Assessment of spirometry in patients with hypothyroidism

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Abstract

Hypothyroid is a relatively common disease worldwide. It defined as clinical state resulting from insufficient secretion of thyroid hormone due to structural and or functional impairment of thyroid hormone production. Hypothyroid affect all organ systems including respiratory system although the respiratory manifestations are seldom the major compliant in hypothyroidism. This involvement has been attributed to decrease in both expiratory and inspiratory muscles strength, alveolar hypoventilation and decrease in maximal breathing capacity. The objective of this study is to evaluate the spirometry in patients with hypothyroidism. A case control study was done in the period between February 2016 to March 2017 in the center of endocrinology in Al-Sadr Medical City, Najaf, Iraq. Thirty patients with hypothyroidism and thirty age and sex matched controls were recruited. Simple spirometry, oxygen saturation, anthropometric and thyroid function were performed. Hypothyroid patients showed FVC was significant lower as compared to control group while other parameters SPO2, FEV1, FEV1/FVC were statistically insignificant. Nine (30%) hypothyroid patients had restrictive pulmonary function test. SPO_2, FEV1 and FEV1/FVC were significantly associated with T4 level with direct significant correlation. In conclusion, respiratory system can be affected in hypothyroid patients in a restrictive pattern.

Keywords: Spirometry; FEV1/FVC; Hypothyroidism

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Introduction

Hypothyroidism is a relatively common disease worldwide. It is a condition that resulting from inadequate secretion of thyroid hormone from thyroid gland because of structural and/or functional insult of thyroid hormone production [1, 2]. The prevalence of hypothyroidism was found to be common in both genders. Iodine deficiency is the most common cause of hypothyroidism, other than that Hashimoto's thyroiditis and some drugs such as amiodarone, interferon alpha, interleukin, rifampicin causes the hypothyroidism in prolonged usage [3].

Hypothyroidism affects body systems and the clinical features include fatigue, skin dryness, weight gain, intolerance of cold,

constipation, extremities swelling, dyspnea, voice hoarseness menorrhagia, bradycardia, hair loss and multiple neurological symptoms [2]. Respiratory system like another body systems can be affected by hypothyroidism though respiratory manifestations are seldom the major complaint in hypothyroidism [4]. The pattern of diseases involvement may range from mild dyspnea to severe life threatening respiratory failure [5, 6]. Lung volumes are usually normal, but few studies have shown findings suggestive of pattern of impairment. This has been attributed to inefficient expiratory and inspiratory muscle power, alveolar hypoventilation because of depression of hypoxic and hypercapnic ventilators drives and deficiency in maximal breathing capacity and diffusion capacity in patients with hypothyroidism [7, 8, 9]. Difficulty in weaning hypothyroid patients from assisted ventilation is another associated complication [10]. Patients with hypothyroidism suffer from easy fatigability and exercise intolerance and these subjective sensations could result from limited pulmonary reserve, limited cardiac reserve, increased muscle fatigue or decreased muscle strength [11]. Dyspnea as a subjective sensation which is common in hypothyroidism, looks secondary to limited cardiac reserve [12]. So, assessment of pulmonary function with spirometry in patients with thyroid disorders are particularly important.

Aim of study

Spirometry was done on hypothyroid patients to show whether there was any impairment in lung function parameters.

Patients and methods

A case control study was done from February 2016 to March 2017 in the center of Endocrinology in Al-Sadr medical city in Najaf –Iraq. Thirty hypothyroid patients in the age group 18-52 years and thirty age and sex matched controls were taken. Hypothyroid patients included with TSH > 10 IU/L and T4 < 0.7 ng /dl and T3 < 77 ng/dl.

Exclusion criteria

- Smokers and ex-smokers
- Chronic respiratory diseases
- Pregnancy.
- Diabetes mellitus.
- Obesity BMI> 30 kg/m2

The study was done after proper ethical clearance. A written informed consent was taken from the patients. Personal and family history were taken. Beside general examination, anthropometry and spirometry were done. Thyroid function test was done in particular laboratory where TSH, T4 and T3 were measured by mini VIDAS. Spirometry was done by Spiro-lab. After rest for 10-15 minutes and briefing the technique of FVC (maximum inhalation

followed by maximum exhalation) was carried out in a private and quiet room, in a sitting position with the nose clip held in position on the nose. Spiro-metric parameters recorded for analysis were: Forced vital capacity (FVC), Forced expiratory volume in 1st second (FEV1), FEV1/FVC.

Spiro-metric criteria :

- FEV1/FVC, FVC, FEV1 > lower limit of normal (normal spirometry).
- FEV1/FVC< lower limit of normal (obstructive spirometry).
- FEV1<lower limit of normal and FEV1/FVC >lower limit of normal (restrictive spirometry).

Lower limit of normal = 80%

Digital pulse oximetry was used for all subject to measure oxygen saturation.

Normal SPO_2 = 95- 99 %

Statistical analysis

Data of the study participants were entered and analyzed using the statistical package for social sciences (SPSS) version 24/IBM/2013. Descriptive statistic presented in standard deviation (SD), means, frequencies and percentages (%). Chi-square was used to compare cases and control in frequency of categorical variables. Students t-test was used to compare means of spirometry, parameters between cases and control, level of significance ($p<0.05$) considered significant. Findings and results presented in tables and figures using MS/Word/2010.

Results

There were 30 patients presented with Hypothyroidism (patients' group) and 30 apparently healthy participants (Controls' group), the mean age of patients and controls was 42.2 ± 7.1 and 40.6 ± 6.9 years, respectively. Females were the dominant gender in both studied groups. However, no statistically significant differences had been found between patients and controls, neither in age nor gender while BMI was significantly higher in hypothyroid patients ($P<0.05$), (Table 1). Regarding the blood pressure and pulse rate, patients had significantly higher mean systolic and diastolic blood pressure, 139.17 ± 14.98, 86.83 ± 7.93, respectively among Hypothyroidism group compared to 119.5 ± 9.86 and 73.33 ± 8.13 among controls, ($P<0.001$). On the other hand, patients had lower mean pulse rate than controls, 68 ± 7 and 75 ± 15, respectively, ($P=0.018$).

Table 1.

Demographic characteristics of the studied group

		Hypothyroidism (n = 30)		Control (n = 30)		P- value
		No.	%	No.	%	
Age (years)	≤ 30	2	6.7	3	10.0	0.88
	31 - 40	10	33.3	12	40.0	
	41 - 50	12	40.0	10	33.3	
	> 50	6	20.0	5	16.7	
	mean ± SD	42.2 ± 7.1	-	40.6 ± 6.9	-	
Gender	Female	22	73.3	23	76.7	0.76
	Male	8	26.7	7	23.3	
BMI (kg/m^2)	*mean ± SD*	27.6 ± 1.8		26.1 ± 1.9		0.006
SBP (mm Hg)	*mean ± SD*	139.17 ± 14.98		119.50 ± 9.86		< 0.001
DBP (mm Hg)	*mean ± SD*	86.83 ± 7.93		73.33 ± 8.13		< 0.001
Pulse rate b/min	*mean ± SD*	68 ± 7		75 ± 15		0.018
SD: standard deviation						

For the spirometry findings, FVC was significantly lower in patients than controls ,92.64 and 99.54, respectively, (P=0.017). Other parameters were statistically insignificantly different between both groups, (P> 0.05), (Table 2).

Table 2.

Comparison of Pulmonary function parameters between studied groups.

	Hypothyroidism (n = 30)		Control (n = 30)		P-value
	Mean	SD	Mean	SD	
SPO2	97.33	1.86	98.13	1.73	0.090
FVC	92.64	12.39	99.54	9.17	0.017
FEV1	93.23	24.31	100.95	15.30	0.15
FEV1/FVC	99.90	17.60	101.87	8.69	0.59

According to the spirometry findings, 9 hypothyroidism patients, (30%) had restrictive PFT and 21 were normal, (Fig. 1). Moreover, the among the 9 patients with restrictive PFT, 4 (13%) patients had mild, 3 (10%) moderate and 2 (7%) patients had severe restrictive PFT, (Fig 1).

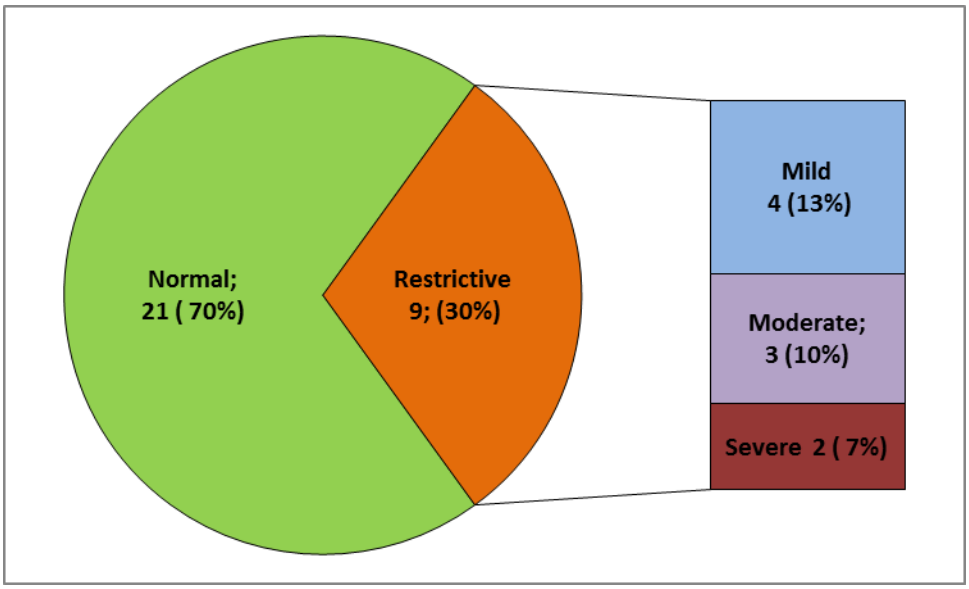

Figure 1.
Distribution of 30 hypothyroism patients according to the final diagnosis and severity of restrictive PFT.

As it shown in (table 3) SPO2, FEV1 and FEV1/FVC were significantly associated with T4 level with direct significant correlation, ($P< 0.05$). Another parameter (FVC) was statistically insignificant with T4 (Fig. 2 ,3 ,4). Regarding T3 and TSH, no statistically significant association had been found with spiro-metric parameters, ($P>0.05$) between these two parameters, (Table 3).

Table 3.

Correlation matrix of Spirometry parameters and thyroid hormones among hypothyroidism group.

		SPO2	FVC	FEV1	FEV1/FVC
T3	R*	-0.320	-0.068	-0.073	-0.075
	P	0.085	0.719	0.702	0.698
T4	R	0.424	0.305	0.400	0.565
	P	**0.019****	0.101	**0.029****	**0.001****
TSH	R	-0.100	-0.135	-0.135	-0.027
	P	0.599	0.477	0.476	0.888
** R: correlation coefficient,* *** correlation is significant at P< 0.05*					

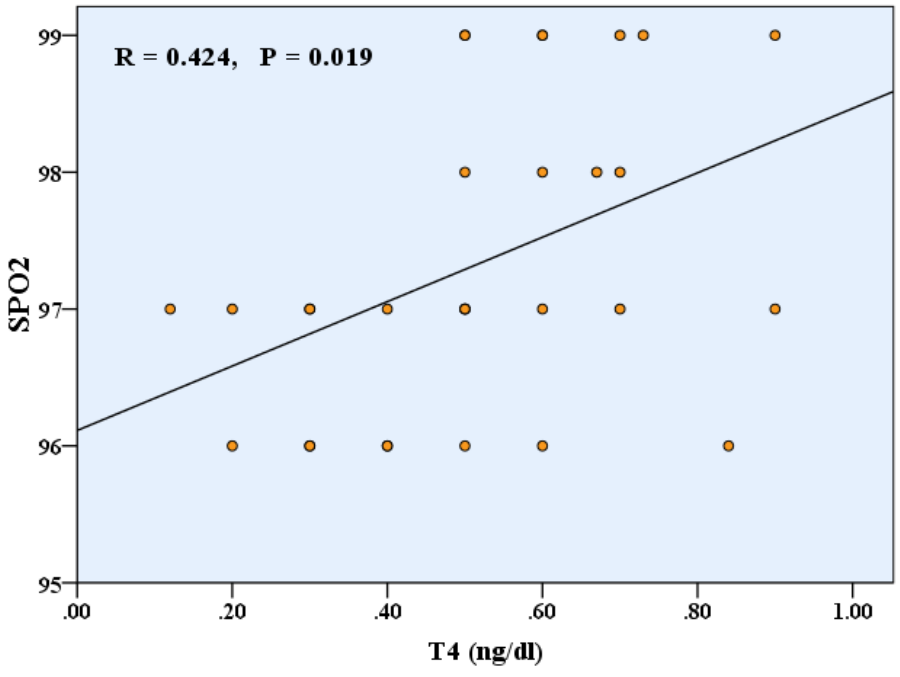

Figure 2.
The significant direct correlation between T4 and SPO2.

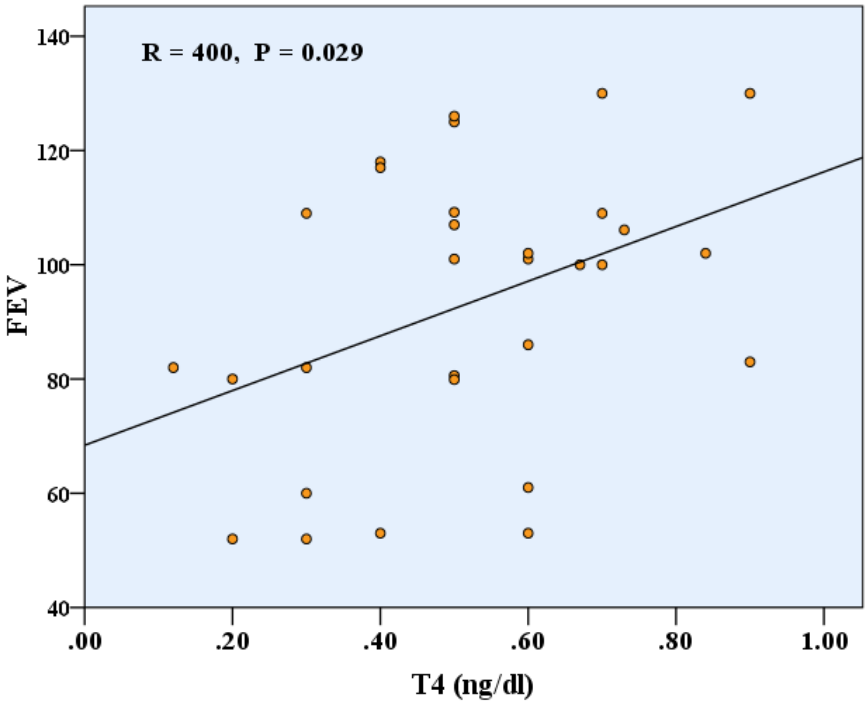

Figure 3.

The significant direct correlation between T4 and FEV1

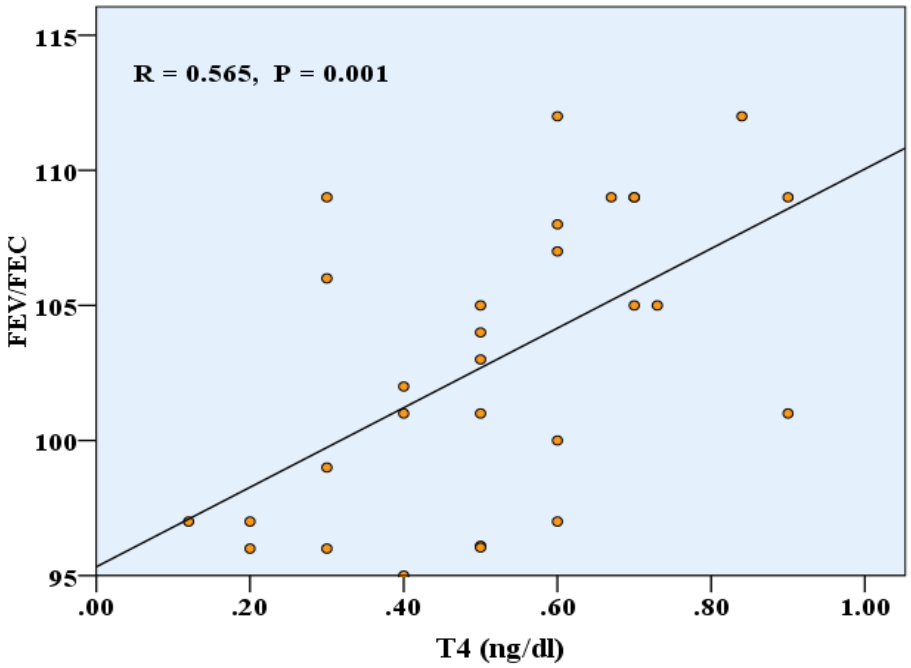

Figure 4.

The significant direct correlation between T4 and FEV1/FVC

Discussion

Hypothyroidism can have numerous effects on the respiratory system. Fatigue and dyspnoea on exertion are frequent symptoms, but in the absence of pulmonary diseases, the diminution in the respiratory function in hypothyroidism is not significant in most cases [4], nevertheless it does affect the respiratory system including respiratory muscle weakness, alveolar hypoventilation due to hypoxia 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 maximally breathing capacity and diffusing capacity are usually reduced [9]. This study was undertaken to compare the spirometry between hypothyroid patients and age and sex matched control. There was significant difference in BMI between hypothyroid and the controls. Col NF *et al* from their study revealed that obese hypothyroid patients have severe reduction in vital capacity and lung volume when compare to normal BMI [13]. Hence obesity was ruled out. In current study there was decrease in SPO2, FVC, FEV1, FEV1/FVC in hypothyroid patients but these diminutions were not significant as compared with control groups except for FVC that was statistically significant. FVC is maximally rapid expiratory vital capacity and its decrease had definite implication in the lung diseases while FEV1 is the volume of air exhaled in first second and it is the most reproducible and most useful measured of lung volume function and this is in accordance with the study conducted by Valjevacet *et al* [14] who suggested that the cause of reduced respiratory function are decreased inspiratory muscle strength, hypoventilation and it is related to the degree and duration of thyroid disorders, while Cakmak *et al* [15] observed a significant reduction in FVC, FEV1 in patients with hypothyroidism as compared with controls. The decrease in all the values of spirometric parameters in hypothyroid patients may be attributed to low serum T4 which may cause inspiratory muscle power weakness or hypoventilation. In the present study nine (30%) hypothyroid patients have restrictive PFT which was agree with Beyer IW *et al* [16] conducted a study on muscle dysfunction in hypothyroidism showed that central nervous system responses, respiratory and cardiovascular performances , that there was decrease in both expiratory and inspiratory muscles strength among hypothyroid patients, limitation in the thoracic movement, reduction in muscle tone, reduces the respiratory force affects the lung volume without disturbing FEV1/FVC ratio there by showing the restrictive pattern in PFT. In current study SPO2, FEV1/FVC were

significant correlation associated T4 level while other parameters T3 and TSH showed not statistically significant with lung parameters. FVC was statistically insignificant correlated with T4. Cakmak *et al* [15] found negative correlation between TSH and FEV1/FVC. Roel S [17] also found statistically non-significant negative correlation TSH with FVC and FEV1/FVC, there also reported a positive correlation between T4 and lung parameters but none were statistically significant.

Conclusion

1. Respiratory system can be affected in hypothyroidism.
2. There is restrictive spirometry in hypothyroid patients as compared with control.

Recommendations

1. Spirometry could have been repeated after levothyroxine therapy to note whether changes were reversed or not.
2. Using large sample of hypothyroid patients with long duration to evaluate the changes in pulmonary function in hypothyroidism.
3. Spirometry can be used routinely in all hypothyroid patients to detect early respiratory dysfunction.

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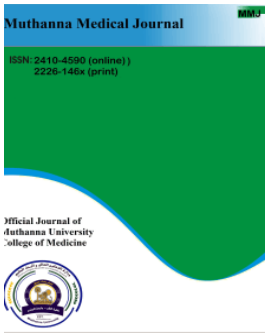

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