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Study of pulmonary function test in comorbid conditions associated with the patients with chronic kidney disease

Dr. Pradeep Prajapati[1], Dr. Sejo Sebastian[2], Dr. Rajkishori Prajapati[3*]
[1] Associate Professor, Department of Medicine, G.R. Medical College, Gwalior, Madhya Pradesh, India
[2] P.G. Student, Department of Medicine, G.R. Medical College, Gwalior, Madhya Pradesh, India
[3] Consultant Gynecologist, Parivar Hospital, Gwalior, Madhya Pradesh, India
[*]Corresponding Author: Dr. Rajkishori Prajapati

Abstract
Background: Chronic kidney disease (CKD) patients may show changes in pulmonary function test (PFT) parameters and it may deteriorate even more with the presence of metabolic disorders like diabetes and hypertension.
Aims and Objectives: To study the effect of diabetes and hypertension on PFT parameters in CKD patients.
Materials and Methods: Ninety CKD patients were studied at Gajra Raja Medical College and JA Group of Hospitals, Gwalior from February 2016 to August 2017. PFT parameters including forced vital capacity (FVC), forced expiratory volume in 1st second (FEV1), peak expiratory flow rate (PEFR), forced expiratory flow during middle half of FVC (FEF25-75%), FEV1/FVC were measured in diabetes and hypertensive patients.
Results: CKD was more prevalent in the age group of 31-40 years (34.1%)] and male (63.7%) patients. A decrease in FVC among diabetics patient compared to non-diabetics in all stages was reported. Our study has not found any statistical difference between PFT of hypertensive CKD and non-hypertensive CKD patients.
Conclusion: In CKD patients there exists a significant pulmonary morbidity in restrictive pattern. There was an addictive effect in restriction of PFT among CKD patients with diabetes.

Keywords: peak expiratory flow rate, chronic kidney disease, hypertension

Introduction
Chronic kidney disease (CKD) is a challenging medical, social, and economic problem for patients and their families [1]. Prevalence of CKD patients will continue to rise, reflecting the growing elderly population and increasing numbers of patients with diabetes and hypertension [2, 3].
Though diabetes affects each and every system of body but its effects on pulmonary functions has not been studied extensively. Various studies in diabetic patients have shown changes in alveolar epithelium and capillaries which results in development of obstructive or restrictive disorders [4].
In India, hypertension is found to be directly responsible for 57% of all stroke deaths, 24% of all coronary heart disease deaths and 10% of all deaths [5]. The number of hypertensive's is expected to nearly double from 118 million in 2000 to 213 million by 2025 [6]. Hypertension and antihypertensive drugs have deleterious effect on respiratory system [7]. But there are very few studies showing involvement of respiratory system in HTN in India. Hence, in present study we tried to evaluate the effect of in diabetes and hypertensive on PFT parameters in CKD patients.

Materials and Methods
Present prospective study was performed on 90 CKD patients at Gajra Raja Medical College and JA Group of Hospitals, Gwalior from February 2016 to August 2017.
All confirmed cases of CKD admitted to JAH groups of Hospitals having age between 16-50 years were included. Known cases of asthma, heart disease, COPD, pulmonary TB and ILD and all critically ill and hemodynamically unstable patients were excluded from the present study.
Study cohort was divided on the basis of diabetes and hypertensive status. Diabetes was diagnosed as per the diagnostic criteria of American Diabetes Association and Hypertension was diagnosed using JNC guidelines of diagnosis.
Demographic parameters including age and sex were recorded. PFT parameters including forced vital capacity (FVC), forced expiratory volume in 1st second (FEV1), peak expiratory flow rate (PEFR), forced expiratory flow during middle half of FVC (FEF25-75%), FEV1/FVC were measured for each patient.
All the data were analyzed using IBM SPSS Ver. 20 software. Data were expressed as percentage and mean±SD. The data was analyzed with "the independent samples t-test." This was significant if the p-value is <0.05.

Results
CKD was more prevalent in the age group of 31-40 years [30 (34.1%)] followed by 21-30 [16 (17.6%)] and majority of the CKD patients were males [58 (63.7%)].
Out of 90 subjects, 26 (28.6%) were having diabetes and 31

(34.1%) had hypertension. Out of 26 diabetic patients, most of them belong to stage 4 [8 (30.76)] and 5 [8 (30.76)] followed by stage 3 [5 (19.23)] and 2 [5 (19.23)].Out of 31 Hypertensive patients, most of them had stage 5 CKD [10 (32.25%)] followed by Stage 4 [9 (29.03%)] and Stage 3 [6 (19.35%)]. and stage 2 [6 (19.35%)].

Table 1: Comparing PFT parameters in patients with and without diabetes and hypertension

CKD Stage	PFT	Diabetes		P value	Hypertension		P value
		Yes	No		Yes	No	
Stage 2	FVC	81.84±7.55	90.13±5.78	0.020	84.65±8.98	88.70±5.95	0.628
	FEV1	90.04±4.97	93.83±3.72	0.056	90.70±5.04	93.80±3.69	0.786
	FEV1/ FVC	103.46±1.94	102.51±2.78	0.92	102.55±2.18	103.27±2.78	0.912
	FEF 25-75	78.48±0.64	78.54±1.60	0.89	78.95±1.22	78.92±1.56	0.956
	PEF	93.58±4.36	97.71±1.22	0.048	94.90±4.85	97.08±0.80	0.812
Stage 3	FVC	65.22±2.99	73.48±2.16	0.031	69.35±4.98	71.64±4.50	0.567
	FEV1	81.54±2.27	83.82±2.30	0.06	81.75±2.67	83.93±2.01	0.676
	FEV1/ FVC	102.22±1.66	104.75±3.35	0.102	106.08±2.98	102.46±2.27	0.042
	FEF 25-75	71.32±4.33	77.97±2.30	0.037	74.33±4.20	76.70±4.50	0.096
	PEF	84.14±1.84	88.37±1.65	0.049	86.90±2.43	87.56±2..29	0.943
Stage 4	FVC	59.98±5.34	72.47±4.67	0.023	66.27±8.41	65.12±8.26	0.867
	FEV1	71.24±4.65	81.29±3.91	0.040	75.87±7.48	76.02±6.11	0.976
	FEV1/ FVC	102.68±5.93	105.56±8.92	0.113	103.69±4.41	104.52±10.92	0.915
	FEF 25-75	64.90±2.01	74.03±6.94	0.025	70.79±6.59	66.72±6.65	0.045
	PEF	81.73±6.94	84.04±1.86	0.721	82.17±2.70	83.77±4.10	0.943
Stage 5	FVC	55.39±8.30	62.78±7.91	0.022	59.73±8.88	59.20±9.09	0.967
	FEV1	64.38±7.86	70.05±9.81	0.039	67.92±8.38	67.04±10.73	0.946
	FEV1/ FVC	102.44±13.29	98.04±13.32	0.780	99.68±11.97	100.39±15.24	0.935
	FEF 25-75	61.99±3.54	63.70±2.29	0.931	62.89±2.86	63.00±3.26	0.974
	PERF	76.05±3.40	78.33±2.61	0.078	77.29±3.59	77.35±2.66	0.993

Data is expressed as mean ± SD, PFT; pulmonary function test, forced vital capacity (FVC), forced expiratory volume in 1st second (FEV1), peak expiratory flow rate (PEFR), forced expiratory flow during middle half of FVC (FEF25-75%)

Discussion

The relationships between the lungs and the kidneys is clinically important in both health and disease. Chronic renal failure may affect respiratory function [8].

Pulmonary dysfunction may be the direct consequence of circulating uremic toxins or may result indirectly from volume overload, anemia, immune suppression, extra osseous calcification, malnutrition, electrolyte disorders, and/or acid–base imbalances [9].

In the study, most common age group was 31-40 years and there is clear cut male predominance (63.37%). This trend is same as those in many other studies indicating the risk of male gender for CKD [10, 11].

In present study out of 60 patients 43.44% were diabetic and 51.66% were hypertensive, but both are considered as the important risk factors for the development of renal complications. Most of them were having stage 5 CKD (30%) followed by stage 3 (25%) and stage 4 (25%) and stage 2 (20%). But study did not take into account the duration of diabetics and hypertension which are important in the pathophysiology. Study has found a decrease in FVC among diabetics patient compared to non-diabetics in all stages.

In this study 26 patients were diabetics. Of them 30.76% were each in stage 4 and stage 5 while 19.23% each in stages 2 and 3. Many studies conducted in diabetic patients had found a restrictive pattern in PFT. Studies by Nandini *et al*. [12] Verma *et al*. [13] Shah *et al*. [14] and Sinha *et al*. [15] were conducted among diabetes patient who were not having CKD. These all studies concluded that diabetes can produce a restrictive pattern. Our study also found more restrictive pattern among diabetic CKD compared to non-diabetic CKD. There may be addictive ill effects in the pathophysiology of these diseases [16-18].

Out of 31 hypertensive patients, most of them had stage 5 CKD [10 (32.25%)] followed by Stage 4 [9 (29.03%)] and Stage 3 [6 (19.35%)]. and stage 2 [6 (19.35%)]. Hypertension, like diabetes, also has deleterious effect on spirometry findings. Schnabel *et al.* [19] found reduction in FEV1 and FVC due to hypertension and medication. Study by Shah *et al*. [20] found an obstructive pattern in hypertensive's especially for those on beta blockers. Another study by Pramodh *et al*. [21] found that hypertensive patients had low FEV1, FVE, FEV1/FVC and PERF. Another study from SMS medical college, Jaipur by Yadav *et al.* also found [22] a restrictive pattern predominant in hypertensive.

However, our study has failed to show any statistical difference between PFT of hypertensive CKD and non-hypertensive CKD patients. It may be because in most cases, it was difficult to deduce if hypertension was the primary disease that caused CKD or if CKD caused secondary hypertension. In the latter case chronic effect of hypertension may not well established as duration of hypertension may be less [23].

Present study had few limitations such as; it was not a randomized trial. Sample size was small. A large randomized clinical trial is required to strengthen the present study findings.

Conclusion

Our study has found that in CKD patients, there exists a significant pulmonary morbidity in restrictive pattern. There was an addictive effect of presence of diabetes in increasing

the restrictive pattern. This is significant as diabetics, till date, remains the most important etiology implicated for CKD.

Given the progressive nature of the restriction with increase in severity of CKD, early diagnosis and preventive interventions like breathing exercises and chest physiotherapy may be useful. Also PFT should be included in the investigation panel of CKD management. Even then the effectiveness of these interventions needs to be analyzed in a large randomized control study.

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