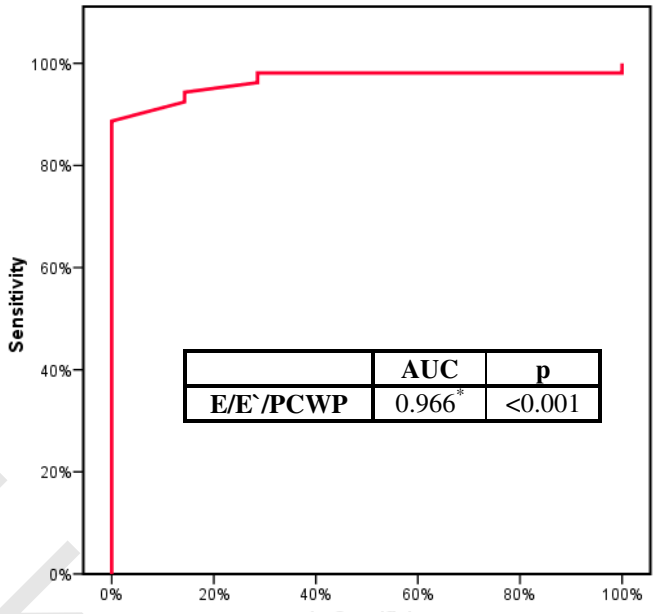

Figure (26): ROC curve for E/E` and PCWP with US chest before dialysis

Table (19): Agreement (sensitivity, specificity and accuracy) for E/E` and PCWP with US chest before dialysis

Before		Mild	Moderate to severe	Sensitivity	Specificity	PPV	NPV	Accuracy
E/E`	**≤12.5**	6	3	94.34	85.71	98.04	66.67	93.33
	>12.5	1	50					
PCWP	**≤17.4**	6	3	94.34	85.71	98.04	66.67	93.33
	>17.4	1	50					

Through the ROC curve E/E` and US chest "bedside gold standard" main final diagnosis non cardiogenic pulmonary edema due to acute renal failure 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 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.

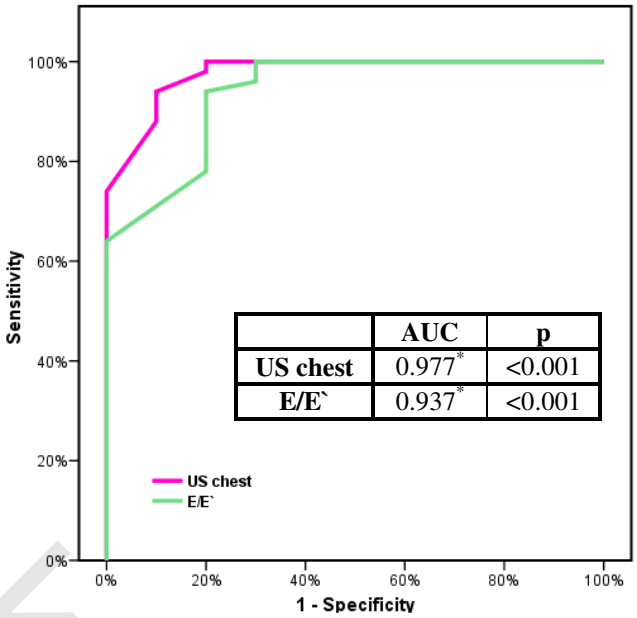

Figure (27): ROC curve for US chest and E/E` after dialysis to diagnose positive CT

Table (20): Agreement (sensitivity, specificity and accuracy) for US chest and E/E` after dialysis with CT

After		-ve CT	+ve CT	Sensitivity	Specificity	PPV	NPV	Accuracy
US chest	**≤3**	9	3	94.00	90.0	97.92	75.0	93.33
	>3	1	47					
E/E`	**≤9**	8	3	94.0	80.0	95.92	72.73	91.67
	>9	2	47					

Through the ROC curve E/E`, US chest and CT chest "gold standard" main final diagnosis non cardiogenic pulmonary edema due to acute renal failure after hemodialysis the area under the receiver operating characteristics curve (AUC) to predict improving of non cardiogenic pulmonary edema by E/E` was 0.937 with a significant p value =0.001. While area under the receiver operating characteristic curve (AUC) to predict improving of noncardiogenic pulmonary edema by US chest was 0.977 with a significant p value =0,001.

As it's shown, 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%. While US chest had diagnosed improving of pulmonary edema with cutoff 3 had sensitivity of 94%, specificity of 90%, positive predictive value 97.92%, negative predictive value of 75% and with accuracy 93.33%.

CASES PRESENTATION

Case (I):

Male patient aged 55 years with past medical history of hypertension and heavy smoking presented with severe dyspnea grade IV and tachypnea.

On examination, patient had bilateral wheezy chest and bilateral mid zonal fine crepitations. ECG showed normal (120 beat/min). Vital signs: the blood pressure=160/110, RR=50 and the heart rate=120. Investigation on admission: Hb=10.7, WBC=8.3, PLT=262, Na+=137, K+=5.1, Creatnine=6, BUN=115, RBS=111. ABG on admission= 7.45, 24, 60, 15.2, 75%. While the follow up ABG= 7.30, 30, 80, 15, 90% on high flow oxygen. Patient was indicated for HD. On lung ultrasonographic examination: B-mode shows multiple B-lines (diffuse lung rockets) (figure 28). On supine AP-CXR bat wing appearance were evident (figure 29). Conventional echocardiographic to assess EF before dialysis (figure 30). DTI to assess mitral inflow velocity and annular velocity figure (31, 32). After 3hrs hemodialysis 2700 cc removed. On lung ultrasonographic examination: B-mode shows significant decrease in B lines (figure 33), On supine AP-CXR still bat wing appearance were evident after dialysis (figure 34), Conventional echocardiographic to assess EF after dialysis (figure 35). DTI to assess mitral inflow velocity and annular velocity figure (36, 37).On CT chest which was our gold standard showed bilateral diffuse ground glass opacities (figure38).

EF changed by dialysis from 69% to 69.3%, while E/E` changed from 12.7 to 9.2

Us chest B line score changed from 22 to 9 by dialysis.

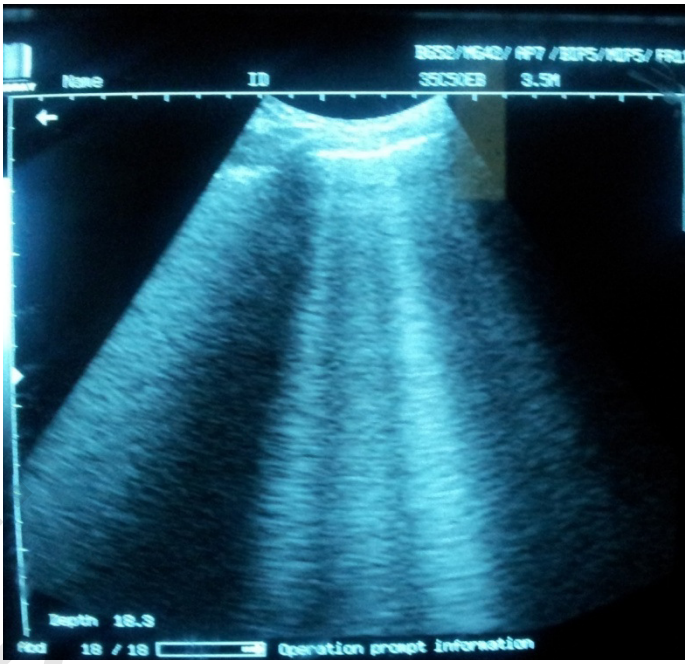

Figure (28): B-mode shows multiple B-lines (diffuse lung rockets) before dialysis.

Figure (29): AP-CXR bat wing appearance before dialysis

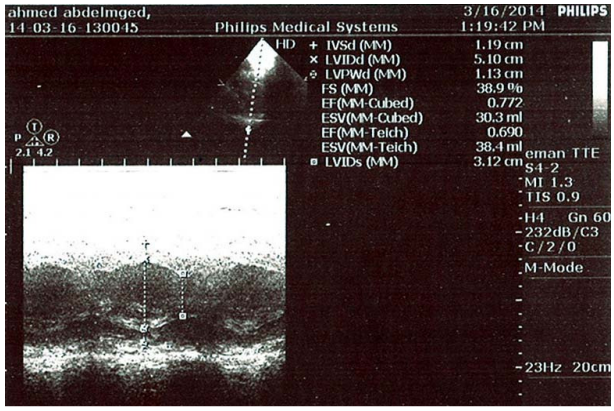

Figure (30): Conventional echocardiographic to assess EF before dialysis.

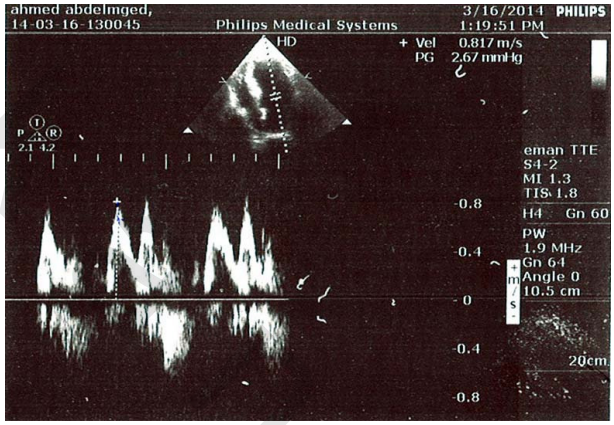

Figure (31): Mitral inflow by pw Doppler before dialysis

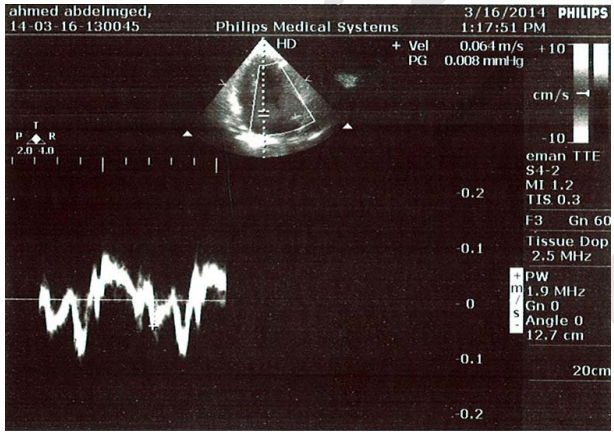

Figure (32): Tissue Doppler mitral annular velocity before dialysis.

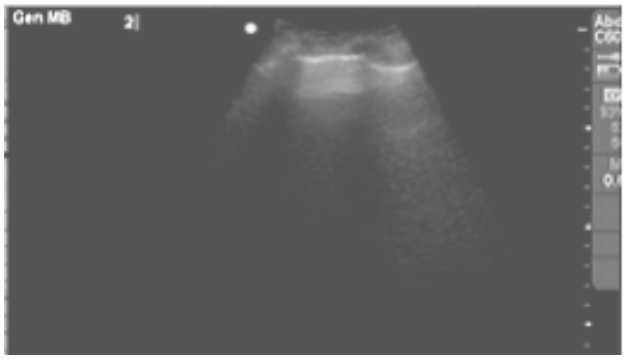

Figure (33): B-mode shows free from B-lines after dialysis.

Figure (34): AP-CXR after dialysis after dialysis.

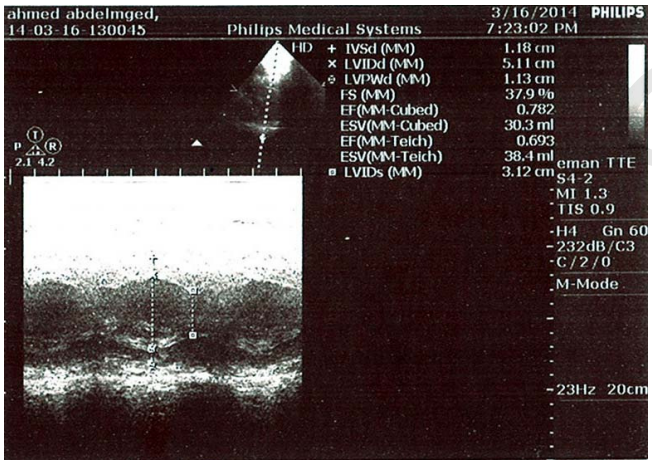

Figure (35): Conventional echocardiographic to assess EF after dialysis.

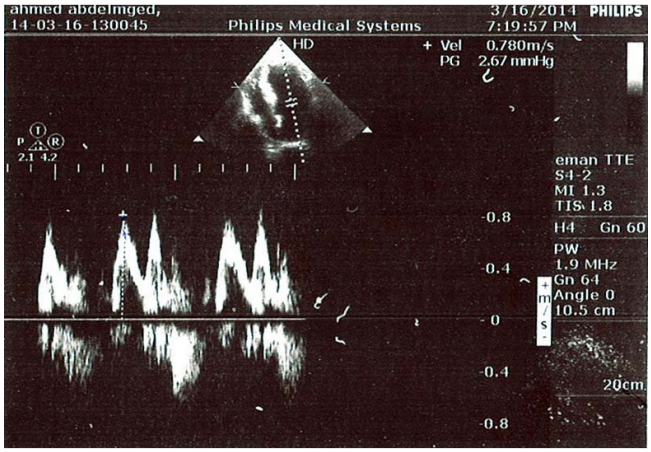

Figure (36): Mitral inflow by pw Doppler after dialysis.

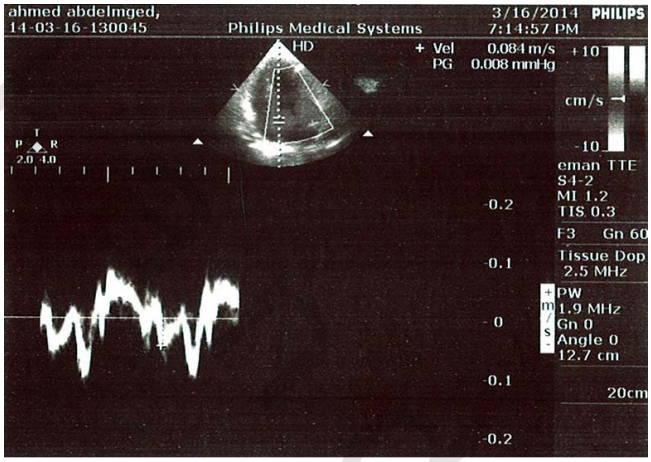

Figure (37): Tissue Doppler mitral annular velocity after dialysis.

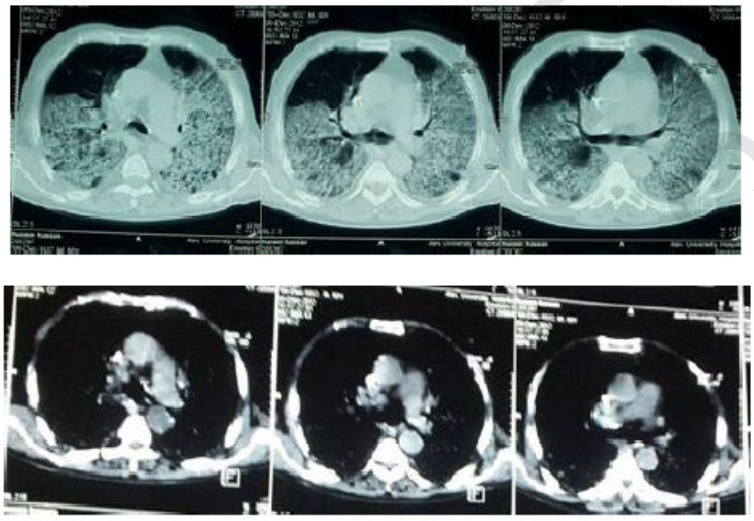

Figure (38): CT chest showing ground-glass opacity, interlobular septal thickening, peribronchovascular interstitial thickening, increased vascular caliber.

Case (II):

Male patient aged 42 years with past medical history of hypertension and Diabetes mellitus presented with severe dyspnea grade III and tachypnea.

On examination, patient had bilateral wheezy chest and bilateral mid zonal fine crepitations. ECG showed normal (100 beat/min). Vital signs: the blood pressure=170/100, RR=45 and the heart rate=100. Investigation on admission: Hb=9.2, WBC=6.7, PLT=320, Na^+=140, K^+=5.7, Creatnine=5, BUN=120, RBS=240. ABG on admission= 7.45, 22, 35, 17, 92% on face mask high flow oxygen. Patient was indicated for HD. On lung ultrasonographic examination: B-mode shows multiple B-lines (diffuse lung rockets) (figure 39). On supine AP-CXR showed enlarged hilar vessels and multiple fine Kerley's A and B lines were evident (figure 40).Conventional echocardiographic to assess EF before dialysis(figure 41). DTI to assess mitral inflow velocity and annular velocity (figure 42, 43). After 2hrs hemodialysis 2000 cc removed. On lung ultrasonographic examination: B-mode shows significant decrease in B lines (figure 44), On supine AP-CXR multiple fine Kerley's B lines were evident after dialysis (figure 45), Conventional echocardiographic to assess EF after dialysis(figure 46). DTI to assess mitral inflow velocity and annular velocity figure (47, 48)On CT chest which was our gold standard showed Interlobular Septal Thickening and ground-Glass Opacity (figure 49).

EF nearly did not changed by dialysis from 71.9% to 72%, while E/E` changed from 10 to 9.2

Us chest B line score changed from 15 to 6.

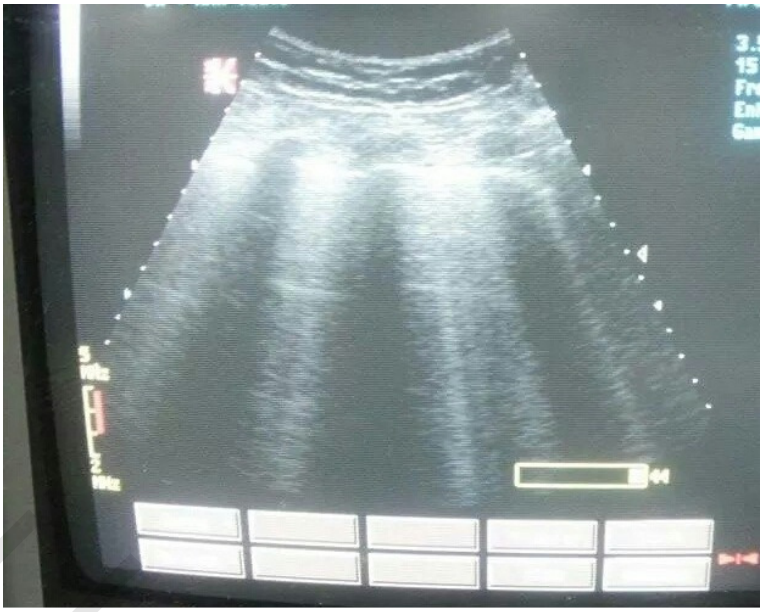

Figure (39): B-mode shows multiple B-lines (diffuse lung rockets) before dialysis.

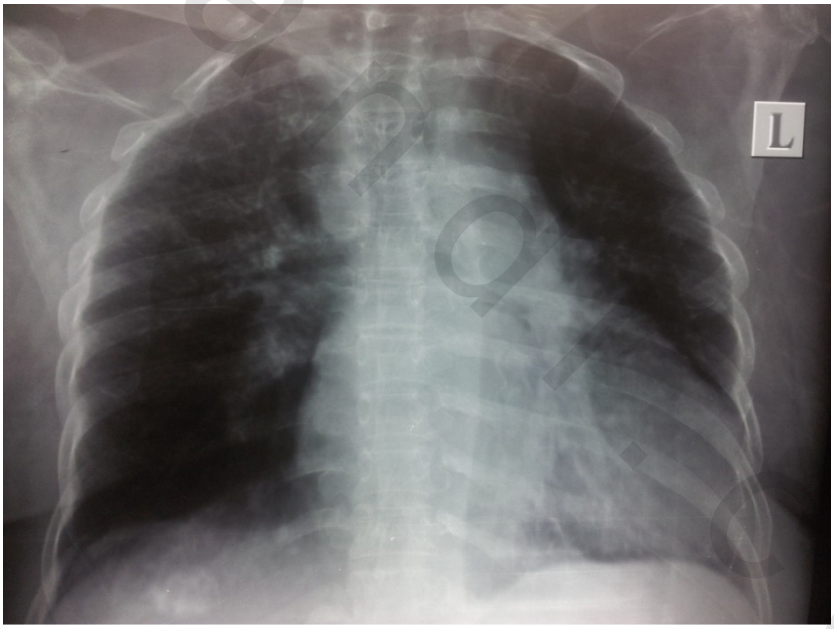

Figure (40): AP-CXR shows enlarged hilar vessels and multiple fine Kerley's A and B lines

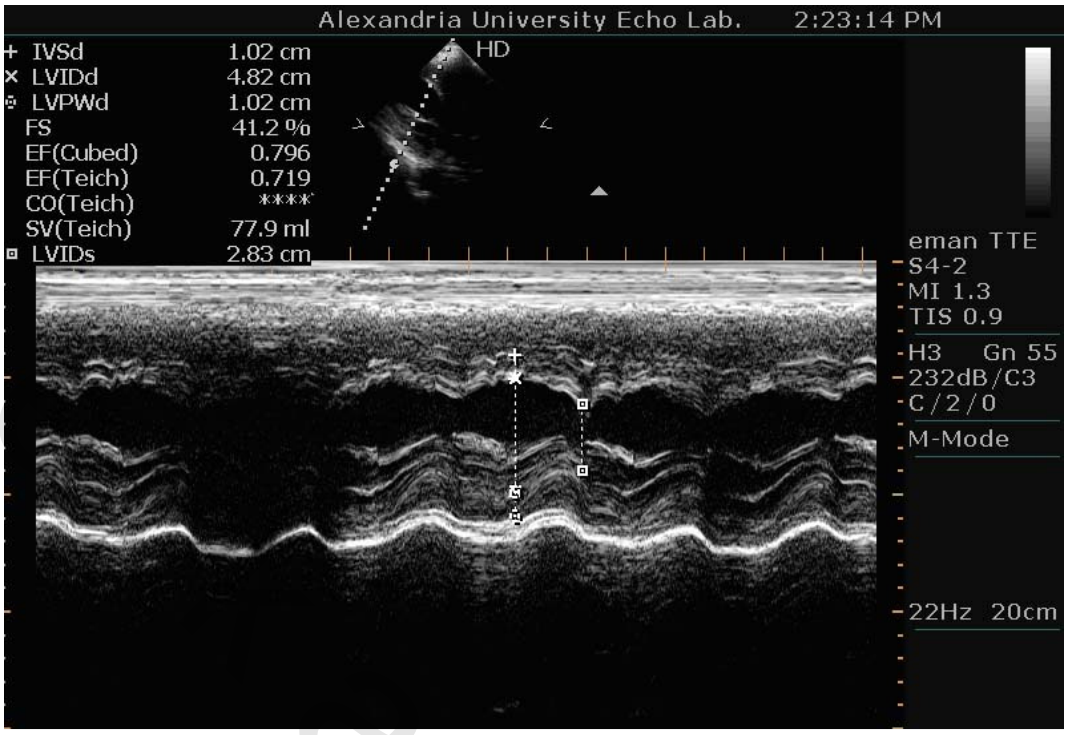

Figure (41): Conventional echocardiographic to assess EF before dialysis.

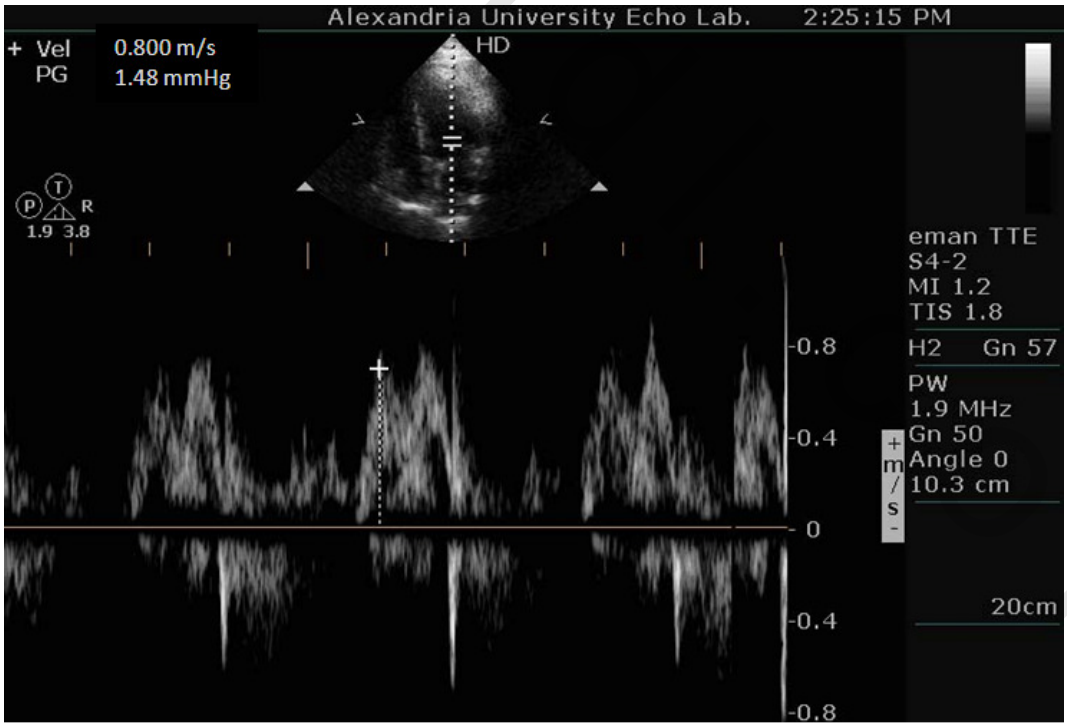

Figure (42): Mitral inflow by pw Doppler before dialysis.

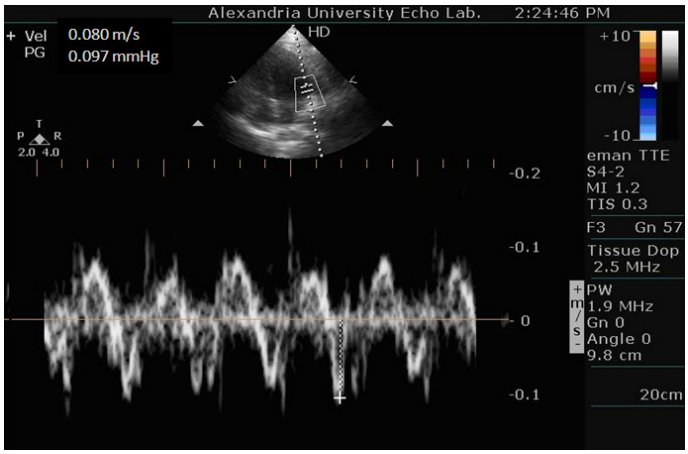

Figure (43): Tissue Doppler lateral mitral annular velocity before dialysis.

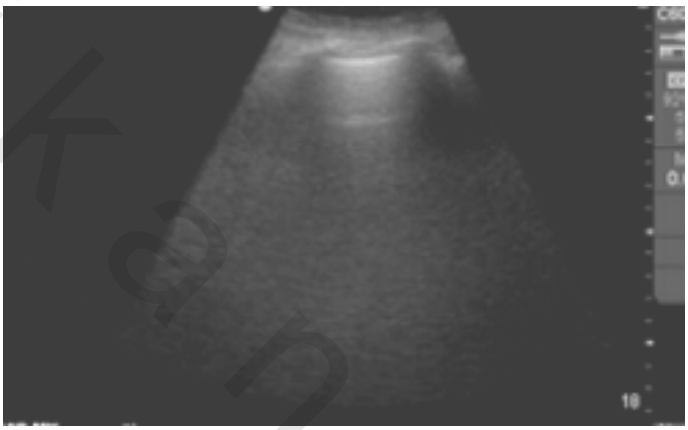

Figure (44): B-mode shows free from B-lines after dialysis

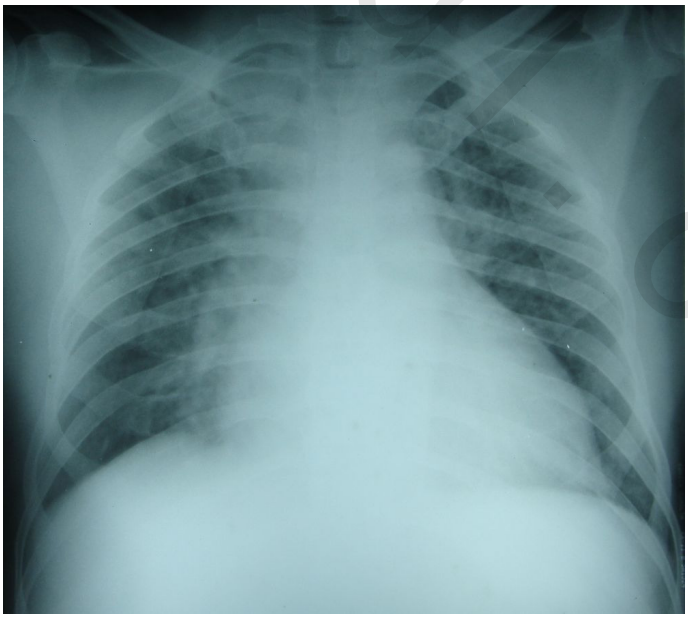

Figure (45): AP-CXR multiple fine Kerley's B lines.

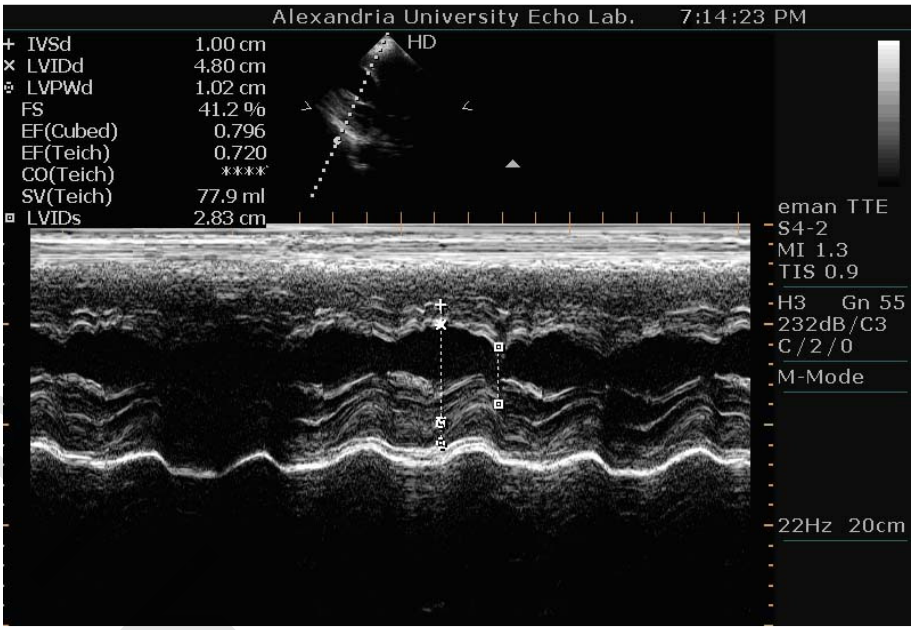

Figure (46): Conventional echocardiographic to assess EF after dialysis.

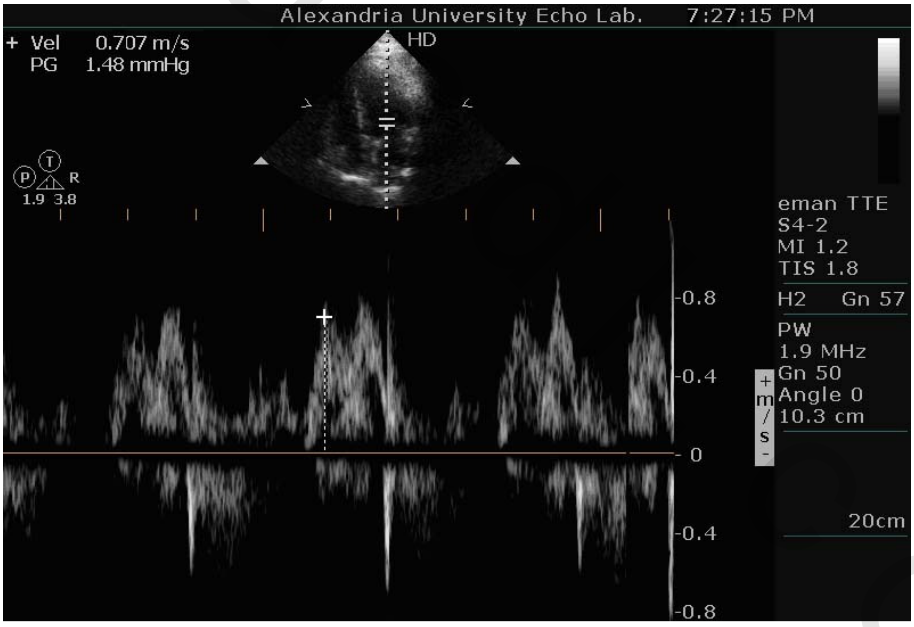

Figure (47): Mitral inflow by pw Doppler after dialysis.

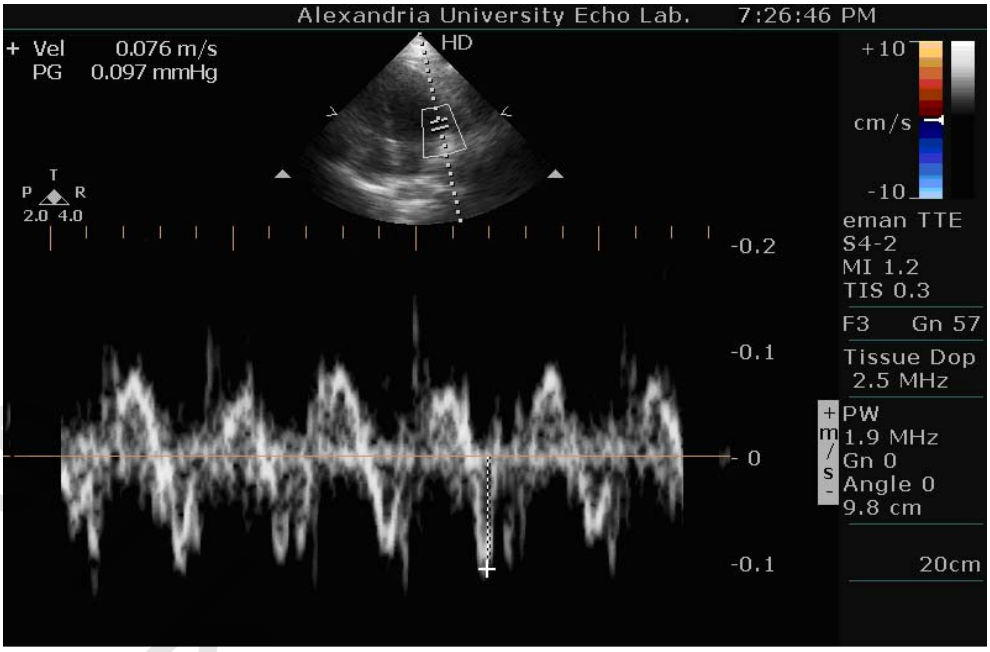

Figure (48): Tissue Doppler lateral mitral annular velocity after dialysis.

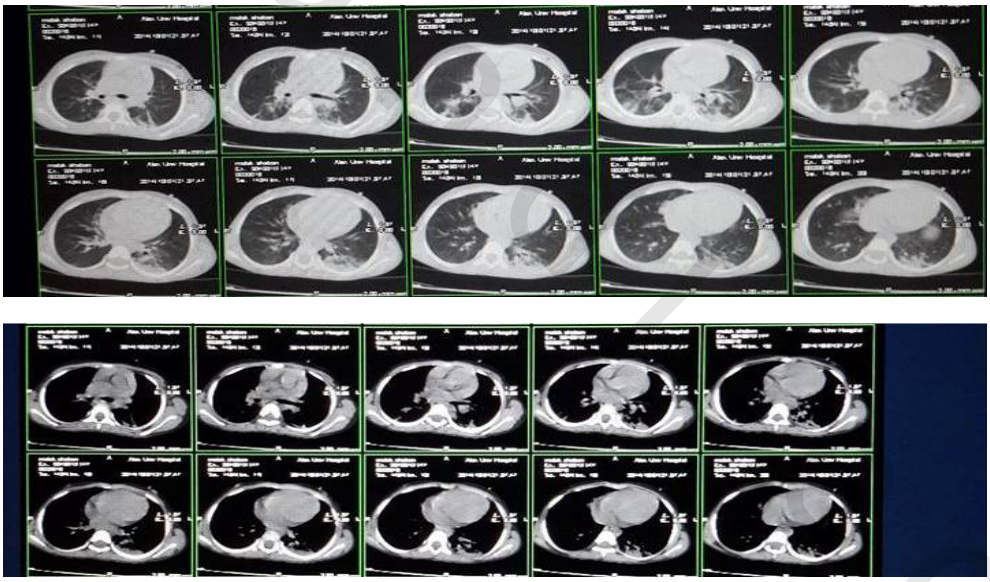

Figure (49): CT chest showing ground-glass opacity, interlobular septal thickening.