Determining the Efficacy of Salbutamol in Obstructive Lung Disease by Spirometry

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ABSTRACT

Among the different parameters of spirometry, FEV_1(forced expiratory volume in fi rst second), FVC (forced vital capacity), FEV_1 /FVC ratio and PEFR (peak expiratory flow rate) are chosen, which provide information about the lung function in obstructive lung disease. The objective of this study was to determine the efficacy of salbutamol on the basis of improvement in these parameters. A descriptive cross sectional study was conducted at Nepal Medical College and Teaching Hospital for a period of 3 months. A total of 150 patients who presented with symptoms of respiratory disease in medicine outpatient department (OPD)in which spirometry was performed were selected. Of the 150 patients, 100 having airway obstruction were selected as obstructive lung disease (OLD) cases and remaining 50 patients who had respiratory symptoms but no airway obstruction were selected as control. After taking informed consent, data were collected from medicine department. All the data were entered in Statistical Package for Social Sciences (SPSS version 22) and FEV_1, FVC, FEV_1/FVC and PEFR were analyzed. There was significant difference (p-value <0.05) between values for spirometry parameter like FEV_1, FVC, FEV_1 /FVC and PEFR before and after salbutamol therapy for both cases and control group. However, percentage change in FEV_1, FVC and PEFR was found to be significantly higher (p<0.05) in cases as compared to control group. Thus, salbutamol was efficacious and produced higher level of bronchodilation in patients with obstructive lung disease.

Keywords: Bronchodilation, Obstructive lung disease, Salbutamol, Spirometry

INTRODUCTION

Salbutamol, a bronchodilator and an essential medicine in the World Health Organization's list, is marketed by several names such as albuterol, ventolin, asthalin, etc. Salbutamol is used in the management of pulmonary diseases including conditions of trachea, bronchi, bronchioles, alveoli as well as the nerves and muscles of breathing.[1] Such diseases can be classified as obstructive, restrictive or combined pattern and is assessed by spirometry. Spirometry is a physiological test that is used for screening of respiratory health in the same way as blood pressure provides information about general cardiovascular health.[2] A good respiratory health is interpreted as normal on the basis of normal spirometry parameter like FEV_1 (forced expiratory volume in first second), FVC (forced vital capacity) and ratio of FEV_1 to FVC.[3,4]Asthma and chronic obstructive pulmonary disease (COPD) although separate conditions may co-exist or can evolve into each other.[5-7] Both are common obstructive lung diseases with obstructive pattern.[8] This can be assessed by spirometry parameters like FEV_1, FVC, FEV_1/ FVC ratio and PEFR. These variables were taken into consideration because of the fact that they determine the pattern

of obstruction in pulmonary disease.[9,10] Patients were subjected to bronchodilator reversibility test; percentage improvement in FEV_1, FVC or both from baseline following bronchodilator administration.[11,12] Percentage changes in spirometry parameters were used to observe efficacy of salbutamol.[13,14]

MATERIALS AND METHODS

A descriptive cross sectional study was conducted in the Department of Medicine, NMCTH from March 2016 to July 2016. Informed consent was taken from all the patients. Ethical approval was obtained from the Research and Ethical Sub Committee (RESC) of NMCTH. Confidentiality and anonymity of the patients was assured and maintained.

A total of 150 patients who presented with symptoms of respiratory disease in medicine outpatient department (OPD) in whom spirometry was performed were selected. Of the 150 patients, 100 of them with airway obstruction were selected as cases of Obstructive Lung Disease (OLD) and remaining 50 patients having respiratory symptoms but no airway obstruction were selected as control. The spirometer used was SCHILLER SP-26C. A qualified pulmonary

technologist performed spirometry in patients referred from outpatient department (OPD). The patients were instructed and were asked to perform spirometry at least three times to observe FEV_1, FVC, FEV_1/FVC ratio and PEFR. The best values were considered for analysis. After completion of spirometry, the same patient was given salbutamol 1ml (5mg) mixed with 2ml of normal saline via nebulizer. Spirometry was performed again in the same patient.

The recordings were compared before and after administration of the drug in order to determine percentage change in spirometry parameters due to salbutamol. Similarly, spirometry value was compared before and after administration of the drug in the control group. Percentage change in spirometry values obtained werecomparedwith that of obstructive cases. All the data were entered in SPSS version 22 and spirometry parameters were analyzed using Paired SampleT-Test and Independent Sample T-Test. P-value less than 0.05 was considered as statistically significant.

RESULTS

Of the 150 patients, 100 were cases of obstructive lung disease, of which 58 were female and 42 were male. The remaining 50 cases having respiratory symptoms but no obstruction were included in control group. Among the control, 25 were female and remaining 25 were male. The results show that patients belonging to age group of 50-59 years were predominant (30%) followed by 60-69 age group (28%) which was in turn followed by 70-80 years (22%). The control group comprised of patients of all age groups ranging from 7 to 85 years.

There were significant changes in FEV_1, FVC, FEV_1/FVC ratio, PEFR (p <0.05) in both OLD patients and controls.

Table 1: Paired Sample T-Test applied for pulmonary measurement in OLD cases.

	Mean	Std. Deviation	p value
FEV_1 before	80.59	26.76	<0.05
FEV_1 after	92.69	30.48	
FVC before	92.81	23.57	<0.05
FVC after	107.18	25.39	
FEV_1/FVC before	79.31	15.80	<0.05
FEV_1/FVC after	79.57	14.74	
PEF before	63.11	25.38	<0.05
PEF after	73.69	27.96	

Table 2: Paired Sample t-Test applied for pulmonary measurement of control.

	Mean	Std. Deviation	p value
FEV_1 before	112.44	27.74	<0.05
FEV_1 after	123.18	27.79	
FVC before	114.93	26.02	<0.05
FVC after	123.11	27.46	
FEV_1/FVC before	99.71	10.71	<0.05
FEV_1/FVC after	102.21	8.016	
PEF before	111.71	23.85	<0.05
PEF after	124.73	27.04	

However, percentage change in FEV_1, FVC and PEFR was greater (p<0.05) in OLD patients as compared to control group.

Table 3: Independent sample t-test applied for pulmonary measurement of OLD cases and control.

		Mean	Standard deviation	P value	F
% change in FEV_1	Cases	16.91	14.29	<0.05	3.42
	Control	10.69	13.76		
% change in FVC	Cases	16.32	10.21	<0.05	26.11
	Control	7.31	5.90		
% change in FEV_1/FVC ratio	Cases	0.93	8.94	<0.05	4.53
	Control	3.11	8.88		
% change in PEFR	Cases	18.48	15.86	<0.05	4.62
	Control	12.18	12.60		

DISCUSSION

The World Health Organization estimates that non-communicable diseases (NCDs) are the leading cause of death worldwide, accounting for 60% of death in all humans.[15] There are two types of NCDs, genetic diseases and environmental diseases. Asthma and chronic obstructive pulmonary disease (COPD) come under environmental diseases. Four diseases under NCDs epidemic proportion worldwide are cardiovascular disease, chronic obstructive pulmonary disease (COPD), cancer and diabetes mellitus. The study showed in total NCDs; 38% were having heart disease, followed by COPD (33%), where as diabetes and cancer accounted for 10% and 19% cases respectively.[16] Bhandari *et al* in 2014[17] stated that the prevalence of non-communicable disease (NCD) in Nepal was 31% and OLD (43%) was the most common non-communicable disease. With such high prevalence it is assumed that this study was needed to provide relevant information to further researchers and to develop effective treatment protocol. In our study which was conducted at NMCTH, OLD was predominant in age group 50-59 years. However, OLD was predominant in age group 60-69 in one of the research done in mid-western region of Nepal.[17] This variation could be due

to difference in geographic region. Kathmandu, that lies in the central region of Nepal has higher pollution as compared to mid-western region. Our study showed that the majority of the OLD patients were female, which is in agreement to a study conducted by Bhandari *et al*. Salbutamol is a β_2 agonist that causes bronchodilation. This bronchodilation improves airflow limitation. The airflow obstruction which was present in OLD was improved by nebulized salbutamol which was seen in our study as well as research conducted by Ipek IO *et al*.[18] There was significant change in spirometry parameters like percentage change in FEV_1, FVC, FEV_1/FVC and PEFR which provides a valuable information regarding efficacy of salbutamol. Increase in these parameters are predictors of bronchodilator response.[19-22] Salbutamol although is efficacious, did not produce similar amount of bronchodilation in control. The reason could be no initial obstruction due to bronchoconstriction. However, since there was initial bronchoconstriction in OLD patient, salbutamol was able to produce greater amount of bronchodilation than the control. In one of the study conducted by Hegeward M *et al*, he concluded that bronchodilator testing can be omitted in patients with normal spirometry as they have low probability of positive response.[23] But other studies show that higher dose of salbutamol was required to produce bronchodilation in asthma patients than in normal subjects.[24] The reason cited was difficulty for the drug to reach the β adrenergic receptors in the constricted airway.[25] In conclusion, this study reaffirms that salbutamol is efficacious and produces bronchodilation in patients with obstructive lung disease and therefore is useful for management of OLD.

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REFERENCES

1. Connellan SJ, Gough SE. The effects of nebulized salbutamol on lung function and exercise tolerance in patients with severe airflow obstruction. *Br J Dis Chest*. 1982;76:135–42.

2. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, *et al*. Standardisation of spirometry. *Eur Respir J*. 2005;26(2):319–38.

3. Pellegrino R, Viegi G, Brusasco V, Crapo RO, Burgos F, Casaburi R, *et al*. Interpretative strategies for lung function tests. *Eur Respir J*. 2005;26(5):948–68.

4. Al-Ashkar F, Mehra R, Mazzone PJ. Interpreting pulmonary function tests: Recognize the pattern, and the diagnosis will follow. *Cleve Clin J Med*. 2003;70(10):866–81.

5. Gibson PG, Simpson JL. The overlap syndrome of asthma and COPD: what are its features and how important is it? *Thorax*. 2009;64(8):728–35.

6. Postma DS, Rabe KF. The Asthma–COPD Overlap Syndrome. *N Engl J Med*. 2015;373(13):1–4.

7. Hardin M, Cho M, McDonald M-L, Beaty T, Ramsdell J, Bhatt S, *et al*. The clinical and genetic features of COPD-asthma overlap syndrome. *Eur Respir J*. 2014;44(2):341–50.

8. Romieu I, Carol T. Diet and obstructive lung diseases. *Epidemiol Rev*. 2001;23(2):268–87.

9. Hansen JE, Sun XG, Wasserman K. Spirometric criteria for airway obstruction. *Chest*. 2007;131(2):349–55.

10. Celli BR. The importance of spirometry in COPD and asthma: Effect on approach to management. *Chest*. 2000; 117: 15-19.

11. Calverley PM, Burge PS, Spencer S, Anderson J , Jones PW. Bronchodilator reversibility testing in chronic obstructive pulmonary disease. *Thorax*. 2003;58(8):659–64.

12. Hanania NA, Celli BR, Donohue JF, Martin UJ. Bronchodilator reversibility in COPD. *Chest*. 2011; 140: 1055–63.

13. Newton MF, O'Donnell DE, Forkert L. Response of lung volumes to inhaled salbutamol in a large population of patients with severe hyperinflation. *Chest*. 2002;121(4):1042–50.

14. Aliverti A, Rodger K, Dellaca RL, Stevenson N, Lo Mauro, Pedotti A, *et al*. Effect of salbutamol on lung function and chest wall volumes at rest and during exercise in COPD. *Thorax*. 2005;60(11):916–24.

15. WHO. Global status report on non-communicable diseases. 2010

16. Bhusal CL. Prevalence of Non-Communicable Disease in Nepal Conducted by Nepal Health Research Council. 2010.

17. Bhandari GP, Angdembe MR, Dhimal M, Neupane S, Bhusal C. State of non-communicable diseases in Nepal. *BMC Public Health*. 2014;14(1):23-8

18. Ipek IO, Yalcin EU, Sezer RG, Bozaykut A. The efficacy of nebulized salbutamol, hypertonic saline and salbutamol/ hypertonic saline combination in moderate bronchiolitis. *Pulm Pharmacol Ther*. 2011;24(6):633–7.

19. Kerstjens HAM, Overbeek SE, Schouten JP, Brand PLP, Postma DS. Airways hyperresponsiveness, bronchodilator response, allergy and smoking predict improvement in FEV_1 during long-term inhaled corticosteroid treatment. *Eur Respir J*. 1993;6(6):868–76.

20. Waheed Z, Irfan M, Haque AS, Siddiqui NH, Awan S, Syed B, *et al*. Assessing two spirometric criteria of pre-bronchodilator and post-bronchodilator FEV_1/FVC ratio in detecting air flow obstruction. *J Pak Med Assoc*. 2011;61(12):1172–5.

21. Chae EJ, Kim T-B, Cho YS, Park C-S, Seo JB, Kim N, *et al*. Airway Measurement for Airway Remodeling Defined by Post-Bronchodilator FEV_1/FVC in Asthma: Investigation Using Inspiration-Expiration Computed Tomography. *Allergy Asthma Immunol Res*. 2011;3(2):111–7.

22. Aggarwal AN, Agarwal R, Gupta D, Jindal SK. Use of peak expiratory flow for assessing bronchodilator responsiveness. *Prim Care Respir J*. 2009;18(1):50–2.

23. Hegewald MJ, Townsend RG, Abbott JT, Crapo RO. Bronchodilator Response in Patients With Normal Baseline Spirometry. *Respir Care*. 2012;57(10):1564–70.

24. Lipworth BJ, Tregaskis BF, McDevitt DG. Beta-adrenoceptor responses to inhaled salbutamol in the elderly. *Br J Clin Pharmacol*. 1989;28(6):725–9.

25. Barnes P, Pride N. Dose-response curves to inhaled beta-adrenoceptor agonists in normal and asthmatic subjects. *Br J Clin Pharmacol*. 1983;15(6):677–82.