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Spirometric Parameters: Hemodialysis Compared to Peritoneal Dialysis

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ABSTRACT

Introduction: Renal failure affects the mechanical and the ventilatory function of the lungs. A few studies have evaluated the ventilatory and pulmonary function in dialysis patients. The present study aimed to compare pulmonary function test (PFT) results in patients undergoing hemodialysis (Hd) and peritoneal dialysis (PD).

Materials and Methods: We conducted a cross-sectional study on 50 patients with hemodialysis (HD) and 50 cases with PD who underwent PFT in Ghaem and Imam Reza Hospital, Mashhad, Iran from November 2010 to July 2012. Spirometric parameters including forced expiratory volume in 1s (FEV1), FEV1/forced vital capacity (FVC), forced expiratory flow 25-75% (FEF) and peak expiratory flow (PEF) were compared between the two groups of patients.

Results: Approximately 68% of the HD patients, 66% of the PD patients, and 67% of all the studied cases showed a normal spirometric pattern. Moreover, there were no significant differences between the two groups considering the mean of the a forementioned spirometric parameters(restrictive ,obstructive pattern) (P=0.969). However, an insignificant inverse correlation was observed between the duration of dialysis with FEV1 (r=0.381, P=0.008), FVC (r=-0.298, P=0.04), FEF 25-75% (r=0.43, P=0.003), PEF (r= 0.349, P=0.02) and FEV1/FVC (r=-0.363, P=0.01,) in the HD patients and between the patients' age with FEV1/FVC (r=0.03, P=0.02) in the PD patients.

Conclusion: This study showed no significant difference in pulmonary function in hemo and peritoneal dialysis,so according this result ,both of the dialysis had the same affect on the lung function.

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Introduction

Renal failure affects every organ of the body and mainly the lungs. Respiratory disorders are among the most prevalent complications in the end-stage renal disease (ESRD) patients. Some of these complications including cough, wheezing and, sleep apnea are a direct result of fluid overload. In addition, pulmonary dysfunction in hemodialysis (HD) cases might be due to an underlying pulmonary disease (1, 2). If the concentration of blood urea reaches above 20 mmol/dl, the effects of uremia on the respiratory system become evident leading to such complications as acute conditions of pulmonary

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edema, pleural effusion, acute respiratory distress syndrome (ARDS) and chronic conditions like pulmonary tissue and vascular wall calcification and changes in the cardio-pulmonary system (3).

On the other hand, renal failure could affect the mechanical and ventilatory function of the lungs either directly or indirectly (4). The major direct impacts of renal failure are as follows: 1) intra- and extravascular volume overload and subsequent interstitial lung tissue edema; 2) increased permeability of capillary walls due to the toxic effects of uremia on the endothelial lining of pulmonary capillaries and subsequent small airways and alveoli edema; 3) increased airway resistance; 4) anemia and decreased blood flow in soft tissues including lungs, vascular walls and the subcutaneous tissues.

Such examples of the indirect effects of renal failure on the pulmonary function are medication side effects and dialysis complications (5).

The hypoxia caused by the partial obstruction of capillary blood flow in the lungs due to leukocyte sequestration is a well-known complication in dialysis patients. Possible complications in peritoneal dialysis (PD) patients include fluid accumulation in the pleura, atelectasis, pneumonia and bacterial bronchitis (6).

Regarding the observations in animal studies, it has been confirmed that dialysis with incompatible cellulosic membranes could increase the release of elastase from activated neutrophils and decline the function of inhibitory proteins. This might lead to the breakdown of elastin fibrils while increasing the susceptibility to emphysema (7).

Pulmonary dysfunction and dyspnea during dialysis were first introduced by Sherlock et al. (5). The predisposing factors consist of associated underlying diseases, solutions used in dialysis, blood-exposed membrane surface and the membrane material.

It seems that through activating the complement and the entrapment of white blood cells, pulmonary dysfunction and dyspnea could cause inflammation in the pulmonary capillaries, impair oxygenation and therefore, increase the airway resistance (8). By using spirometry, such subtle changes in the rate of air flow due to different etiologies could be discovered.

Changes in the respiratory drive, muscular function and gas exchange are frequent in dialysis patients. Pulmonary dysfunction could be the direct result of the circulatory toxins or the indirect effects of volume overload, anemia, immunosuppressants, extravascular calcification, malnutrition, electrolyte disorders or acid-base imbalances (9).

Few studies have been conducted on the pulmonary function of dialysis patients. Therefore, the present study aimed to compare the spirometric parameters between HD and PD patients.

Materials and Methods

Patients and assesment

This cross-sectional study was conducted in Ghaem and Imam Reza hospitals Mashhad University of Medical Sciences, Iran from November 2010 to july 2012. Patients over the age of 15 years undergoing HD or PD were enrolled in this study. The exclusion criteria were as follows:

1) pulmonary involvement based on a medical history, physical examination or chest x-ray; 2) the presence of kyphoscoliosis or chest deformity; 3) a history of thoracic or open heart surgery; 4) valvular heart diseases; 5) peritonitis in PD patients; 6) hospitalization within the past two months.

A full medical history was provided from each patient through an expert-designed questionnaire checklist and physical examination by one experienced pulmonologist was performed as well. We collected the samples from Imam –Reza and Ghaem hospital,Mashhad,Iran and on the basis of this formula:

N_1=(1.96+0-84)2(3.752+4.752)/(90.00-87.6)2=49.85

The duration of dialysis was recorded and the HD patients underwent regular dialysis 3 times a week with bicarbonate dialysis solution. Furthermore, continuous ambulatory peritoneal dialysis (CAPD) patients were preserved on a standard CAPD program. The Pulmonary function tests (PFTs) were performed the day after dialysis on HD patients and at the middle of the week on the PD patients while the dialysis solution was still present in the abdomen (full status). The patient was asked to take the deepest breath they can, and then exhale into the sensor as hard as possible, for as long as possible, preferably at least 6 seconds.

By three consecutive spirometric maneuvers, the values of forced expiratory volume in 1s (FEV1), forced vital capacity (FVC), FEV1/FVC, forced expiratory flow 25–75% (FEF 25-75%) and peak expiratory flow (PEF) were determined. Following that, the highest value in these maneuvers was recorded for each patient (Chest-hi. 801 model spirometer, Japan).

Informed consents were obtained from each patient prior to the beginning of the study and the study protocol was approved by the Ethics Committee of the Review Board of Mashhad University of Medical Sciences.

Statistical analysis

The collected data were represented as mean ± standard deviation (SD). Independent student's t-test was used in order to compare FEV1, FVC, FEV1/FVC, FEF25-75% and PEF values between the two study groups and Chi-square test was used for the analysis of the qualitative variables. P<0.05 was regarded as statistically significant.

Table 1. Comparison of spirometric parameters between the two study groups

Parameter	Hemodialysis	Peritoneal Dialysis	P value
FEV1	87.87±18.98	85.02±21.76	0.48
FVC	89.67±19.34	87±21.11	0.56
FEV1/FVC	81.84±8.16	80.97±7.53	0.58
FEF 25-75%	89.09±32.9	84.92±30.46	0.51
PEF	78.16±24.48	82.68±27.88	0.40

FEV1; Forced Expiratory Volume in 1 Second
FVC: Forced Vital Capacity
FEF 25-75%: Forced Midexpiratory Flow Rate

Results

The mean age of the HD and PD cases was 39±13.12 and 41.32±16.08 years, respectively in which the student's t-test showed no significant differences (P=0.44). Moreover, 27 cases (54%) and 29 patients (58%) of the cases were female in the HD and PD group, respectively which was proven to have no significant differences according to the Chi-square test (P=0.432).

In the HD group, 34(68%) patients had a normal pattern whereas a restrictive, obstructive and mixed patterns were observed in 8(16%), 5(10%) and 3(6%) patients, respectively. The same patterns were detected in 33(60%), 9(18%) and 4(8%) patients in the PD groups, respectively. No significant differences were found between the two groups regarding their spirometric patterns (P=0.969).

In addition, no significant differences were observed between the HD and the PD groups in the comparison of the mean spirometric values of FEV1, FVC, PEF, FEF25-75% and FEV1/FVC (Table 1).

An insignificant, inverse correlation was also observed between the duration of dialysis with FEV1 (P=0.008, r=0.381), FVC (P=0.04, r=-0.298), FEF 25-75% (P=0.003, r=-0.43), PEF (P=0.02, r=-0.349) and FEV1/FVC (P=0.01, r=-0.363) in the HD patients. The same relationship was detected in the PD group only between the patient's age and FEV1/FVC (r=-0.3, P=0.02).

Discussion

To the but of our knowledge the present study is the first research for the comparison of PFT in two groups hemo and peritoneal dialysis. We showed no significant differences in quantitative simple spirometry parameters between the hemodialysis (HD) and peritoneal dialysis (PD). Our study represented the 68% of the HD cases, 66% of the PD patients and 67% of all the studied dialysis patients had a normal spirometric pattern. Previous studies reported that dialysis affected pulmonary function test (9-15).

It is also noteworthy that the prevalence of the restrictive pattern was higher in comparison to the obstructive one. Kovacevic et al. claimed that long-term HD patients experienced a significant decline in the FVC level following five years of treatment (9). In another study Chan et al. assessed the pulmonary funtion before and at monthly intervals after the renal transplantation in HD patients. The mean FEV1, FVC and the total lung capacity (TLC) values were normal both before and 6 months after the surgery (10). For instance, Wanic and Kosswaska studied 18 HD patients and observed a restrictive pattern with a reduced vital capacity (VC), FEV1 and maximal breathing capacity (11). Similarly, Musacchio reported a significant reduction in the PEFs and FEV1 within the first hour after dialysis with low-flux membranes (12). In another research, Rahgoshai et al claimed that patients under long-standing hemodialysis showed a restrictive pattern in the PFTs (13). In our study, in those patients with a disturbed spirometric pattern, the restrictive pattern had the highest prevalence. These findings are consistent with the similar studies.

Andrew Bush studied the PFTs in four separate groups of 20 individuals. The first group consisted of chronic renal failure patients without dialysis, the 2nd group were PD patients, the 3rd group were HD patients and the 4th group consisted of the patients with a successful transplantation from a donor cadaver. According to his findings, there were no correlations between the dialysis duration and the spirometric parameters (14). In this study, as previously mentioned, no correlations were observed between the dialysis duration and spirometric parameters (14). By contrast, Herrero et al reported a decrease in the PFTs in patients undergoing long-term hemodialysis (15).

However, Kovelis et al stated that long-term dialysis could be associated with reduced respiratory muscle strength (16). Moreover, chronic lung diseases with hypoxia and hypercapnia were found to be likely to affect renal function (17).

The main limitation of the current study was the small sample size .Different seasons may influence affected in pulmonary function test.

Conclusion

According to the results of this study, there are no significant differences in the spirometric parameters between the two groups of HD and PD patients. Thus, it could be concluded that pulmonary dysfunction in the patients undergoing dialysis is not likely to affect the type of dialysis required.

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Conflict of Interest

The authors declare no conflict of interest.

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