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Effect of Hyperthyroidism on Respiratory Muscle Power

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ABSTRACT

Introduction: Hyperthyroidism affects respiratory system by many ways e.g. hyper metabolic effect and direct compression of enlarged thyroid on the trachea. Hyperthyroidism is also accompanied by skeletal muscle weakness so in the present study we assessed the effect of hyperthyroidism on respiratory muscle power in Gezira state in Sudan.
Methods: Twenty patients with hyperthyroidism (19 female, one male) aged 20-50 years, and twenty normal subjects matched for age, gender and height were investigated for pulmonary function tests (FVC,FEV1,PEFR) and respiratory muscle power (maximum expiratory pressure MEP)by using a spirometer, and Respiratory pressure meter (RPM).
Results: pulmonary function (FEV1, PEFR) and respiratory muscle pressure (MEP) in the hyperthyroid patients were significantly decreased compared with the normal control subjects (FEV1 p=0.013, PEFR p=0.010, MEP p=0.000), but there was no significant decrease in FVC (p=0.179).
Conclusion: These results confirm the impaired lung function and respiratory muscle weakness in patients with hyperthyroidism.

Key words: hyperthyroidism; respiratory muscle weakness; respiratory muscle strength; respiratory muscle power.

INTRODUCTION

Hyperthyroidism is a clinical state resulting from excessive secretion of thyroid hormones thyroxin (T4) and tri-iodothyronine (T3). (1,2,3,4) The most common cause is Grave's disease. (1,3,4) Robert Graves first identified the association of goiter, palpitations, and exophthalmos in 1835, although Caleb Parry had published details of a case 10 years earlier. (5) The weakness associated with hyperthyroidism typically result from myopathic effects of the disease. (1, 8, 11) Serum concentrations of creatine kinase are normal or low. Most hyperthyroid patients have electromyographic evidence of motor unit potentials of reduced duration and high frequency of polyphasic potentials in proximal muscle. Muscle biopsies are usually normal or show nonspecific evidence of fatty infiltration, fiber atrophy, and nerve terminal damage. (1) Dyspnea at rest and in exercise is reported as a common symptom of hyperthyroidism. (6,8,11) The tissue oxygen requirement increases due to the activation of catabolic processes and intensified heat production. (6,11) Some studies found that there is weakness of respiratory muscles in patients with hyperthyroidism, pulmonary function in patients without coincident congestive heart failure has demonstrated reduction in vital capacity, decreased pulmonary compliance and weakness of the respiratory muscles. (6,7,10,11) In thyrotoxicosis respiratory muscle weakness that occurs affects both inspiratory and expiratory muscles. [12] In some patients with thyrotoxicosis ventilatory support may be required in rare cases of severe involvement of respiratory muscles. [1,9] This study aim to find if there is any effect of hyperthyroidism on respiratory muscle power in Gezira state, Sudan.

MATERIALS AND METHODS

Study design and study area:

A descriptive cross sectional study was performed to assess the effect of hyperthyroidism on respiratory muscle power in Gezira state, Sudan from December 2013 to July 2014.

Study population (Subjects):

Twenty patients with newly discovered hyperthyroidism (19 female ,one male) not complicated with cardiac problems and not known to have any chronic respiratory disease or any other chronic disease were selected randomly from Alshaheed Alzubair health center in Wadmedani, Gezira state, Sudan and twenty normal control subjects matched for age, gender and height were included.

Data collection:

A questionnaire was filled by all hyperthyroid patients and normal control subjects. The questionnaire included personal data (age, gender), anthropometric data (height and weight) and thyroid function tests results of the patients.

A tape meter was used to measure the standing height of the subject in centimeters. A sensitive balance was used to measure the body weight in kilograms. The subjects were investigated for pulmonary function and respiratory muscle power, the procedure was explained to all subjects. A pocket spirometer was used to measure forced vital capacity (FVC), forced expiratory volume in the first second (FEV1) and peak expiratory flow rate (PEFR). After maximal inspiration, the subject blew forcibly and continuously into the mouthpiece of the spirometer for at least six seconds and the highest measurement of three trials was taken for FVC, FEV1and PEFR. Respiratory mouth pressure meter (RPM) was used to measure maximum expiratory pressure (MEP). The subject was instructed to insert the mouthpiece into the mouth, ensuring the flange is positioned over the gums and inside the lips, whilst the 'bite blocks' are between the teeth. The subject should then inhale to TLC (Total Lung Capacity), lungs full, then perform a 'Valsalva' manoeuvre, a forced exhalation against the RPM with as much effort as possible for as long as possible (minimum 2 seconds). The display will report the result, the maximum average expiratory pressure sustained over a 1 second period of the test, in cmH2O. The subject repeated this test 3 times to ascertain a best value. [13, 14]

Data analysis:

Data analysis was performed using SPSS program statistic version 20. ANOVA test and t- test were used to compare between the two groups. The significance of difference was taken for P-value $\leq .05$.

RESULTS

Pulmonary function (FEV1, PEFR) and expiratory muscle pressure (MEP) in the hyperthyroid female patients (19) were significantly decreased compared with the normal control subjects (19 female) (FEV1 p=0.013, PEFR p=0.010, MEP p=0.000),but there was no significant decrease in FVC, p=0.179).

The hyperthyroid male was excluded from the analysis but a comparison between him and a normal male matched for age, height and weight confirmed that there was decrease in FEV1, PEFR and MEP in the patient than in the control.

Table (1): The mean, standard deviation and P-value of age, weight and height for study group and control group:

	Sample (hyperthyroid female 19) Mean ± SD	Control (19) Mean±SD	P-value
Age	3.58±1.924	3.79±1.960	0.740
Weight	65.68±19.726	66.42±13.858	0.895
Height	165.632± 4.3232	164.237±6.0699	0.420

Table (2):The mean, standard deviation and P-value of lung function tests for study group and control group:

	sample Mean ± SD	control Mean ± SD	P-value
FEV1	2.1753±.53575	2.5411±.28981	0.013
FVC	2.5753±.75863	2.8447±.39740	0.179
PEF	296.95±91.169	369.79±74.039	0.010

Table (3): The mean, standard deviation and P-value of respiratory muscle pressure (maximum expiratory pressure) for study group and control group:

	sample Mean ±SD	Control Mean ±SD	P-value
MEP	84.68±11.662	106.42±21.508	0.000

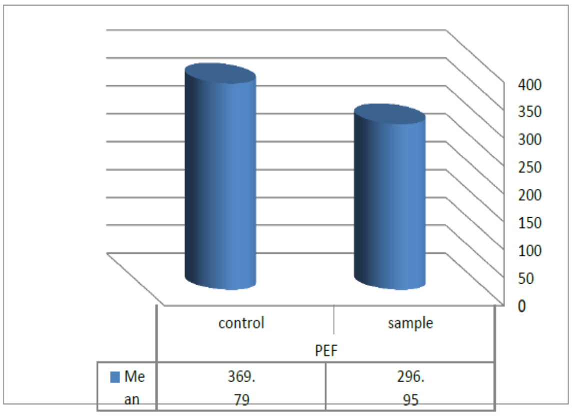

Figure (1):Mean values for lung function test (PEF) in study group and control group:

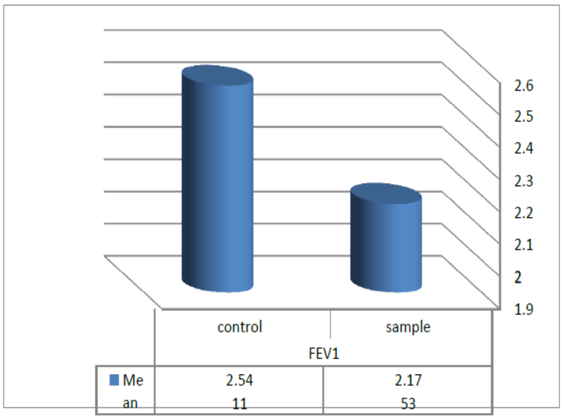

Figure (2): Mean values for lung function test (FEV1) in study group and control group:

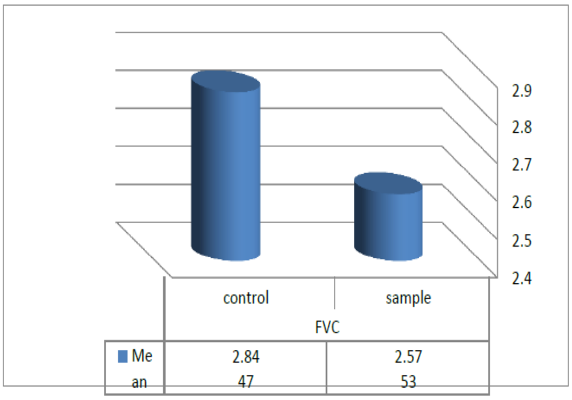

Figure (3): Mean values for lung function test (FVC) in study group and control group:

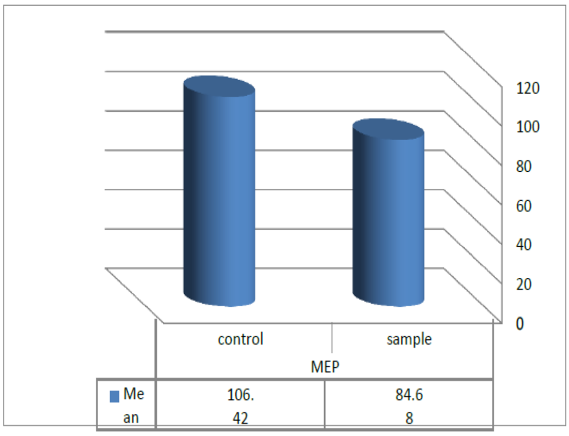

Figure (4): Mean values for respiratory muscle power (MEP) in study group and control group:

DISCUSSION

Previous studies found that hyperthyroidism affect lung function and cause reversible respiratory muscle weakness which affect both inspiratory and expiratory muscles.

A study done by Myron stein (1960), confirm weakness of the respiratory muscles in patients with hyperthyroidism. H.P. Wassermann (1962) confirm Significant increase in respiratory muscle power as the condition of hyperthyroidism is brought under control, and the increase in respiratory muscle power shows a positive correlation (significant at the 5% level) with the increase in vital capacity. Ayres J(1985) found that reversible respiratory muscle myopathy which may explain the frequent finding of breathlessness on exertion in patients with hyperthyroidism .Kendrick AH (1988), confirm that maximal pressures which could be generated by the respiratory muscles were reduced in some patients with thyrotoxicosis, as was functional residual capacity. Mier A (1989) reported that respiratory muscle weakness occurs in hyperthyroidism and that such weakness is reversible with medical treatment. McElvaney GN (1990), the respiratory muscles were weaker in patients with hyperthyroidism than controls. Siafakas NM (1992), both maximal pressures were significantly reduced before treatment in thyrotoxic patients in relation to the mean values of the normal subjects, and they increased significantly after treatment.

Ravinder Goswami (2002), found that significant functional subnormal pressures in the thyrotoxic state of global inspiratory muscle and thoracic diaphragm strength with significant improvement to normal following treatment which indicated the presence of respiratory muscle weakness in patients with thyrotoxicosis. This weakness improved in treated patients.

These results agree with our findings in the present study in which there was significant improvement in PFT values (FEV1, PEFR) and expiratory pressure (MEP).

Some other studies disagree with our finding. S. Freedman (1978), found that changes in maximum respiratory pressures were small and inconsistent and clearly unrelated to changes in Vital capacity (VC). Additional evidence against muscle weakness as the cause of the low initial VCs in the present study is provided by the static lung pressure - volume curves. Guleria R(1996), reported that no significant changes in tidal volume (VT) and maximum- mid expiratory flow rates (MMEFR) MIP and MEP were observed. Lung function parameters, MIP and MEP did not correlate with the severity of dyspnoea. Serum T4 levels correlated inversely with the distance covered during 6 min walking test, MIP and MEP.

CONCLUSION

In this study the results confirm that in patients with thyrotoxicosis there is impaired lung function and respiratory muscle weakness.

REFERENCES

1. Richard J Joseph, Mark E Peterson. (1992).Review and comparison of neuromuscular and central nervous system manifestations of hyperthyroidism in cats and humans. Progress in veterinary neurology Vol.3,No.4 page 114-119.
2. R. S. Bahn, H. B. Burch, D. S. Cooper et al.2011.Hyperthyroidism and other causes of thyrotoxicosis: management guidelines of the American Thyroid Association and American Association of Clinical Endocrinologists .Endocrine Practice. Vol 17 No. 3
3. Golden SH, Robinson KA, Saldanha I, et al. 2009. Prevalence and incidence of endocrine and metabolic disorders in the United States: a comprehensive review. Journal of Clinical Endocrinology Metabolism. ;94(6):1853–1878.
4. David Cooper, Michael McDermott, and Leonard Wartofsky. July 02, 2013.Hyperthyroidism. The journal of clinical endocrinology and metabolism vol 91 issue 7.
5. Anthonyp, Weetman .October 26, 2000. GRAVES’ DISEASE .The New England Journal of Medicine 1236-1248.
6. R. NesrinDemirtaß, NurKebap• Ý, BelginEfe, YaseminKavlak.(2000) .The Assessment of Anthropometric measurements, Muscle Strength, Flexibility, Energy Consumption and Pulmonary Function in Hyperthyroid Patients Before and After Medical Treatment .Turkish Journal of Endocrinology and Metabolism, 2 : 55-61
7. Leslie J. DeGroot .November 1, 2012. Graves’ Disease and the Manifestations of Thyrotoxicosis .thyroid disease manger.
8. McElvaney GN, Wilcox PG, Fairbarn MS, Hilliam C, Wilkins GE, Pare PD, Pardy RL. May 1990. Respiratory muscle weakness and dyspnea in thyrotoxic patients.Am Rev Respir Dis;141(5 Pt 1):1221-7
9. Mier A, Brophy C, Wass JA, Besser GM, Green M .Feb 1989. Reversible respiratory muscle weakness in hyperthyroidism. Am Rev Respir Dis;139(2):529-33.
10. BinduNayak, Kenneth Burman. 2006. Thyrotoxicosis and Thyroid Storm. EndocrinolMetabClin N Am35 ,663–686
11. Michael Eberlein and David B. Pearse.2007. 56-Year-Old Man With Choking, Recurrent Pneumonia, and Weight Loss.CHEST ; 131:1248–1251.
12. Siafakas NM, Milona I, Salesiotou V, Filaditaki V, Tzanakis N, BourosD. Oct 1992.Respiratory muscle strength in hyperthyroidism before and after treatment. Am Rev Respir Dis;146(4):1025-9
13. Carefusion.com/micromedical
14. American Thoracic Society/European Respiratory Society.2002. ATS/ERS Statement on respiratory muscle testing. Am J RespirCrit Care Med Vol166:518 -624.

15. Myron stein, Philip Kimbeltand Robert L Johnson ,JR .17 October 1960 . Pulmonary function in hyperthyroidism .348-363.
16. H. P. Wassermann. 24 November 1962 . Lung volume and respiratory muscle power in hyperthyroidism .S.A.Tydskrifvirgeneeskunde,985- 989
17. Ayres J, Rees J, Clark TJ, Maisey MN. Jan1982.Thyrotoxicosis and dyspnoea. ClinEndocrinol (Oxf) ;16(1):65-71.
18. Kendrick AH, O'Reilly JF, Laszlo G.Aug 1988. Lung function and exercise performance in hyperthyroidism before and after treatment.Q J Med ;68(256):615-27.
19. RavinderGoswami, Randeep Guleria1, Arun Kumar Gupta2, Nandita Gupta, Raman Kumar Marwaha, JitenderNath Pande1 and Narayana Kochupillai.2002. Prevalenceof diaphragmatic muscle weakness and dyspnoea in Graves' disease and their reversibility with carbimazole therapy .European Journal of Endocrinology 147 299– 303.
20. S. FREEDMAN .1978. Lung volumes and distensibility, and maximum respiratory pressures in thyroid disease before and after treatment. Thorax, 33, 785-790.
21. Guleria R, Goswami R, Shah P, Pande JN, Kochupillai N.1996.Dyspnoea, lung function & respiratory muscle pressures in patients with Graves' disease. The Indian Journal of Medical Research, 104:299-303.

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