Article

FVC, FEV_1, FEV_1/FVC ratio and $FEF_{25-75\%}$ in End-stage renal disease (ESRD) patients undergoing maintenance haemodialysis

Farhana Hoque[1], Shelina Begum[2], Abdul Latif[3], Afroza Begum[4], Shamima Sultana[5]

Abstract

Background: End-stage renal disease causes multiple pulmonary complications and lung functions are decreased in ESRD patients undergoing maintenance haemodialysis. **Objectives:** To observe FVC, FEV_1, FEV_1/FVC ratio and $FEF_{25-75\%}$ in ESRD patients undergoing maintenance haemodialysis to evaluate their lung functions status. **Methods:** This cross sectional study was carried out in the Department of Physiology, BSMMU, Dhaka, from July 2011 to June 2012. For this, 30 ESRD patients aged 25-55 years undergoing maintenance haemodialysis with less than 1 year duration were studied and 30 age, sex matched healthy subjects were taken as control. Patients were selected from the Nephrology department of BSMMU, Dhaka. FVC, FEV_1, FEV_1/FVC ratio and $FEF_{25-75\%}$ were measured by a Digital Spirometer. For statistical analysis Independent Sample 't' test and One way ANOVA test were performed as applicable. **Results:** The mean percentage of predicted values of FVC, FEV_1 and $FEF_{25-75\%}$ were significantly lower in patients except FEV_1/FVC ratio which was almost similar to control. 63.33% patients had restrictive and 36.67% patients had both restrictive and obstructive (small airway obstruction) feature. **Conclusion:** This study concluded that some pulmonary functions were markedly reduced in ESRD patients undergoing maintenance haemodialysis. In addition most of the patients were suffering from restrictive and some of them were affected with both obstructive and restrictive type of pulmonary disorders.

Key words: FVC, FEV_1, FEV_1/FVC ratio, $FEF_{25-75\%}$ and ESRD

J Bangladesh Soc Physiol. 2013 June; 8(1): 33-36
For Authors Affiliation, see end of text.

http://www.banglajol.info/index.php/JBSP

Introduction

End -stage renal disease (ESRD) is an irreversible decline in kidney function, which is severe enough to be fatal in the absence of dialysis or transplantation[1]. In Bangladesh the prevalence of ESRD is 150-200 per million populations[2]. The mean age of the ESRD patients is 42 years, which is similar to those of India and Pakistan but much less than that of the developed countries where the mean age is 61years and most of the patients die due to lack of renal replacement therapy[3].

The commonest cause of the ESRD is glomerulonephritis (40%) with diabetes mellitus (24%) & hypertension (13%) being the other leading cause[4]. Additional risk factors for developing ESRD include a history of heroin abuse, tobacco, analgesic use, ethnicity, obesity, lower socioeconomic status, hyperuricaemia & family history of kidney disease[5]. Clinical feature

Received April 2011; Accepted November 2011

of ESRD include hypertension, anemia, anorexia, nausea, vomiting, autonomic neuropathy, myopathy, generalized weakness, metabolic bone disease, metabolic acidosis, fluid & electrolyte imbalance[6].

Pulmonary complications such as pulmonary edema & pleural effusion are common in ESRD[7]. Others are pulmonary fibrosis & calcification, pulmonary hypertension, hemosiderosis & pleural fibrosis[7,8]. Haemodialysis associated hypoxemia due to fall in white cell count is a response to intrapulmonary sequestration of neutrophils which causes partial obstruction of capillary blood flow in the lung & may induce acute changes in lung function[9].

Pulmonary edema due to hypoalbuminemia which decrease plasma oncotic pressure & increased pulmonary capillary hydrostatic pressure leads to alterations of pulmonary intravascular starling forces & increases pulmonary capillary membrane permeability & allowing for the efflux of protein rich fluid from the capillary into the lung[10]. Metastatic pulmonary calcification occurs in 50% or more of renal patients with metastatic soft tissue calcification[11]. This lesion predominantly affects alveolar septa with varying degrees of fibrosis, calcification & macrophagic giant cells and causes septal thickening[11, 12].

In fact, some authors have reported that 75% of patients on long term haemodialysis had history of restrictive pulmonary abnormalities[13]. Several investigators of different countries reported lower spirometric lung function variables in haemodialysis patients[14-17]. Of these variables FVC, FEV_1, FEV_1/FVC ratio and $FEF_{25-75\%}$ were most commonly evaluated.

In Bangladesh, assessments of pulmonary functions among ESRD patients undergoing maintenance haemodialysis have not yet been done. Though other studies found restrictive feature in ESRD patients but no studies reported obstructive feature in these group of patients. Therefore, the present study has been undertaken to assess some aspects of pulmonary function status in ESRD patients undergoing maintenance haemodialysis and also to detect the presence of pulmonary function disorders.

Methods

This cross sectional study was carried out in the Department of Physiology, BSMMU, Dhaka, between July 2011 to June 2012. Thirty male ESRD patients aged 25 to 55 years undergoing maintenance haemodialysis with a duration of less than 1 year were taken as study group. Thirty age, sex matched healthy subjects were taken as control. Study protocol was approved by ethical Review Committee of BSMMU, Shahabag, Dhaka. Patients were randomly selected from the Nephrology Department of BSMMU, Dhaka. Subjects with history of acute or chronic lung & chest wall disease e.g. pneumonia, tuberculosis, COPD, malignancy etc, history of coronary heart disease, diabetes mellitus, alcohol/tobacco users and smokers were excluded from the study. After selection of the subject objectives, benefits of this study were explained to each subjects and encouraged for voluntary participation. When they agree to participate, an informed written consent was taken from each subject. A detail personal, medical, family, socioeconomic, occupational and drug history were recorded in a preformed questionnaire and thorough physical examinations were done and were documented. For the assessment of lung function FVC, FEV_1, FEV_1/FVC ratio and $FEF_{25-75\%}$ of all the subjects were recorded by a digital Spirometer. Data were expressed as mean of percentage of predicted value ± SD and also in percentage of the frequency. Independent sample‘t’ test was done to compare between the groups by using SPSS for windows version 12.0 as applicable. P value <0.05 was accepted as level of significance.

Results

The mean of the percentages of predicted values of FVC, FEV_1 and FEF_{25-75} were significantly lower ($P<0.001$) in study group than those of

control. Again the mean percentage of predicted value of FEV_1/FVC% was higher in study group in comparison to that of control but the difference was statistically non significant (Table I).

Among the ESRD patients, 36.67% patients had both restrictive and obstructive type of and 63.33% patients showed features of only restrictive type of lung dysfunction (Figure I).

Table I: Percentages of predicted values of FVC, FEV_1, FEV_1/FVC% and $FEF_{25-75\%}$ in different groups (n=60)

Parameters	Group A (n=30)	Group B (n=30)	P value
FVC(L)	79±6.57	52.97±13.66	0.000***
FEV_1(L)	82.17±7.46	55.97±13.68	0.000***
FEV_1/FVC%	104.26±7.89	106.27±6.33	0.280 ns
$FEF_{25-75\%}$	82.5±19.65	59.07±17.91	0.000***

Data were expressed as mean ± SD.

Group A: Apparently healthy subjects (control)

Group B: ESRD Patients undergoing maintenance haemodialysis (Study).

*** = significant ($p<0.001$)

ns = non significant ($p > 0.05$)

n = total number of subjects

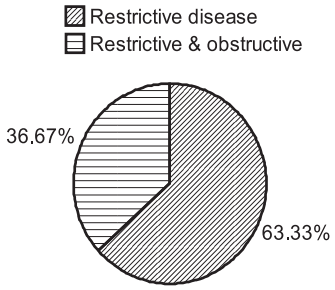

Figure 1: Frequency distribution of pulmonary dysfunction in ESRD patients (n=30)

Discussion

In this study, the mean percentages of predicted values of FVC, FEV_1 and $FEF_{25-75\%}$ in ESRD patients undergoing maintenance haemodialysis were significantly lower than those of apparently healthy subjects. Similar findings were also reported by investigators of other countries[14-17]. But FEV_1/FVC ratio was found higher in this group of ESRD patients than those of healthy subjects and the differences between the groups were statistically non significant. In the contrary lower values of this ratio were also reported by other researcher[15].

In this study, all the patients had pulmonary functional abnormality. In addition, restrictive type of lung function disease was found in 63.33% and both restrictive and obstructive pattern were found in 36.67% of these ESRD patients. But Bush and Gabriel (1991) found that 20% patients under haemodialysis in their study had normal lung function, 30% patients had restrictive and 20% patients had both restrictive and obstructive features[10]. Karacan et al. found 59.26% patients had normal lung function and 18.52% patients had restrictive and 7.4% had both restrictive and obstructive dysfunction[17].

Literature survey proposed different mechanisms linking pulmonary dysfunction to renal failure. It has been suggested that uremia exerts toxic effects on the vascular endothelium leading to inflammation of pulmonary capillaries which may enhances its permeability. So there may be efflux of protein-rich fluid from the capillaries leading to pulmonary edema. This effect causes increased resistance in the small airways and alveoli which causes narrowing of small airways[18].

Research evidences suggested that restrictive and obstructive lung disease in these patients may attributed to pulmonary hypertension, pulmonary edema, pulmonary fibrosis and calcification, pleural effusion and pleural fibrosis[12,18,19].

From the nature of the present study, the exact mechanism of pulmonary involvement in ESRD patient cannot be elucidated. However, the above mentioned factors may have the role for the pulmonary involvement in this group of patients.

This study also revealed that patients under haemodialysis may present features of pulmonary dysfunction and showing intensive lung

involvement in end-stage renal failure. The magnitude of pulmonary abnormality in this study is quite high compared to the other similar studies[10, 17]. Furthermore restrictive type of dysfunction is evident in majority patients. This is supported by the history of moderate degree dyspnea affecting most of the patients.

Conclusion

The result of the study concluded that the spirometric lung function variables were decreased in ESRD patients undergoing maintenance haemodialysis and may suffering from either restrictive or both restrictive and obstructive pulmonary disorders.

Author affiliations

1. * Farhana Hoque, Assistant Professor, Department of Physiology, Kumudini Women's Medical College, Mirzapur, Tangail. Email: www. ltfmn@ yahoo.com
2. Shelina Begum, Professor, Chairman Department of Physiology, Bangabandhu, Sheikh Mujib Medical University (BSMMU), Shahbag, Dhaka.Email: shelina1985@gmail.com
3. Abdul Latif, Student of MD Nephrology (thesis part) BSMMU, Dhaka.
4. Afroza Begum, Assistant Professor, Community medicine, Shohid Sorwardi Medical College, Sherebanglanagar, Dhaka.
5. Shamima Sultana, Medial Officer, Department of Physiology, BSMMU, Dhaka

**** For correspondence***

References

1. Abbasi M, Chertow GM, Hall YN. End- Stage Renal Disease. Am Fam Physician. 2010; 82(12): 1512-1514.
2. Rashid HU. Renal transplant in Bangladesh-problem and issues, solution and where we are. JNRT. 2009; 2(1): 116-121.
3. Rashid HU. Health delivery system for renal disease care in Bangladesh. Saudi J Kidney Dis Transpl. 2004; 15(2): 185-189.
4. Rashid HU, Rahman M, Islam S, Sharmin S, Muqueet MA, Faruque O. The silent epidemic of CKD in Bangladesh & need for its prevention. [Internet][cited 2011 nov 16] Available from: http://www.jsn.or.jp/AFCKDI2007.
5. Hall YN, Hsu CY, Iribarren C, Darbinian J, McCulloch CE, Go AS. The conundrum of increased burden of end-stage renal diseasein Asians. Kidney Int. 2005; 68(5): 2310-6.
6. Goddard J, Turner AN, Cumming AD, Stewart LH. Kidney and urinary tract disease. In: NA Boon, NR Colledge, BR Walker, JAA Hunter (eds). Davidson's principles & practice of Medicine. Elsevier Limited; 2006. p
7. Bush A, Gabriel R. The lungs in uraemia: a review. Journal of the Royal Society of Medicine. 1985; 78: 849-855.
8. Milliner DS, Zinsmeister AR, Leiberman E, Landing B. Soft tissue calcification in pediatric patients with end-stage renal disease. Kidney Int. 1990; 38(5): 931-6.
9. Craddock PR, Fehr J, Brigham KL, Kronenberg RS, Jacob HS. Complement and Leukocyte-Mediated Pulmonary Dysfunction in Haemodialysis. N Engl J Med 1977; 296: 769-774.
10. Bush A, Gabriel R. Pulmonary function in chronic renal failure: effects of dialysis and transplantation.Thorax. 1991; 46(6): 424-8.
11. Firooznia H, Pudlowski R, Golimbu C, Rafil M, McCauley D. Diffuse interstitial calcification of the lungs in chronic renal failure mimicking pulmonary edema. Am J Roentgenol. 1977; 129: 1103- 1105.
12. Justrabo E, Genin R, Rifle G. Pulmonary metastatic calcification with respiratory insufficiency in patients on maintenance haemodialysis. Thorex.1979; 34: 384-388.
13. Kovelis D, Pitta F, Probst VS, Peres CP, Delfino VD, MOcelin AJ, Brunetto AF. Pulmonary function and respiratory muscle strength in chronic renal failure patients on haemodialysis. J Bras Neumol 2008; 34(11): 907-12.
14. Wanic-Kossowska M. Immediate effect of haemodialysis with cuprophane membrane and acetate containing dialysis fluid on respiratory function in patients with chronic renal failure. Pol Tyg Lek. 1993; 48: 175-7.
15. Cury JL, Brunetto AF, Aydos RD. Negetive effects of chronic kidney failure on lung function and functional capacity. Rev Bras Fisioter. 2010; 14(2): 91-8.
16. Kovacevic P, Stanetic M, Rajkovaca Z, Meyer FJ, Vukoja M. Changes in spirometry over time in uremic patients receiving long-term haemodialysis therapy.Pneumologia. 2011; 60(1): 36-9.
17. Karacan O, Tutal E, Colak T, Sezer S, Eyuboglu FO, Haberal M. Pulmonary function in renal transplant recipients and end-stage renal disease patients undergoing maintenance dialysis. Transplant Proc. 2006; 38(2): 396-400.
18. Rackow EC, Fein IA, Sprung C Grodman RS. Uremic pulmonary edema. Am J Med. 1978; 64(6): 1084-8.
19. Pierson DJ. Respiratory considerations in the patients with renal failure. Respiratory Care. 2006; 51(4): 413-422.