Original Research Article

Spirometric assessment of pulmonary functions in adult with documented primary hypothyroidism

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Abstract

Introduction: Hypothyroidism is a common endocrine problem, state of deficient thyroid hormones, may be result of many etiologies. Primary hypothyroidism is a subset of Hypothyroidism which accounts for 95% of the cases, only 5% are due to secondary causes. Respiratory manifestations are seldom the major complaints in hypothyroidism. Lung volumes are usually normal, but few studies have shown findings suggestive of restrictive pattern of impairment. This has been attributed to decrease in both expiratory and inspiratory muscle strength, alveolar hypoventilation due to depression of hypoxic and hypercapnic ventilatory drives.

Aim of the Study: To study the pulmonary functions of individuals with primary hypothyroidism by performing spirometry, to compare the spirometric findings of primary hypothyroidism patients with euthyroid individuals.

Materials and methods: Sample size of the study was around 50 patients. 25 patients were controls who were free from thyroid disease. 25 subjects were diagnosed primary hypothyroidism patients were included in the study. The patients and controls were evaluated as per the predesigned proforma and relevant investigations were done to assess their cardiac status and pulmonary status.

Results: The FEV1, FVC, PEFR were found to be decreased and the FEV1/ FVC % was found to be increased in Primary hypothyroidism group when compared to control group.

Conclusion: Pulmonary functions of individuals with primary hypothyroidism patients was by assessed by spirometry and compared with euthyroid individuals. Spirometry values were consistently lower in primary hypothyroidsm patients .Females are more affected than males. Spirometry values shows restrictive pattern.

Key words

Spirometry, Obstructive lung disease, Restrictive lung disease, Pulmonary function Test.

Introduction

The thyroid gland lies in the neck, in front of the upper part of the trachea [1]. Two types of hormones are produced, which are the iodine containing hormones; tri-iodothyronine (T_3) and thyroxine (T_4). T_3 is also formed from peripheral de iodination of T_4. Both are iodine containing aminoacids.T_3 is more active than T_4, RT_3 is inactive.99.98% of T_4 is plasma bound, and biological half life is longer (6-7 days). T3 is less protein bound, so lesser half life. 87% of circulatingT_3 is formed by de iodination; only 13% of T_3 is formed by thyroid gland. T_3 and T_4 are also converted into glucuronide conjugates that enter the bile and pass into the intestine [2]. T_3 acts more rapidly and is 3-5 times more potent than T_4. However almost all the thyroxine is eventually converted to triiodothyronine in the tissues, so that both are functionally important [3]. Pulmonary function is generally normal. But dyspnoea may be caused by depression of hypoxic/hypercapnic ventilatory drive, pleural effusion, impaired respiratory muscle function, obstructive sleep apnea and deposition of glycosaminoglycans leading to lung fibrosis [4]. Pulmonary function abnormalities denote a disease of either airways or lung parenchyma or both interfering with normal alveoli arterial gas exchange. Broadly pulmonary function abnormalities are categorized into 2 patterns:- Obstructive and Restrictive. In this study, spirometry was done to determine any functional lung impairment in hypothyroid patients and to compare with control subjects who are matched for their age and sex. BMI was also analyzed to determine if it has any contribution to the lung impairment if it is indeed present. And also to determined if there is any correlation between the thyroid function with the pulmonary function among the study population.

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Aim of the Study

- To study the pulmonary functions of individuals with primary hypothyroidism by performing spirometry.
- To compare the spirometric findings of primary hypothyroidism patients with euthyroid individuals.

Materials and methods

This hospital based prospective descriptive study was conducted in Raja muthaiah medical college and Hospital, Chidambaram with documented primary hypothyroidism patients during the period November 2014 to July 2016. Sample size of the study was around 50 patients. 25 patients were controls who were free from thyroid disease. 25 subjects were diagnosed primary hypothyroidism patients were included in the study. The patients and controls were evaluated as per the predesigned proforma and relevant investigations (free T_3, freeT_4, TSH, X-ray chest, 2D echo) were done to assess their cardiac status and pulmonary status. Functional status of lungs was assessed by spirometry [5, 6].

Study type: Descriptive study

Thyroid hormone Test

Venous Blood was withdrawn from the patient and thyroid function tests were done at the Department of biochemistry, Rajah Muthiah Medical College and hospital.

Two methods are available for assay of thyroid stimulating hormone. They are Immuno – radiometric assay and Enzyme - linked

immunosorbent assay. The immuno – radiometric method was used in my study for the estimation of thyroid hormone levels.

Inclusion criteria

- The age group of patients was between 18-65 years
- Patients who were newly diagnosed overt primary hypothyroidism were taken up for the study
- Patients who are on thyroid replacement therapy

Exclusion Criteria

- Patients with chronic pulmonary disease, hypertension, diabetes mellitus and chronic kidney disease. Cardiac disease, stroke
- Patients who were taking drugs that alter the cardiovascular functions like amiadarone, Beta blockers and calcium channels blockers etc.
- Cigarette smokers and other forms of tobacco usage products
- Critically ill patients

Subject group

A detailed history and physical examination of each subject was carried out. Subjects with any history of smoking, chronic cough, past H/O Asthma, Chronic obstructive lung disease, obesity and other chronic illness were excluded from the study. The age, body weight and height without shoes were recorded, which gives the BMI of the subject. The test was carried out in the morning during the post absorptive phase. Testing procedure were quite simple, non-invasive and harmless to the subject [7, 8].

Technique

The data of the subject was entered. The subjects were familiarized with the spirometer instrument (Schiller R5-232) and the technique used. The forced vital capacity (FVC) manoeuvre was done. The test was done in sitting position. The subject is asked to take a maximal inspiration to total lung capacity, and then to breathe out as fast as rapidly as he can, until he can exhale no further which is maximal exhalation to residual volume; he then takes a rapid and maximal inspiration. Each subject was given three trials and best of the three test readings was taken. The computer stores and calculates various volumes and flow data with the values corrected for BTPS (Body Temperature Ambient Pressure Saturated with water vapour). No corrections were made for BTPS.

Functional Parameters Studied

- Forced vital capacity (FVC in Liters and FVC %)
- Forced Expiratory volume (FEV1 in Liters & FEV1%)
- FEV_1/ FVC %
- Peak Expiratory flow Rate (PEFR in Liters/s & PEFR %)

Statistical analysis

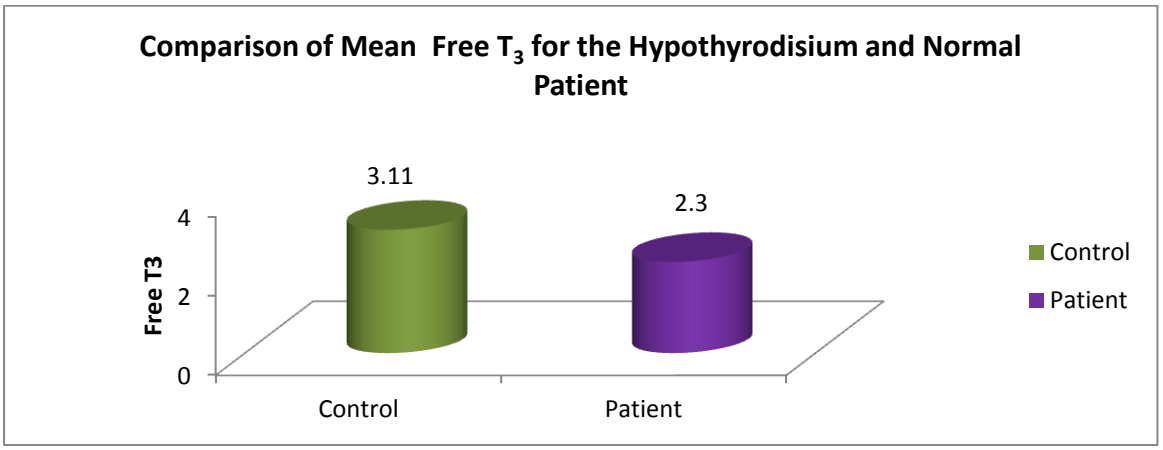
The results were expressed as Mean ± SEM of the mean. The data were analyzed by one way analysis of variance (ANOVA) and were performed using the Statistical Package (SPSS) program, version 20.

Results

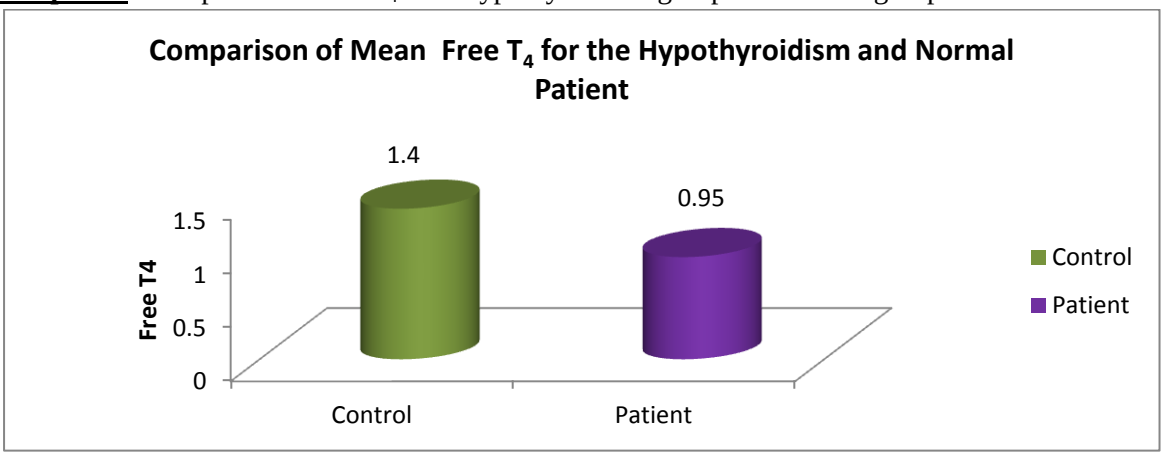
The hypothyroid group comprised of 2.3020 and the control group comprised of 3.1080. There was significant difference between the two groups in these parameters as per **Graph – 1**. The hypothyroid group comprised of 0. 9496 and the control group comprised of 1.4000. There was significant difference between the two groups in these parameters (**Graph – 2**). The hypothyroid group comprised of 10.6440 and the control group comprised of 3.5200. There was significant difference between the two groups in these parameters (**Graph – 3**). The hypothyroid group comprised of 75.25 and the control group comprised of 106.30. There was significant difference between the two groups in these parameters (**Graph – 4**). The hypothyroid group comprised of 67.16 and the control group comprised of 96.28. There was significant difference between the two groups in these

parameters (**Graph – 5**). The hypothyroid group comprised of 107.52 and the control group comprised of 93.81. There was significant difference between the two groups in these parameters (**Graph – 6**). The PEFR % of the study population is depicted in table 9. The hypothyroid group comprised of 68.88 and the control group comprised of 101.34. There was significant difference between the two groups in these parameters (**Graph – 7**).

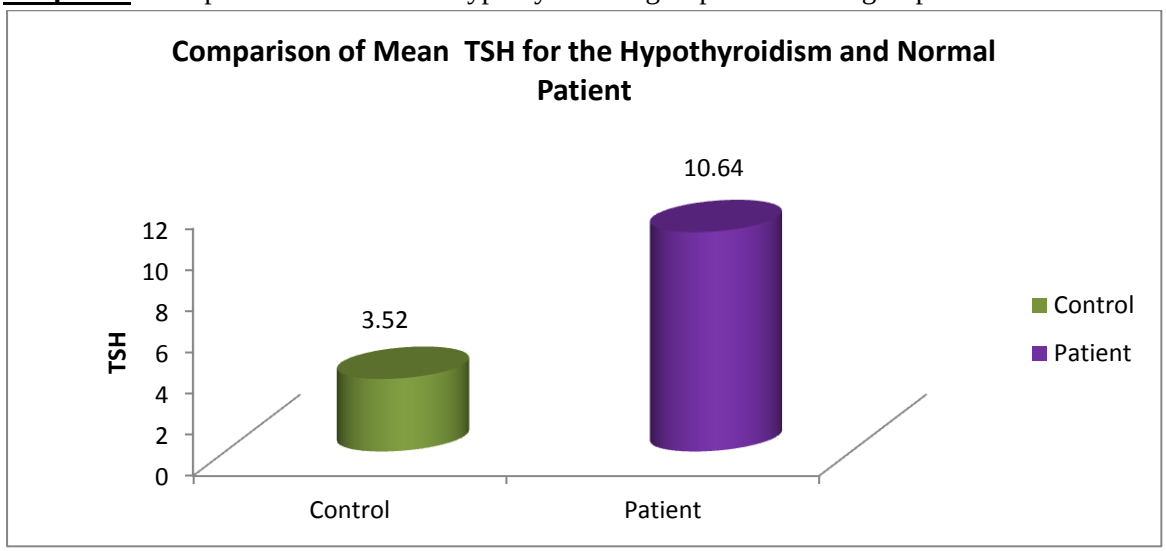
Graph – 1: Comparison of free t_3 both hypothyroisium group and control group.



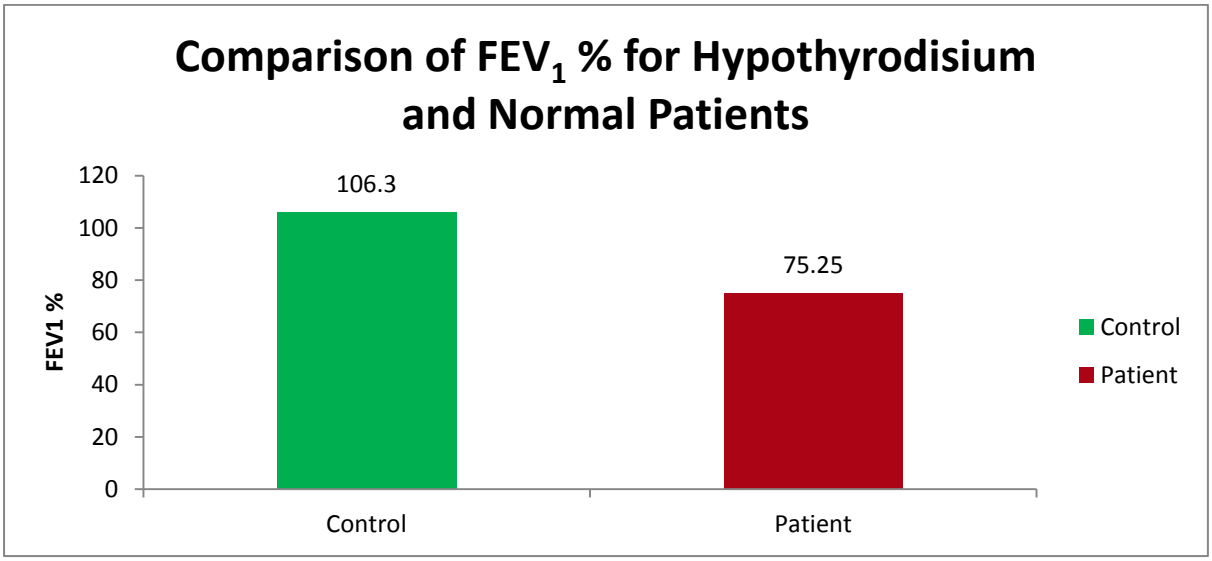
Graph – 2: Comparison of free t_4 both hypothyroidism group and control group.



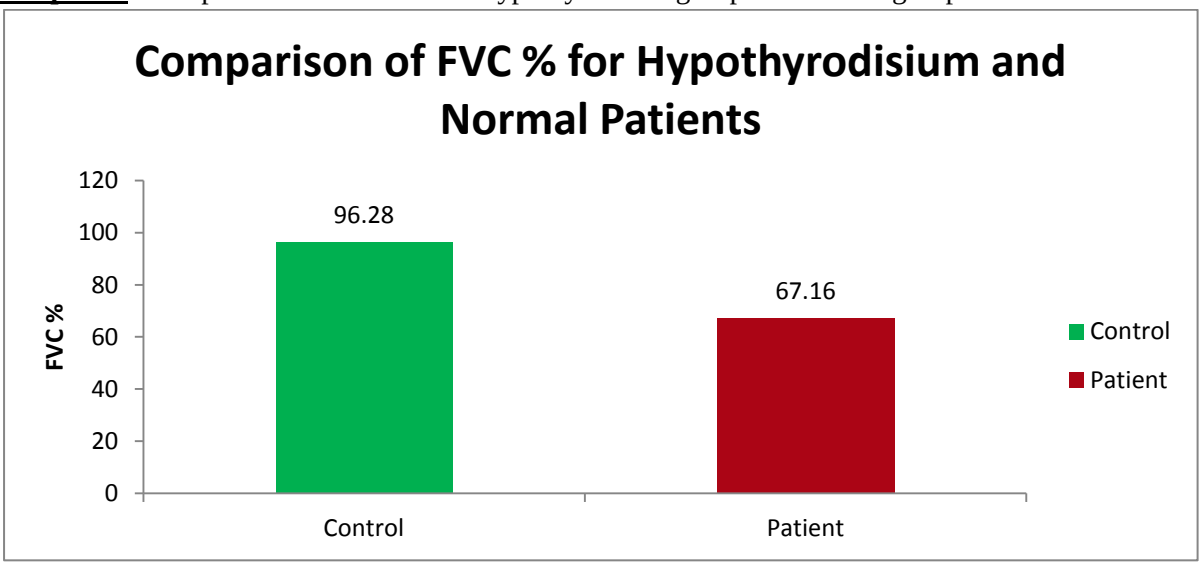
Graph – 3: Comparison of TSH both hypothyroidism group and control group.



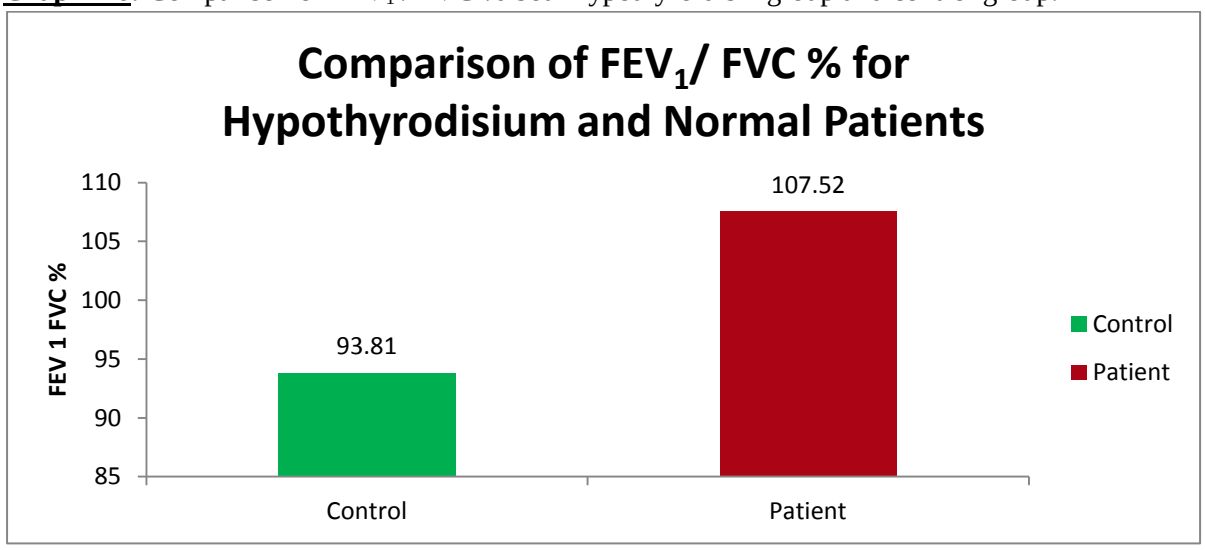
Graph – 4: Comparison of FEV_1 % both hypothyroidism group and control group.



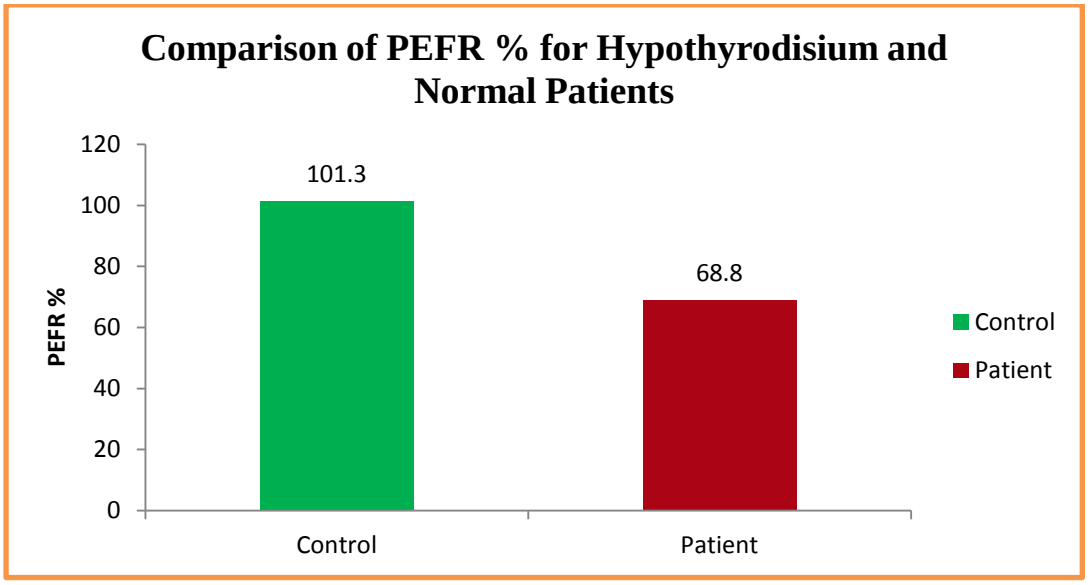
Graph – 5: Comparison of FVC % both hypothyroidism group and control group.



Graph – 6: Comparison of FEV_1 / FVC % both hypothyroidism group and control group.



Graph – 7: Comparison of PEFR % both hypothyroidism group and control group.



Discussion

This study was undertaken to assess the pulmonary functions of primary hypothyroidism patients and to compare it with euthyroid individuals. The different groups i.e. males and females, hypothyroidism and euthyroid individuals were compared in terms of age, sex and BMI [9]. These groups were also homogenous in respect of having no chronic respiratory, cardiovascular system and all being nonsmoker. A total of 25 newly diagnosed primary hypothyroid Patients were analyzed. There were 17 (65%) females and 8 (32%) males. The mean age of presentation was 42.76 Years. 73% of patients were in the age group of 21 to 40 Years of age. . The control group comprised mean age of 41.96±8.65 years. The mean BMI was noted as 23.93. Of the 25 patients studied (42%) patients had TSH values of less than 20, classified as mild hypothyroidism. Moderate hypothyroidism (TSH 20-50) and Severe Hypothyroidism (TSH more than 50) were present in 29% patients each. The Mean TSH value was 10.6m IU/L and Mean fT_4 level was 0.9 ng/dl. The mean value of FEV_1%, FVC%, PEFR% and FEV_1/FVC % are respectively 75.25%, 67.10%, 68,88% and 107% . Hypothyroidism can have numerous effects on the respiratory system. Fatigue and dyspnea on exertion are frequent symptoms [10, 11]. But in the absence of primary respiratory disease, the diminution of the respiratory function in the hypothyroid patients is not significant in most cases. Nevertheless, it does affect the respiratory system including respiratory muscle weakness, alveolar hypoventilation due to decreased hypoxic and hypercapnic ventilatory drives, upper airway obstruction, central and obstructive sleep apnea and even pleural effusion. Lung volumes are usually normal or mildly reduced, but maximal breathing capacity and diffusing capacity are usually reduced [12, 13]. In our study, both FVC and FEV_1 values were found to be lower in hypothyroids as compared with controls but it was significantly for FVC. This is in accordance with other study conducted by Valjevac S, et al. who demonstrated decreased in FVC and FEV_1 among the hypothyroid subjects and suggested that the degree and the duration of thyroid disorders lead to reduced ventilator lung function in patients with thyroid dysfunction. Schunemann HJ, et al. demonstrated that there was a significant difference in the lung functions between those subjects not on treatment and those on thyroid hormone replacement therapy and the decreased in these spirometric parameters in hypothyroidism can be corrected by hormone replacement therapy. Respiratory infections are more common in hypothyroid patients than healthy people which might be the

cause of low PFT parameters [14]. Sharifi F, Amari A, et al. in their study showed that hypothyroidism could cause restrictive changes in respiratory system that are reversible after treatment with levothyroxin. These changes are more significant in females of older ages. Respiratory muscle strength is reduced in patients with hypothyroidism, and improves with treatment; the reduction is caused by both myopathy and neuropathy [15]. Some patients with hypothyroidism have alveolar hypoventilation. Frequently reported findings include decreased vital capacity, FEV_1, FVC, and total lung capacity, which some authors have explained also occurring through alveolar hypoventilation and inspiratory muscle power weakness. The changes observed in our spirometry findings can be explained on the basis of researches by some investigators which suggest that respiratory centre depression, interference of neural conduction or neuromuscular transmission to the respiratory muscles and respiratory muscles diseases in hypothyroidism may cause alveolar hypoventilation which may affect central ventilator control and can impair ventilation. In addition, in hypothyroidism, reduced surfactant phospholipids, phosphatidylglycerol and phosphatidic acid along with increase in surface active lipidsphosphatidylserine and phosphatidyl inositol in alveolar epithelium may decrease alveolar septation and reduce lung compliance and surfactant adsorption. Moreover, mucopolysaccharide deposition in the lungs may cause fibrosis and thickening of the alveolar wall with loss of elastic tissue and may increase the work of breathing. All these changes may reduce ventilator lung functions. In our study, decrease in both FVC and FEV_1 and increased FEV_1/FVC ratio Showing restrictive pattern of pulmonary dysfunction. The decreased values for FVC, FEV_1 and PEF in untreated hypothyroid patients as compared to treated hypothyroids and healthy controls can be attributed to low serum T_4 which may cause respiratory muscle weakness and decreased contractile strength. Low thyroid hormone levels also decrease lung elastic tissue and increase the work of breathing. The treated hypothyroids showed significant changes in pulmonary functions after hormone replacement therapy as compared to untreated hypothyroids thought significant correlation [16, 17].

Conclusion

In our study, both FVC and FEV_1 values were found to be lower in hypothyroids as compared with controls but it was significantly for FVC and FEV_1/FVC values were increased. Females are more affected than males. We conclude that the values of interpretation of spirometry among the primary hypothyroidism shows restrictive pattern of pulmonary dysfunction when compared to euthyroid patients.

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