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COMPARISON OF PULMONARY FUNCTION PARAMETERS IN PATIENTS WITH CHRONIC RENAL FAILURE BEFORE AND AFTER HEMODIALYSIS

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ABSTRACT **Back ground:** Respiratory system disorders are one of the most prevalent complications in end-stage renal disease patients on hemodialysis. Several mechanisms may impair pulmonary function and alter bronchial responsiveness in patients on long term regular hemodialysis . We conducted a study on the acute effects of hemodialysis on lung function using a computerized spirometry . **Methodology:** 36 patients undergoing hemodialysis were recruited for the study and all were more than 18 years of age and were on hemodialysis for more than 3 months and undergoing the procedure 3 times a week . The pulmonary function parameters – forced expiratory volume in the first second (FEV1), forced vital capacity (FVC), vitalcapacity (VC) was measured in renal failure patients before and after hemodialysis by a computerized spirometer and the values were compared. **Results:** After hemodialysis, the FVC significantly increased (*P<0.05*), with improvement in FEV_1FVC ratio while there was no significant changes in the FEV1 and VC. **Conclusion:** Improvement in pulmonary function especially Forced vital capacity may be attributed to the decrease in fluid overload after hemodialysis.

KEYWORDS : chronic renal failure, hemodialysis, pulmonary function test, spirometry

INTRODUCTION:

Chronic diseases have become a major cause of global morbidity and mortality. With increasing life expectancy and prevalence of life style diseases, India has seen an increasing trend in the prevalence of non communicable diseases especially diabetes and hypertension. This has lead to an increase in the prevalence of renal diseases , among whom 6.3% of population would progress to chronic renal disease(Varma, 2015). About 20-30% of patients have severe renal dysfunction and needs a renal transplant.

Dialysis is the only way to keep these patients alive until transplantation and their vital parameters improves with dialysis which removes excess of metabolic waste and water.

Even though, dialysis has not completely replaced the kidney function, it can manage kidney function activities as the result of diffusion and ultra filtration(Bush & Gabriel, 1991) . On the other hand, patients with end stage renal disease are potentially prone to lung edema and respiratory dysfunction. Volume overload in them may cause cough, wheeze and sleep apnea. Impaired pulmonary function in these patients may be caused by an underlying pulmonary disease; however the impact of uremia and the effects of hemodialysis treatment are not well understood. Several mechanisms may impair pulmonary function and alter bronchial responsiveness in patients on long term regular hemodialysis (Prezant, 1990).

Non-infectious pulmonary complications are common in patients with advanced chronic kidney disease (CKD) , especially in those with volume overload, and include pulmonary edema, pleural effusions, increased pulmonary capillary permeability, pulmonary fibrosis, pulmonary calcification, respiratory muscle myopathy and low respiratory muscle strength(Prezant, 1990). As a consequence, lung function is often impaired with spirometry showing low forced vital capacity (FVC), low forced expiratory volume in the first second (FEV1), and low peak expiratory flow (PEF) indicating *obstructive impairment* (*2018/2019 ICD-10 Code J44.9 - Chronic Obstructive Pulmonary Disease, Unspecified*, n.d.).

Inflammation is inherently associated with uremia due to immune cell dysfunction leading to increased susceptibility to infections(DePass et al., 1956) . In CKD, an inflammatory state is sustained by impaired renal elimination of pro-inflammatory cytokines and increased generation of cytokines in the uremic milieu(Wanic-Kossowska, 1993) . A low glomerular filtration rate (GFR) associated with elevated circulating concentrations of pro-inflammatory cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor (TNF), that may induce muscle proteolysis, increase energy expenditure and decrease appetite, thereby contributing to Protein Energy Wasting (Jadeja & Kher, 2012).

This study may help in indicating the effect and impact of hemodialysis in maintaining and improving lung function by evaluating the alterations of pulmonary function indicators before and after hemodialysis, measured by spirometry.

MATERIALS AND METHODS:

The study was a cross sectional study and was conducted after obtaining clearance from the Institutional Human Ethics Committee. Study was conducted from October 2019 to December 2019 in Department of Nephrology, in a tertiary care hospital. 36 ambulant, clinically stable patients who were more than 18 years of age and were on hemodialysis for more than 3 months and undergoing the procedure 3 times a week were included. All the patients were of end stage renal disease of acquired cause. Patients with the history of chronic/ recent respiratory disease, cardiac insufficiency [EF < 50%], musculoskeletal disorder, tuberculosis, acute lung infection and smokers were excluded.

Detailed history of the co morbid condition, treatment schedule and duration were collected and recorded. Subjects were educated regarding the procedure in detail with the aid of photographs and videos of spirometry testing (*Spirometry: Procedure, Normal Values, and Test Results*, n.d.). Spirometry was performed in the eligible patients who consented to participate in the study before the hemodialysis session and immediately after it. The results were recorded thrice and the best of the three values were taken in to consideration. The data collected also included age, BMI, body weight change, duration of treatment hemodialysis, cause of end stage renal disease, hemoglobin level, serum creatinine level.

The lung function parameters were compared and analyzed using SPSS software (Statistical package for Social Sciences version 16) . Data were tabulated and the continuous variables were expressed as mean and standard deviation. The average of the spirometery values FEV1, FVC, VC, FEV1/FVC were compared by paired 't' test. A total of 36 patients (18 male and 18 female) on hemodialysis were evaluated. Their mean age was 49.72 ± 11.39 years. The mean hemoglobin and serum creatinine values were 9.75 ± 1.05 g/dl and 5.02 ± 2.81 mg/dl respectively. Their mean weight was 61.88 ± 10.25 kg and their mean weight loss after hemodilalysis was 2600 ± 1288 grams .

FVC and FEV_1/FVC ratio alone had significant changes in comparison with those before hemodialysis. Other factors including VC, FEV_1 had no significant changes. There was no significant association between the changes in spirometry parameters and age, creatinine, hemoglobin values and weight changes before and after hemodialysis.

Table 1: Spirometry parameters Before and After Hemodialysis:

Factor	Before hemodialysis	After hemodialysis	t value	P value

FVC (Liters)	1.4525 ± 0.2308	1.6021 ± 0.1851	2.319	<0.05
FEV_1 (Liters)	1.3634 ± 0.2373	1.3851 ± 0.2324	1.956	>0.05
$FEV_{1/}$ FVC	0.8474 ± 0.066	0.6709 ± 0.0707	2.372	<0.05
VC (Liters)	1.6752 ± 0.328	1.8672 ± 0.4215	1.897	>0.05

DISCUSSION:

Several respiratory disorders owing to continuous pulmonary insults of multifactorial origin were common among patients with ESRD(Kim et al., 2018). Several mechanisms may impair pulmonary function and alter bronchial responsiveness in patients on long term regular hemodialysis treatment.

Protein-energy wasting (PEW) and inflammation are common (30-50%) interlinked conditions in patients with advanced CKD, and presence of chronic low-grade inflammation is thought to play a central role in the pathophysiology of a range of complications in uremia(Jeon et al., 2004). Pulmonary dysfunction may be a direct consequence of uremic toxin or may indirectly result from volume overload, anemia, immune suppression, extra osseous calcification, malnutrition, electrolyte disorders and or acid base imbalances.

In our study, the improvement in FVC after hemodialysis may be due to decrease in the small airway resistance resulted by the reduction in volume overload and thereby clearing of lung alveoli from uremic toxins(Pierson, 2006).

In the present study FVC and FEV_1/FVC significantly improved in patients after hemodialysis. Studies conducted by Herrero et. Et.al.(Herrero et al., 2018) reported a decrease in pulmonary function test in patients on maintenance hemodialysis.

Momeni Et.al evaluated spirometry parameters in 41 patients on hemodialysis which showed difference with the change in the hemodialysate(Momeni et al., 2013).

Wanic –Kossowska Et.al evaluated 18 patients on hemodialysis and observed ventilation disturbances of restrictive type which were demonstrated with decreased VC, reduced maximal breathing capacity, an increased residual volume, and a lower FEV_1(Wanic-Kossowska, 1993). In contrast FEV_1increased in our study.

In a study by Jakovljevic et al., 61 dialysis patients were evaluated and spirometry was done before and after the dialysis. Improvement of FEV1 and FVC after dialysis was correlated with weight loss of patients(Jakovljevic B, 2013). They also concluded that decreased volume overload after dialysis is an important factor in improvement of PFT findings. Conversely, Langs et al. did not find any correlation between lung function parameters and intra-dialytic weight loss with cellulose or high flux membrane in 14 hemodialysis patients(Lang et al., 2006).

CONCLUSION:

It is obtained from our study that there is significant improvement in FVC and FEV_1/FVC ratio in hemodialysis patients with no significant improvement in FEV1 and VC. This also suggests that there is restrictive pattern of pulmonary dysfunction . PFT before and after dialysis may be included in the protocol in patients undergoing hemodialysis to assess their lung performance .

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