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Acute effect of hemodialysis on FVC, FEV_1 and FEV_1/FVC% in chronic kidney disease stage- V patients

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Abstract

Background: Chronic kidney disease (CKD) stage-V is associated with impairment of pulmonary functions which may be improved by taking hemodialysis treatment. **Objective:** To observe the acute effect of hemodialysis on FVC, FEV_1 and FEV1/FVC% in CKD stage-V patients. **Methods:** This prospective observational study was carried out in the Department of Physiology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka from September 2015 to August 2016 on 40 male newly diagnosed CKD stage-V patients aged 30-55 years who were advised to take maintenance hemodialysis. Forty age and BMI matched apparently healthy male were control. FVC, FEV_1 and FEV_1/FVC% were assessed by portable digital spirometer before and after their first hemodialysis session in patients and once in healthy control. For statistical analysis, paired and independent sample 't' tests were done, as applicable. **Results:** Percentage of predicted values of FVC and FEV_1 were found significantly lower in patients than the healthy control at baseline but FEV_1/FVC% was almost similar to control. Again, FVC, FEV_1 and FEV_1/FVC% were found significantly increased after the end of hemodialysis than before hemodialysis session. **Conclusion:** The pulmonary functions were reduced in newly diagnosed CKD stage-V patients and hemodialysis cause immediate improvement of lung functions in patients with CKD stage-V.

Key words: Chronic kidney disease (CKD) stage-V, maintenance hemodialysis, FVC, FEV_1, FEV_1/FVC%.

Introduction

Chronic kidney disease (CKD) is a worldwide public health problem. The diseases of kidney and urinary tract contribute to the global burden of diseases, with approximately 850,000 deaths every year and 15,010,167 disability-adjusted life per year.[1] In Bangladesh perspective, the prevalence of CKD leading to End Stage Renal Disease (ESRD) or CKD stage-V is 100-120 per million populations.[2] The mean age of the patients with ESRD is 42 years, which is similar to India and Pakistan which is much less than that of the developed countries where the mean age is 61 years.[3] CKD is a progressive loss in renal function over a period of months or years. In CKD Stage -V GFR is <15 ml/min/1.73 m^2 which is also known as End Stage Renal Failure . This group of patients needs renal replacement therapy either in the form of renal transplantation or maintenance hemodialysis.[4]

CKD patients present not only progressive and irreversible loss of renal function but also a complex syndrome with various effects on the cardiovascular, nervous, respiratory, musculoskeletal, immune, endocrine and metabolic systems.[5] Cardio-pulmonary disorders are the main causes of mortality and morbidity in CKD stage-V patients.[6] Early intervention and appropriate measures may slow the progression to CKD stage-V, prevent the loss of kidney function or ameliorate organ dysfunction and comorbid conditions.[7]

Respiratory complications of CKD stage-V include pulmonary oedema, pulmonary hypertension, pleural effusion, dysfunction of respiratory muscles, respiratory infections, pleuritis and lung calcification.[8] But pulmonary oedema and pleural effusions are most common.[9] The toxic effects of renal failure on the endothelium of the pulmonary capillaries lead to increased permeability of the pulmonary capillary, leading to oedema and increased resistance in the small airways and alveoli.[10] Also hypoalbuminemia, characteristic of chronic renal failure, decreases plasma oncotic pressure and thus foster movement of fluid out of the pulmonary capillaries, leading to pulmonary oedema.[11] Hemodialysis removes excess fluid accumulated in the body and which causes better diffusing capacity of lungs and increase in ventilation of basal lung area.[12]

Earlier studies showed that, spirometric parameters in CKD stage-V patients on hemodialysis were significantly improved after hemodialysis.[10,12-13] But it was also reported that 75% of patients on long term hemodialysis had decreased FVC, FEV_1 with normal or increased FEV_1/FVC%.[14] Several investigators of different countries reported lower spirometric lung function variables in hemodialysis patients.[12-16]

With best of our knowledge, little published data compared the lung functions before hemodialysis and after hemodialysis session among chronic kidney disease stage-V patients. Therefore, the present study aimed to evaluate the immediate effect of hemodialysis on some aspects of pulmonary functions in newly diagnosed chronic kidney disease stage-V patients before and after first day of their hemodialysis.

Methods

Study design and setting

This prospective observational study was conducted during September 2015 to August 2016 in the Department of Physiology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka

Study participants

Forty male newly diagnosed CKD stage-V patients aged 30-55 years were enrolled from Out Patient Department of Nephrology of BSMMU.These new patients were advised for maintenance hemodialysis. Forty age, sex and BMI matched healthy subjects participated as control.

Sampling

Participants were recruited by purposive sampling.

Inclusion & exclusion criteria

Diagnosis of CKD stage-V was done by the nephrologist, based on a thorough clinical evaluation and by eGFR<15 ml/min/1.73 m^2 of the patient.[4] Subjects with history of acute or chronic lung & chest wall diseases e.g. asthma, pneumonia, tuberculosis, COPD, bronchiectasis, pneumothorax, malignancy, history of connective tissue diseases, cardiovascular disease, diabetes mellitus, alcohol/tobacco users, smokers and drugs that can damage the lungs e.g. cyclophosphamide were excluded from the study.

Data collection

The aim, objectives, benefit and procedure of the study were explained and informed written consent was taken from all the subjects. A through clinical examination of all subjects was done and a detailed family and medical histories were recorded in a prefixed questionnaire.

In patients group, data were collected before and after hemodialysis session in same patients. Dialysis was performed alike in all patients complying with the following criteria: constant blood flow 200-250 ml/min, constant dialysate flow 500 ml/min, dialysate type- bicarbonate and duration of hemodialysis 2-4 hours.For the assessment of lung function FVC, FEV_1 and FEV_1/FVC% of all the subjects were recorded by a digital spirometer (PONY FX, Cosmed, Italy). In all patients, spirometry was done at least half to one hour before and after hemodialysis session

Statistical analysis

Data were expressed as mean ± SE of the percentage of predicted value and in frequency percent. Paired sample "t" test was done to compare between pre and post hemodialysis data. Independent sample "t" test compared lung function parameters between control and study group. SPSS for windows version 16 was used for statistical analysis. The p value of ≤0.05 was taken as statistically significant

Results

There were no significant differences in respect of age and BMI between study group and healthy control (Table 1). The mean percentage of predicted values of FVC and FEV_1 were significantly lower (p≤0.001) in patient group than those of control. The value of FEV_1/FVC% was lower before hemodialysis in patient group in comparison to that of control. But these differences were statistically non significant (Table II). The values of FVC, FEV_1 and FEV_1/FVC% significantly increased (p≤0.001) after the end of hemodialysis (Table III).

Table I: Age and BMI in different groups (N=80)

Parameters	Control (n=40)	CKD stage-V (n=40)	P value
Age(Years)	43.65±0.49 (30-55)	43.32±0.68 (30-55)	>0.05
BMI(kg/m^2)	24.35±0.26 (16.40-27.70)	24.68±0.30 (16.40-27.40)	>0.05

Data were expressed as Mean ± SE. Statistical analysis was done by Independent sample't' test. n= number of subjects

Table II: FVC, FEV_1 and FEV_1/FVC% in two groups (N=80).

Parameters	Control (n=40)	CKD stage-V patients (n=40)	P value
FVC (% predicted)	91.22±1.18	46.15±1.52	<0.001
FEV_1 (% predicted)	95.65±1.34	45.72±1.83	<0.001
FEV_1/FVC%	102.42±1.14	101.65±2.25	>0.05

Data were expressed as Mean ± SE. Statistical analysis was done by Independent sample't' test. n= number of subjects

Table III: FVC, FEV_1 and FEV_1/FVC% before and after hemodialysis session in newly diagnosed CKD stage-V patients (n=40).

Parameters	Newly diagnosed CKD stage-V patients(n=40)		P value
	Before hemodialysis	After hemodialysis	
FVC (% predicted)	46.15±1.52	57.10±1.57	<0.001
FEV_1 (% predicted)	45.72±1.83	57.20±2.11	<0.001
FEV_1/FVC%	101.65±2.25	106.07±1.96	<0.001

Data were expressed as Mean ± SE. Statistical analysis was done by Paired sample 't' test, n= number of subjects

In this study, all the control subjects were with normal lung function on the basis of spirometric results. On the contrary, no patients had normal lung function. In patients group before hemodialysis, 34(85%) patients had both restrictive and obstructive disorders and 6(15%) patients had only restrictive disorder. And after hemodialysis, 23(57.5%) patients had both restrictive and obstructive disorders and 17(42.5%) had only restrictive disorder (Figure 1).

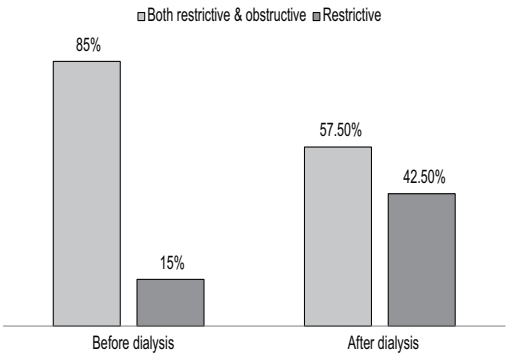

Figure 1: Frequency percent of different type of pulmonary disorders in newly diagnosed CKD stage-V patients before and after their 1st hemodialysis session.

Discussion

The present study had been undertaken to observe the acute effect of hemodialysis on pulmonary functions in newly diagnosed male CKD stage-V patients.

Significantly lower value of FVC and FEV_1 and non significant FEV_1/FVC% in patients group is all most similar to others[17-21]

FVC, FEV_1 and FEV_1/FVC% significantly increased in CKD stage-V patients after hemodialysis than before hemodialysis session. No previous study compared the FVC, FEV_1 and FEV_1/FVC% after first hemodialysis session with that of the pre dialysis session. But several investigators reported that these values significantly improved in post dialysis period than pre dialysis period in those patients who received 6 months maintenance hemodialysis.[22-24]

In this study,all patients had abnormal lung functions before dialysis. In addition, 34(85%) and 23(57.5%) patients had both restrictive and obstructive disorders before and after hemodialysis session respectively. 6(15%) and 17(42.5%) patients had only restrictive disorder before and after hemodialysis session respectively. These results of this study showed that after hemodialysis session obstructive disorder was improved more than the restrictive disorder.

Several investigators have suggested different mechanisms for pulmonary involvement in this specific group of patients.[23-25] Research evidence has shown that decrement of ventilatory variables in CKD stage-V patients may be due to pulmonary oedema, pulmonary fibrosis and calcification, pleural effusion, intravascular and interstitial volume overload, pulmonary hypertension, decrease respiratory muscle strength, anemia, uremic toxins, electrolyte disorders and/or acid base imbalance.[10,18] These abnormalities have been demonstrated to improve or resolve after hemodialysis.[25] Kovacevic and their colleagues also reported that

hemodialysis has a positive effect on ventilating function in patients with CKD stage-V as a result of removal of excess fluid, better diffusing capacity of lungs and increase in ventilation of basal lung area.[12] So this study is giving emphasis on the importance of screening of lung function status in CKD patients to minimize the risk of lung dysfunction.

Conclusion

From this study, it can be concluded that the spirometric lung function variables significantly decreased in newly diagnosed CKD stage-V patients and hemodialysis can improve lung function. CKD stage-V patients were commonly affected by restrictive type of pulmonary disorder.

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Conflict of interest

None.

Ethical aspects

The ethical aspects of the protocol of this study was approved by the institutional review board of BSMMU.

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