RESULTS

Data of study group :

The study group comprised 25 patients, their age ranged between 9 – 18 year with a mean of 13.76 ± 2.69 years. Their height ranged between 115 – 164 cm with a mean of 142 .8 ± 11.74 cm. their weight was between 18 - 52 kg with a mean of 31.88 ± 7.97 kg. 11 patients were males (44%) and 14 females (56%). The duration of the start of treatment has a wide range between 1-60 months with a mean of 22.72 ± 15.53 months.

Table (1): Clinical data of patients

	Patients data	**Mean ± SD**
No.	25	
Males (No. - %)	11 – (44 %)	
Females (No. - %)	14 – (56 %)	
Age (year)	9 - 18	13.76 ± 2.697
Wt (kg)	18 - 52	31.88 ± 7.970
Ht (cm)	115 - 164	142.8 ± 11.740
Duration of H.D. (months)	1 - 60	22.72 ± 15.528

Table (2) and Figure (1) show the classification of patients according to treatment program.

20 patients were on regular hemodialysis using fresenius medical care 4008B machine with bicarbonate dialysate and polysulfone filter membrane. The HD schedule of treatment was regular 3 sets per week, every one for 3 hrs. the duration and volume filteration was specific for each patient according to the dry weight and weight gain at sitting time. Another 5 patients were on conservative treatment in the form of protein-restricted diet, oral $NaHCO_3$ according to PH & HCO_3 of blood gas of each patient, active vitamin D, Calcium tablets, Iron and folic acid.

Table (2): Classification of studied patients according to treatment.

Treatment schedule	Patients	
	No.	%
Conservative	5	20
Haemodialysis	20	80

Fig. (1): Classification of studied patients according to treatment

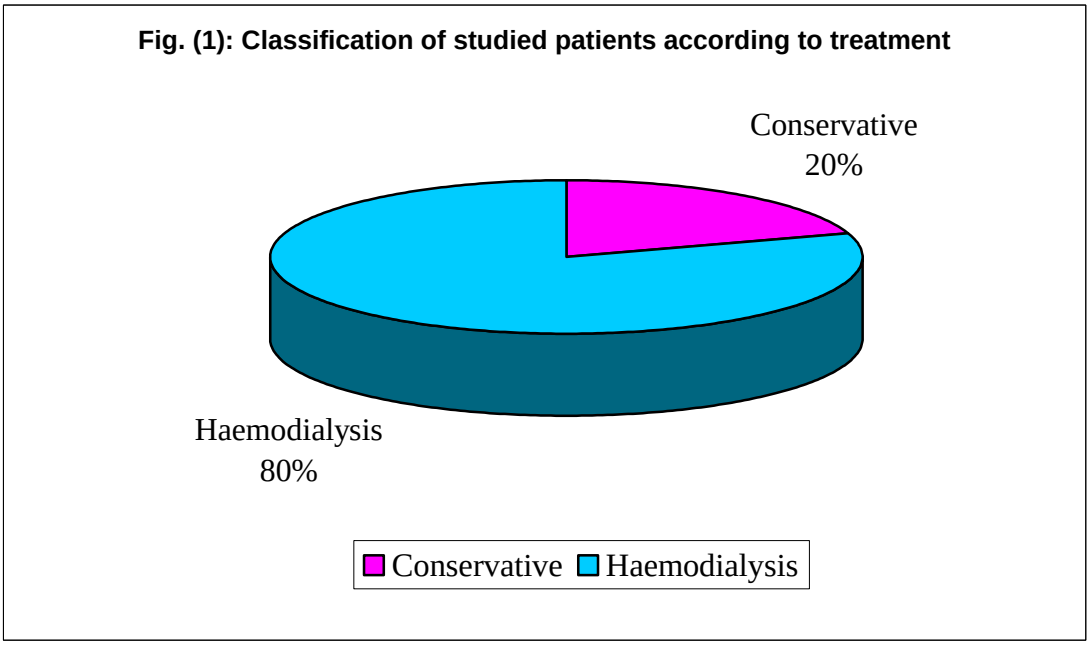


Table (3) Summarizes the laboratory findings of the studied patients with its mean values.

Table (3): Laboratory data in studied patients

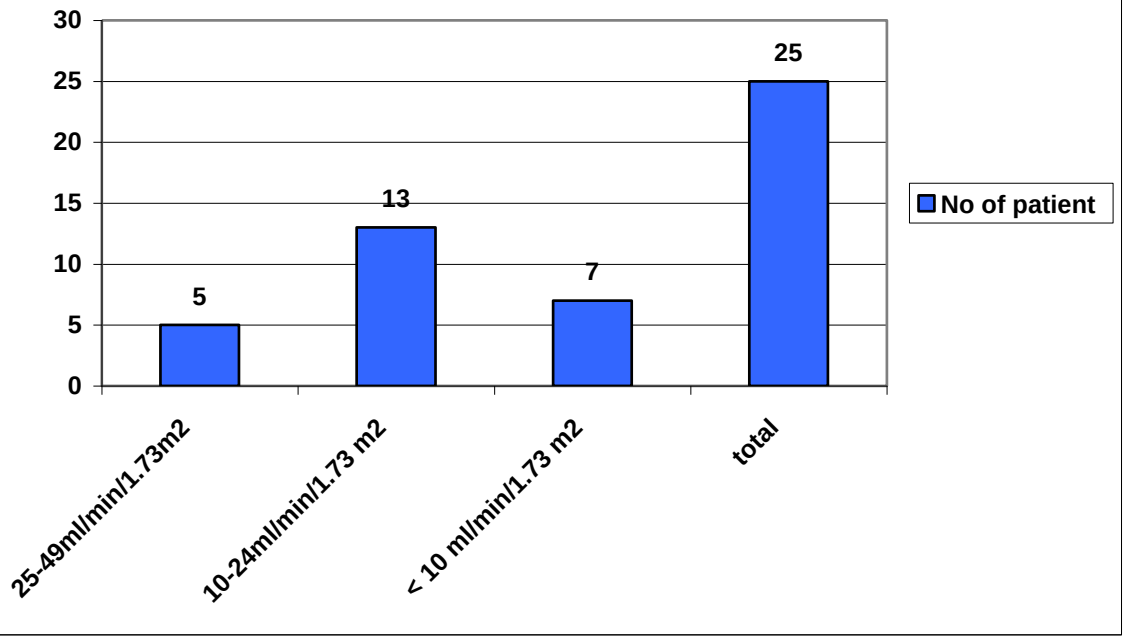
	Range	**Mean ± SD**
GFR	4 – 43 ml/min/1.73m^2	16.08 ± 10.56
BUN	43 – 157 mg/dl	72.68 ± 25.95
Cr.	2.4 - 7.8 mg/dl	5.924 ± 1.27
Albumin	2.2 - 4.5 gm/dl	3.28 ± 0.51
Hb	7.3 - 11.6 gm/dl	8.97 ± 1.28
Ca	6.4 - 10.5 mg/dl	8.46 ± 1.17
PO_4	3.8 - 6.8 mg/dl	5.384 ± 0.79
Na^+	122 – 154 mEq/l	133.52 ± 9.69
K^+	3 – 7 mEq/l	4.968 ± 0.87

To estimate the effect of renal impairment on pulmonary function tests, patients were classified according to their GFR level into 3 categories as seen in (Table 4 and Figure 2) with illustration of no. and sex distribution of patients in each GFR category.

Table (4) : Classification of studied patients according to their GFR level

GFR range	Patients		Males		Females	
	No.	%	No.	%	No.	%
25 - 49 ml/min/1.73 m^2	5	20	1	20	4	80
10 - 24 ml/min/1.73 m^2	13	52	5	38.5	8	61.5
< 10 ml/min/1.73 m^2	7	28	5	71.4	2	29
Total	25	100	11	44	14	56

Fig. (2):Distribution of patients in each GFR category



- No patients with GFR > 50ml/min/1.73 m^2 in our study.
- Patients with GFR < 10 as well as those with GFR 10 – 24 are on regular hemodialysis while patients with GFR 25 – 49 are on conservative treatment.

Table (5): Spirometry in studied patients in comparison with reference values.

PF Prameters	Reference values		Patients values		P values
	Range	Mean ± SD.	Range	Mean ± SD.	
FVC	0.81 - 3.43	2.20 ± 0.79	0.65 - 3.79	1.59 ± 0.63	P < 0.01
FEV1	0.68 - 3.15	1.97 ± 0.70	0.53 - 3.27	1.43 ± 0.52	P < 0.01
FEV1/ FVC	81 - 88	85.68 ± 1.22	74 - 100	90.48 ± 7.14	N.S.
FEF 25-75	1.09 - 3.53	2.43 ± 0.71	0.34 - 3.56	1.89 ± 0.74	P < 0.05
PEF	2.91 - 7.07	4.73 ± 1.33	1.67 - 4.23	2.84 ± 0.72	P < 0.05

All spirometric parameters show significant lower values than reference values except FEV_1 / FVC where there was no significant difference.

Fig. (3): Mean & Range of Spirometry

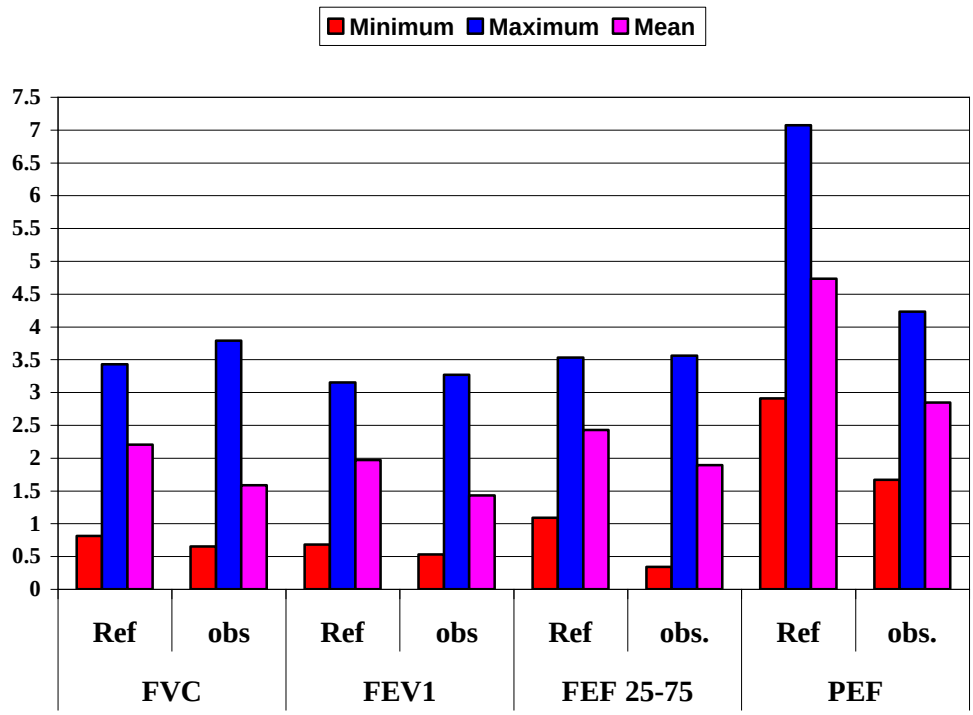


Table (6): Lung volumes in studied patients in comparison with reference values.

PF Prameters	Reference values		Patients values		P values
	Range	Mean ± SD.	Range	Mean ± SD.	
TLC	1.02 - 4.38	2.88 ± 0.98	0.89 - 4.93	2.10 ± 0.81	P < 0.05
RV	0.27 - 1.09	0.63 ± 0.20	0.17 - 1.14	0.72 ± 0.21	P < 0.01
RV / TLC	20 - 27	22.36 ± 1.75	18.9 - 38.7	26.36 ± 4.41	P < 0.01

Lung volumes show significantly lower TLC (P < 0.05), Significantly higher RV (P < 0.01) and RV/ TLC (P < 0.01).

Fig. (4): Mean & Range of lung Volumes

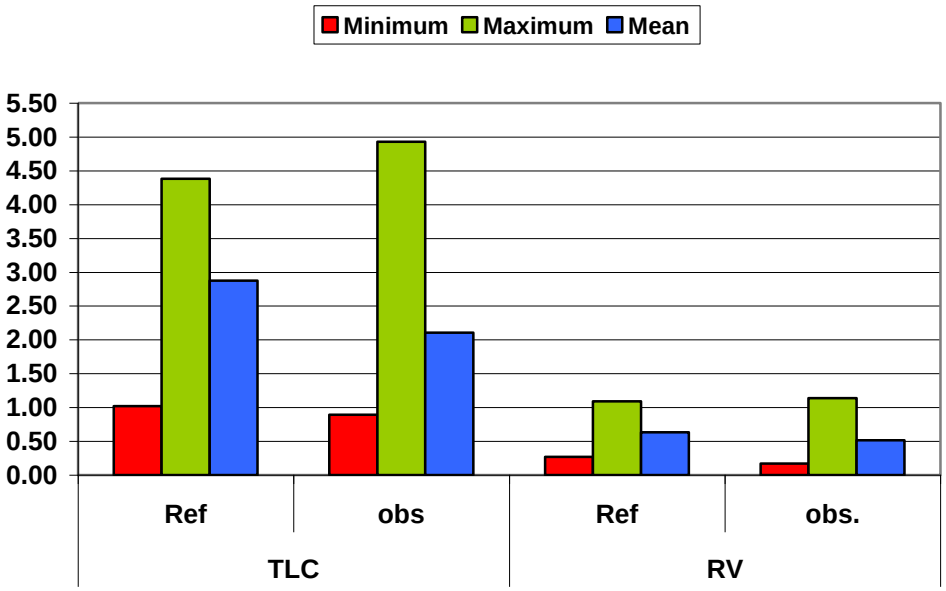


Table (7): DLCo adj. in studied patients in comparison with reference values.

PF Prameters	Reference values		Patients values		P values
	Range	Mean ± SD.	Range	Mean ± SD.	
DLCo adj.	11.7 - 25.7	17.86 ± 4.38	8.7 - 23	14.167 ± 3.54	P < 0.01

DLCo adj. was significantly lower (P< 0.01) than reference values.

Fig. (5): Mean & Range of DLCo adj.

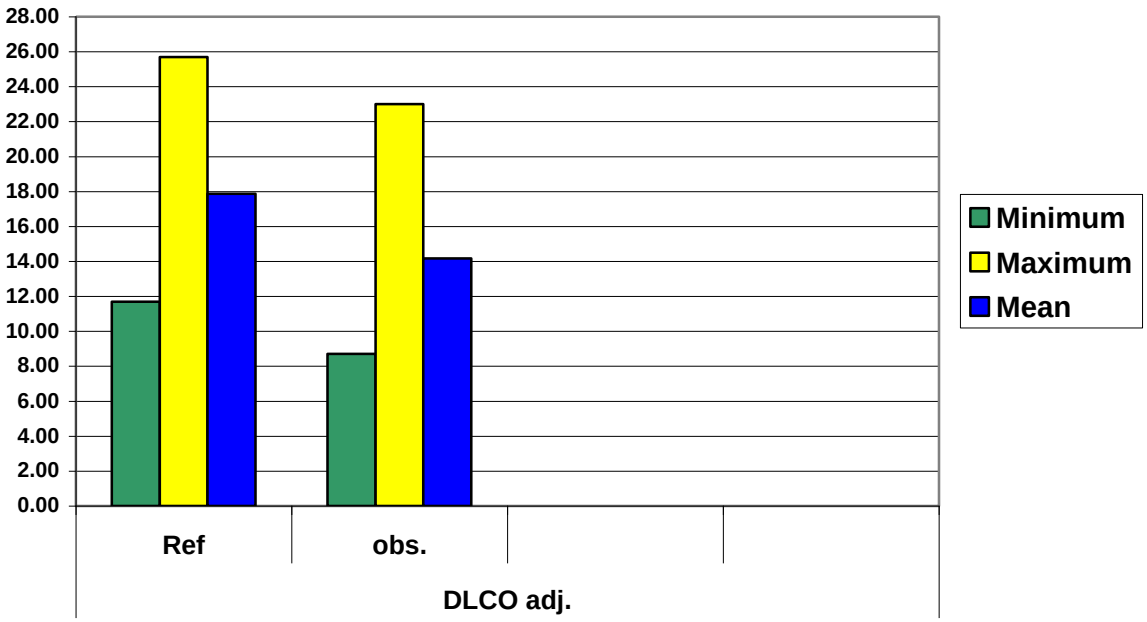


Table (8): Correlation of patients according to GFR level in relation to different clinico-laboratory parameters.

Item	GFR based group	Mean ± SD.	Comparison with study group
Age 13.76 ±2.72	25 - 49	14.60 ± 2.88	NS
	10 - 24	12.92 ± 2.43	NS
	< 10	14.71 ± 2.93	NS
Height 142.8 ±1176	25 - 49	149.20 ± 11.95	NS
	10 - 24	140.54 ± 10.07	NS
	< 10	142.43 ± 14.42	NS
Weight 31.88 ± 7.99	25 - 49	35.00 ± 11.98	NS
	10 - 24	30.54 ± 5.80	NS
	< 10	32.14 ± 8.90	NS
HD duration 22.72 ± 15.55	25 - 49	22.40 ± 21.96	NS
	10 - 24	21.46 ± 9.87	NS
	< 10	25.29 ± 20.90	NS
Hb% 8.97 ± 1.30	25 - 49	10.90 ± 0.60	NS
	10 - 24	8.53 ± 1.03	P < 0.05
	< 10	8.41 ± 0.53	P < 0.05
Albumin 3.28 ± 0.53	25 - 49	3.26 ± 0.11	NS
	10 - 24	3.49 ± 0.57	NS
	< 10	2.89 ± 0.31	NS
Ca 8.64 ± 1.19	25 - 49	8.52 ± 0.80	NS
	10 - 24	8.18 ± 0.99	NS
	< 10	7.94 ± 1.63	P < 0.05

Table (8) shows the classified categories of patients according to GFR level in relation to different clinico-Laboratory parameters. There was no statistically significant difference in relation to age, height, weight, HD duration and albumin.

The Hb level showed statistically significant drop in patients with GFR < 10 ($P < 0.05$) and those with GFR 10 – 24 ($P < 0.05$).

Also Ca showed statistically significant diminution in patients with GFR < 10 ($P < 0.05$).

Table (9): Statistical comparison of the spirometry parameters in different categories of patients.

PF parameter	GFR levels of significant difference	R value	P value	Mean
FVC	GFR < 10	0.958	P < 0.01	1.42
	GFR 10 – 24	0.831	P < 0.05	1.53
	GFR 25 – 49	0.456	NS	1.96
FEV1	GFR < 10	0.596	NS	1.31
	GFR 10 – 24	0.568	NS	1.38
	GFR 25 – 49	0.424	NS	1.74
FEV1/FVC	GFR < 10	0.881	P < 0.01	92.00
	GFR 10 – 24	0.424	NS	90.62
	GFR 25 – 49	0.440	NS	88.00
FEF 25 – 75	GFR < 10	0.936	P < 0.01	1.41
	GFR 10 – 24	0.836	P < 0.05	1.74
	GFR 25 – 49	0.501	NS	2.26
PEF	GFR < 10	0.770	P < 0.05	2.67
	GFR 10 – 24	0.958	P < 0.01	2.71
	GFR 25 – 49	0.503	NS	2.81

Table (9) summarizes the results of statistical comparison of parameters of spirometry in different categories of patients:

- There was significant diminution in FVC in patients with GFR < 10 (P < 0.01) and those with GFR 10 – 24 (P < 0.05). The correlation coefficient with GFR was +ve as decrease in GFR level was associated with decrease in FVC value.
- There is no effect of GFR on FEV_1.

- There was significant increase in FEV_1/FVC in patients with GFR < 10 ($P<0.01$) demonstrating a restrictive pattern of pulmonary function defect.
- There was significant lower FEF_{25-75} in patients with GFR < 10 ($P < 0.01$) and those with GFR 10 – 24 ($P < 0.05$) with a +ve correlation coefficient with GFR.
- PEF was significantly lower in patients with GFR < 10 ($P< 0.05$) and those with GFR 10-24 ($P < 0.01$) with +Ve correlation coefficient with GFR.

Table (10) Statistical comparison of lung volumes in different categories of patients.

PF parameter	GFR levels of significant difference	R value	P value	Mean
TLC	GFR < 10	0.959	P < 0.01	1.90
	GFR 10 – 24	0.828	P < 0.05	2.04
	GFR 25 – 49	0.448	P < 0.05	2.56
RV	GFR < 10	- 0.817	P < 0.05	0.61
	GFR 10 – 24	- 0.769	P < 0.05	0.50
	GFR 25 – 49	- 0.334	NS	0.48
RV/TLC	GFR < 10	- 0.733	P < 0.05	31.04
	GFR 10 – 24	- 0.668	NS	24.69
	GFR 25 – 49	- 0.637	NS	24.12

Table (10) summarizes the results of statistical comparison of lung volumes in different categories of patients:

- TLC was significantly decreased in all categories of patients; in GFR < 10 (P< 0.01), GFR 10 – 24 (P< 0.05) and GFR 25 – 49 (P < 0.05) with +ve correlation coefficient with GFR.
- There was significant increase in RV in patients with GFR < 10 (P < 0.05) and those with GFR 10 – 24 (P < 0.05) with –ve correlation coefficient with GFR.
- There was statistically significant rise in RV/TLC in patients with GFR < 10 (P < 0.05) with –ve correlation coefficient as decrease in GFR level was associated with a rise of RV/TLC value.

Table (11): Statistical comparison of DLCo adj. in different categories of patients.

PF parameter	GFR levels of significant difference	R value	P value	Mean
DLCo adj.	GFR < 10	0.849	P < 0.05	13.34
	GFR 10 – 24	0.773	P < 0.05	13.47
	GFR 25 – 49	0.439	NS	17.12

Table (11) shows the statistical comparison of DLCo adj. in different categories of patients.

- DLCo adj. was significantly decreased in patients with GFR < 10 (P< 0.05) and those with GFR 10 – 24 (P < 0.05) with +ve correlation coefficient with GFR.

Table (12): Correlation of pulmonary function tests with clinico-laboratory parameters in studied patients.

	FVC	**FEV1**	**FEF_{25-75}**	**PEF**	**RV/TLC**	**DLCo adj.**
Age	- .101	-.081	-.164	-.542**	.255	-.090
RF duration (month)	- .015	.022	-.092	-.240	-.232	-.227
Hb%	. 497*	.451*	.190	.034	-.062	.546**
Albumin	.325	.293	.073	.075	-.230	.394
BUN	-.532**	-.437*	-.169	-.285	.390	-.418*
Ca	.098	.134	-.049	.160	-.426*	.034
HD duration (month)	-.019	-.072	-.125	-.273	.152	-.020

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

*. Correlation is significant at t he 0.05 level (2- tailed).

Table (12) shows the correlation of pulmonary function tests with Clinico-laboratory parameters of studied patients:

- The age of studied patients did not show statistically significant difference in all PFT parameters except with PEF ($P < 0.01$) and there was a –ve relation between age of patients and all PFT parameters except RV/TLC where there was a +ve relation as with increased age of patients there was an increase in RV/TLC.
- The duration of RF was not statistically significant with all parameters of PFT. There was –ve correlation with all PFT parameters except with FEV_1 where there was a +ve correlation.
- Hb level showed statistically significant correlation with FVC ($P<0.05$), FEV_1 ($P< 0.05$) and DLCo adj. ($P< 0.01$). and there was +ve correlation coefficient with all PFT parameters except with RV/TLC where there was –ve correlation.

- Serum albumin did not show statistically significant correlation with all parameters of PFT with a +ve correlation with all parameters except with RV/TLC in which there was –ve correlation.
- Blood urea showed statistically significant difference with FVC ($P<0.01$), FEV_1 ($P < 0.05$) and DLCo adj. ($P <0.05$) with a –ve relation with all parameters of PFTs except in RV/TLC where there was a +ve correlation.
- Serum Ca did not show statistically significant difference with all PFT parameters except RV/TLC ($P <0.05$) with a +ve correlation with all parameters except with FEF_{25-75} and RV/TLC where there was –ve correlation.
- HD duration did not show statistically significant difference in all PFT parameters with a –ve correlation with all parameters except RV/TLC where there was +ve correlation.