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Chronic Kidney Disease and its Effect on the lungs

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Abstract

Background: Chronic kidney disease (CKD), which is also referred to as chronic renal disease, refers to the gradual deterioration of kidney function that occurs over several months or years. Anyone whose glomerular filtration rate (GFR) has been less than 60 mL/min/1.73 m2 for at least three months is diagnosed with chronic kidney disease, regardless of whether or not there is any kidney damage present. **Aim and objectives:** to study the effect of chronic kidney disease on the pulmonary system, **Subjects and methods:** The study was performed on 40 patients with chronic kidney disease at Faculty of Medicine – Benha University , **Result:** There was significant differences between two groups as regard CBC, urea, creatinine, K and uric acid. There was insignificant differences between two groups as regard D dimer. There was a statically significant correlation between PE max % predictive and duration of illness and dialysis , temperature , Sat.O2, FVC ,Hb,WBCs , PLTT, urea , creatinine , INR, K, , uric acid and albumin. **Conclusion:** Awareness of the interrelatedness of respiratory and renal function is important in managing patients with diseases of both the lungs and the kidneys.

Keywords: chronic kidney; diseases (CKD); lung-protective; ventilation.

Introduction

Chronic kidney disease (CKD) is a medical condition characterized by a gradual loss of kidney function over a prolonged period.**[1]**

Regardless of the presence or absence of kidney damage, individuals who have had a GFR of less than 60 mL/min/1.73 m² for a continuous period of 3 months are considered to have chronic kidney disease The symptoms of worsening kidney function are non-specific, and might include feeling generally unwell and experiencing a reduced appetite. The most common causes of chronic kidney disease are hypertension and diabetes mellitus. Chronic kidney disease may also be diagnosed when it leads to one of its recognized complications, such as anemia, CVD, or pericarditis.**[2]**

Physiologically, the lungs and kidneys are intricately related, not least as homeostatic organs controlling the cellular electrolyte and acid-base status that guarantee the best microenvironment for cellular function. Per-ceptually, pulmonary abnormalities may arise as a direct consequence of renal disease (primary consequences) or through generalized systemic processes that specifically involve both organ systems concomitantly.**[3]**

The management of patients with chronic renal failure is frequently complicated by pulmonary edema and the effects of both fluid overload and metabolic acidosis.**[4]**

These processes affect the management of mechanical ventilation in such patients and may interfere with weaning successful lung-protective ventilation in patients with renal failure and acute lung injury may require modification of hemodialysis in order to combat severe acidemia.**[5]** Hemodialysis related hypoxemia, which was once believed to be the result of pulmonary leukostasis and complement activation, is explained by diffusion of CO2 into the dialysate, with concomitant alveolar hypoventilation in the process of maintaining a normal PaCO2. Like acute lung injury, renal failure is a common complication of critical illness.**[4]**

Patients And Methods

The study was performed on 40 patients with chronic kidney disease on Department of Internal Medicine, Faculty of Medicine – Benha University.

Inclusion criteria: CKD patients on medical treatment without hemodialysis and CKD patients on regular hemodialysis.

Exclusion criteria: CKD patients with chronic lung disease and Smoker's patients.

Methods

All patients were subjected to: Complete history taking, Physical examinations (General examination, local examination, abdominal examination, Examination of the Kidneys and Chest Examination) and Investigation (Routine laboratory investigations, Urine Culture, Radiological investigation and Computed tomography chest without contrast).

Ethical Consideration

The data that were obtained from participants are confidential. The study participants will not be identified by name in any report or publication concerning this study. Before the participants were admitted in this

study, the purpose and nature of the study, as well as the risk–benefit assessment was explained to them. An informed consent was obtained.

Statistical Analysis

Data were checked, entered and analyzed using SPSS version 23 for data processing. The following statistical methods were used for analysis of results of the present study.

Results

60% of included cases were males, 40% were females with mean age 52.1 years and mean BMI was 23.32 **(table 1)**

Table (1) Demographic data of the studied patients (n = 40)

	No.	%
Sex		
Male	24	60.0
Female	16	40.0
Age (years)		
Min. – Max.	36.0 – 67.0	
Mean ± SD.	52.10 ± 10.54	
Median (IQR)	45.0 (43.0 – 65.0)	
BMI (kg/m^2)		
Min. – Max.	19.80 – 27.0	
Mean ± SD.	23.32 ± 2.26	
Median (IQR)	23.0 (21.0 – 25.0)	

Data were expressed as mean ± SD (standard deviation), Median (IQR): **Inter quartile range**

CT findings shows 35% had BVM, 25% had interstitial thicknening, 32.5% had lung congestion , 355 had cardiomegaly , 32.5% had infection , 37.5% had pleural effusion , 37.5% had calcification , 22.5% had consolidation , 37.5% had ground glass opacity and 25% had pulmonary embolism. **(Table 2)**

Table (2) CT findings of the studied patients (n = 40)

CT findings	No.	%
BVM	14	35.0
Interstitial thickening	10	25.0
Lung cognation	13	32.5
Cardiomegaly	14	35.0
Infection	13	32.5
Pleural effusion	15	37.5
Calcification	15	37.5
Consolidation	9	22.5
Ground glass opacity	15	37.5
Pulmonary embolism	10	25.0

There was a considerably higher in **FEV1% predictive** in dialysis cases than medical treatment cases but as regard **FVC% predictive** it was significantly lower among dialysis cases. Regarding **FEV1/FVC ratio** was insignificant differences between two groups. **(Table 3)**

Table (3) Medical treatment and dialysis according to pulmonary functions of the studied patients

Pulmonary functions	Medical treatment (n = 22)	Dialysis (n = 18)	t	p
FEV1% predictive				
Min. – Max.	78.70 – 85.60	79.80 – 88.70		
Mean ± SD.	81.82 ± 2.70	84.16 ± 3.27	2.480*	0.018*
Median (IQR)	80.70 (78.70–85.60)	83.60 (83.50–88.70)		
FVC% predictive				
Min. – Max.	80.0 – 86.0	69.0 – 75.0		
Mean ± SD.	82.45 ± 2.06	71.89 ± 2.61	14.305*	<0.001*
Median (IQR)	82.0 (80.0 – 83.0)	72.0 (69.0 – 75.0)		
FEV1/FVC ratio				
Min. – Max.	77.0 – 82.0	73.0 – 85.0	0.105	0.918
Mean ± SD.	79.73 ± 1.91	79.61 ± 4.38		

Median (IQR)	80.0 (77.0 – 82.0)	80.0 (78.0 – 85.0)

IQR: **Inter quartile range** SD: **Standard deviation** **t: Student t-test**
P: p value for comparing between **medical treatment** and **dialysis**
*: significant as $p \leq 0.05$

There was significant differences between two groups as regard PFT result as normal finding founded only among medical treatment cases. **(Table 4)**

Table (4) Medical treatment and dialysis according to PFT result

PFT result	**Medical treatment(n = 22)**		**Dialysis (n = 18)**		χ^2	^{MC}p
	No.	**%**	**No.**	**%**		
Normal	12	54.5	0	0.0	17.787*	<0.001*
Restrictive	6	27.3	9	50.0		
Obstructive	4	18.2	5	27.8		
Mixed	0	0.0	4	22.2		

χ^2: **Chi square test** MC: **Monte Carlo**
p: p value for comparing between **medical treatment** and **dialysis**
*: significant as $p \leq 0.05$

There was significant differences between two groups as regard CBC, urea, creatinine, K and uric acid. There was insignificant differences between two groups as regard D dimer. **(Table 5)**

Table (5) Medical treatment and dialysis according to laboratory data

Laboratory data	**Medical treatment (n = 22)**	**Dialysis (n = 18)**	**Test of Sig.**	**p**
Hb				
Min. – Max.	10.0 – 11.20	8.90 – 9.80	t= 9.687*	<0.001*
Mean ± SD.	10.71 ± 0.41	9.48 ± 0.38		
Median (IQR)	10.80 (10.60 – 11.20)	9.70 (9.0 – 9.80)		
WBCs				
Min. – Max.	9879.0 – 12357.0	7656.0 – 8987.0	t= 13.917*	<0.001*
Mean ± SD.	11377.91 ± 890.95	8157.39 ± 560.77		
Median (IQR)	11789.0 (10987.0 – 12357.0)	7867.0 (7656.0 – 8768.0)		
PLT				
Min. – Max.	236.0 – 314.0	234.0 – 354.0	t= 4.019*	<0.001*
Mean ± SD.	265.55 ± 32.63	311.67 ± 39.98		
Median (IQR)	265.0 (236.0 – 314.0)	324.0 (276.0 – 354.0)		
Urea				
Min. – Max.	24.0 – 34.0	76.0 – 140.0	U= 0.000*	<0.001*
Mean ± SD.	28.36 ± 4.08	119.44 ± 22.60		
Median (IQR)	26.0 (24.0 – 34.0)	130.0 (97.0 – 140.0)		
Cr				
Min. – Max.	1.60 – 2.50	6.70 – 14.0	U= 0.000*	<0.001*
Mean ± SD.	2.07 ± 0.34	10.77 ± 2.45		
Median (IQR)	2.10 (1.60 – 2.50)	10.80 (8.70 – 14.0)		
INR				
Min. – Max.	1.20 – 1.40	1.10 – 1.40	t= 3.100*	0.004*
Mean ± SD.	1.28 ± 0.09	1.18 ± 0.13		
Median (IQR)	1.30 (1.20 – 1.40)	1.10 (1.10 – 1.20)		
Na				
Min. – Max.	124.0 – 134.0	127.0 – 138.0	t= 0.430	0.670
Mean ± SD.	130.82 ± 3.95	130.22 ± 4.82		
Median (IQR)	134.0 (129.0 – 134.0)	127.0 (127.0 – 134.0)		
K				
Min. – Max.	3.90 – 4.30	3.80 – 4.20	t= 2.064*	0.046*
Mean ± SD.	4.13 ± 0.16	4.02 ± 0.16		
Median (IQR)	4.20 (3.90 – 4.30)	4.0 (3.90 – 4.20)		
Uric acid				

Min. – Max.	5.80 – 6.50	4.70 – 5.10	t= 17.010*	<0.001*
Mean ± SD.	6.08 ± 0.28	4.93 ± 0.14		
Median (IQR)	6.0 (5.80 – 6.50)	5.0 (4.80 – 5.0)		

Data were expressed as mean ± SD (standard deviation), Median (IQR): Inter quartile range
t: Student t-test **U: Mann Whitney test**
p: p value for comparing between **medical treatment** and **dialysis**
*: significant as $p \leq 0.05$

There was significant lower in PE **max % predictive** in dialysis cases than in medical treatment cases p value was <0.001 **(table 6)**

Table (6) Comparison between medical treatment and dialysis according to PE max % predictive

PE max % predictive	**Medical treatment (n = 22)**	**Dialysis (n = 18)**	**t**	**p**
Min. – Max.	65.0 – 70.0	43.0 – 45.0		
Mean ± SD.	67.09 ± 2.37	43.78 ± 1.0	41.809*	<0.001*
Median (IQR)	65.0 (65.0 – 70.0)	43.0 (43.0 – 45.0)		

IQR: **Inter quartile range** SD: **Standard deviation** **t: Student t-test**
p: p value for comparing between **medical treatment** and **dialysis**
*: Statistically significant at $p \leq 0.05$

There was significant correlation between **PE max % predictive** and duration of illness and dialysis , temperature , **Sat.O2**, **FVC** ,Hb,WBCs , PLTT, urea , creatinine , INR, K, , uric acid and albumin. **(Table 7)**

Table (7) Correlation between PE max % predictive and different parameters

	PE max % predictive	
	r	**p**
Age	-0.115	0.480
BMI	0.067	0.683
Duration.illness	-0.819	<0.001*
Duration.dialysis	-0.153	0.544
Temp	-0.633	<0.001*
Pulse	0.038	0.816
Systolic	-0.156	0.335
Diastolic	0.026	0.875
PH	0.098	0.549
PCo1	-0.232	0.149
PO2	0.103	0.526
Sat.O2	0.965	<0.001*
FEV1	-0.255	0.113
FVC	0.938	<0.001*
FEV1.FVC.ratio	0.098	0.545
Hb	0.793	<0.001*
WBCs	0.900	<0.001*
PLT	-0.557	<0.001*
Urea	-0.927	<0.001*
Cr	-0.911	<0.001*
INR	0.417	0.007*
Na	0.053	0.744
K	0.327	0.039*
Uric.acid	0.901	<0.001*
SGOT	0.054	0.741
SGPT	0.114	0.483
Albumin	0.917	<0.001*

r: Pearson coefficient
*: significant as $p \leq 0.05$

There was significant relation between PE **max % predictive** and se, co morbidities, drug history, PET result and mortality. **(Table 8)**

Table (8) Relation between PE max % predictive and different parameters

	N	PE max % predictive			Test of Sig.	p
		Min. – Max.	Mean ± SD.	Median		
Sex						
Male	**24**	43.0 – 69.0	53.42 ± 11.48	45.0	t=2.170*	0.036*
Female	**16**	43.0 – 70.0	61.38 ± 11.18	65.0		
Co morbidities						
DM	**14**	45.0 – 70.0	64.29 ± 8.52	65.0	t=3.692*	0.001*
HTN	**18**	43.0 – 65.0	50.89 ± 10.30	45.0	t=3.020*	0.005*
Collegenic disease	**4**	43.0 – 43.0	43.0 ± 0.0	43.0	t=7.829*	<0.001*
Cancer	**10**	65.0 – 69.0	66.60 ± 2.07	65.0	t=5.853*	<0.001*
Drug history						
Anti HTN	**12**	43.0 – 45.0	43.83 ± 1.03	43.0		
Inhaled corticosteroids	**4**	43.0 – 43.0	43.0 ± 0.0	43.0		
Insulin	**6**	70.0 – 70.0	70.0 ± 0.0	70.0		
Insulin , short acting b2 agonist	**2**	45.0 – 45.0	45.0 ± 0.0	45.0	F= 742.323*	<0.001*
Insulin , long acting b2 agonist	**6**	65.0 – 65.0	65.0 ± 0.0	65.0		
Theophylline	**10**	65.0 – 69.0	66.60 ± 2.07	65.0		
Symptoms						
Dyspnea	**18**	43.0 – 45.0	43.78 ± 1.0	43.0		
Cough	**10**	65.0 – 69.0	66.60 ± 2.07	65.0	F= 1180.323*	<0.001*
Chest pain	**6**	65.0 – 65.0	65.0 ± 0.0	65.0		
Hemoptysis	**6**	70.0 – 70.0	70.0 ± 0.0	70.0		
PFT result						
Normal	**12**	65.0 – 65.0	65.0 ± 0.0	65.0		
Restrictive	**15**	43.0 – 70.0	54.07 ± 13.48	45.0	F=5.304*	0.004*
Obstructive	**9**	45.0 – 69.0	55.67 ± 12.65	45.0		
Mixed	**4**	43.0 – 43.0	43.0 ± 0.0	43.0		
D. Dimer						
Negative	**29**	43.0 – 70.0	56.86 ± 12.56	65.0	t=0.243	0.810
Positive	**11**	45.0 – 65.0	55.91 ± 10.44	65.0		
Mortality						
Survival	**35**	43.0 – 70.0	58.54 ± 11.45	65.0	t=8.030*	<0.001*
Died	**5**	43.0 – 43.0	43.0 ± 0.0	43.0		

T: Student t-testF: **F for One way ANOVA test**
*: Statistically significant at $p \leq 0.05$

Discussion

The international scientific community has increasingly focused on CKD due to its high prevalence, as shown by recent studies. This condition can be linked to hypertension and diabetes mellitus, as well as complications affecting various systems such as cardiovascular, cardiopulmonary, nervous, respiratory, musculoskeletal, immune, and endocrine/metabolic systems.**[6]**

The respiratory system is specifically affected by the disease and by the treatment (hemodialysis or peritoneal dialysis).**[7]**

By analysis of our finding we founded that 60% of included cases were males, 40% were females with mean age 52.1 years and mean BMI was 23.32.

This was in agreement with **[8]** a study was conducted in an out-patient department and hemodialysis unit of a tertiary care facility. Patients included had either pre-dialysis CKD or ESRD on dialysis found that A total of 152 patients were included in the study. The patients has a mean age of 47.3 ± 18.3 years, 93 (61.2%) were males, and 59 (38.8%) were females.

In comparison to **[9]** another study conducted on CKD patients to test the malnutrition-inflammation score ,this study comprised 144 patients, median age 53 years (38–63 years of interquartile range), From them 94 men and 50 women and BMI (kg/m^2) 24.8 (22.6–27.4).

In our study there was significant differences between two groups as regard PFT

result as normal finding founded only among medical treatment cases and restrictive pattern was most common in dialysis patients 50%.

This come in agreement with **[10]** involved 73 subjects in their study, including 49 patients who were either on peritoneal dialysis (n = 22) or hemodialyis (n = 27), and 24 renal transplant recipients founded that the PFT results identified restrictive pattern as the most common disorder in all groups

In this study as regard Comparison of laboratory data between medical treatment and dialysis there was significant differences between two groups in CBC , urea , creatinine , K and uric acid also there was insignificant differences between two groups as regard SGPT , SGOT but as regard albumin there was significant decrease among dialysis cases.

We are supported by **[11]** where hemodialysis group have significant higher urea and creatinine and lower HB and albumin than transplant group and control group

We also supported by **[8]** founded that Patients with pre-dialysis CKD had higher hemoglobin, higher albumin.

As regard X ray finding in this study the only significance between two groups was in BVM mainly founded among medical treatment and pleural effusion mainly founded among dialysis cases

This come in agreement with **[12]** aimed to examine the frequency of occurrence, causes, clinical features and management strategies of pleural effusion in patients with CKD including renal transplant recipients founded that of the 29 patients with CKD and pleural effusion, 18 were on hemodialysis and the mean interval between the start of hemodialysis and onset of pleural effusion was 6.5±0.8 months.

There was significant positive correlation between PE max % predictive and, Sat.O2, FVC, Hb, WBCs, INR, K, uric acid and albumin and negative correlation with duration of illness and dialysis, temperature, PLTT, urea , creatinine this had close relation why PE max% was lower in dialysis than medical treatment

This come in agreement with **[13]** found that the correlation between pre- and post-dialysis difference in PI and PE max significantly increased with shorter duration of disease, higher Hg level, lower urea level, and lower PTH and phosphorous level, lower calcium level. It is speculated that a decrease in albumin induces interstitial edema and decreases the pulmonary function.

This was supported also by**[7]** found that duration of hemodialysis to have a significant negative correlation with MIP and MEP.

Conclusion

Awareness of the interrelatedness of respiratory and renal function is important in managing patients with diseases of both the lungs and the kidneys. From analysis on the results, we can conclude that respiratory muscle strength, lung function and functional capacity in patients undergoing dialysis show lower values than those on medical treatment. Factors that increase dialysis possibility among Cases were FEV1% predictive, PLT, X ray finding (BVM and Pleural effusion)**.**

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