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Original Research Article

Variations of physiological parameters in newly detected hypothyroidism

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ABSTRACT

Background: Emergence of hypothyroidism as a public health issue apart from a common clinical entity, has gained much attention nowadays. The non-specific features of hypothyroidism lead to incorrect diagnoses, inadequate treatment and complications in the future. The present study was designed to unravel the effects of hypothyroidism on physiological parameters and to highlight the importance of early diagnosis and treatment. This study was done to assess the effects of hypothyroidism on pulse rate, blood pressure and respiratory rate.
Methods: This descriptive cross-sectional study was done in 60 hypothyroid patients of 18-45 years age, both males and females, who were either newly detected or on treatment for less than 6 months. Patients with history of other systemic diseases, pregnancy and hyperthyroidism were excluded. After obtaining written consent from the patients, clinical examination was done.
Results: Student t-test and ANOVA were used for analysis. Physiological parameters like pulse rate, blood pressure and respiratory rate had variations in the patients and there were changes with age, gender and BMI even though they were not significant. These changes were attributed to increased arterial wall thickness and endothelial dysfunction in blood vessels.
Conclusions: The patients showed changes in cardiovascular and respiratory profiles. The variations in systolic and diastolic blood pressures were significant with increase in age. Physiological parameters had variations with gender and BMI also. This proves the cardiovascular and respiratory morbidity in newly detected hypothyroidism, which emphasizes the importance of early diagnosis and treatment in them.

Keywords: Age, Body mass index, Gender, Hypothyroidism, Physiological

INTRODUCTION

Thyroid, the master gland of metabolism, produces the hormones, T3 (Triiodothyronine) and T4 (Thyroxine), that help to ensure the normal metabolic functions of body. Their synthesis and secretion are regulated by Thyroid Stimulating Hormone (TSH) from anterior pituitary. An overactive or underactive thyroid can result in a wide range of complications. Although a considerable proportion of the population suffers from these conditions, the type of disorder and the prevalence depends on ethnic and geographical factors too.[1]

Thyroid diseases as such will not cause mortality but causes disabilities sequentially which is measured by Disability Adjusted Life Years (DALY). Goiter is the 32nd most prevalent disease sequel in humans. Iodine deficiency is 85th largest contributor of DALY globally and 79th largestin

South Asia in 2010.[1,2] Of the thyroid dysfunctions, hypothyroidism is a common metabolic disease.

Hypothyroidism is the condition in which there are decreased levels of thyroid hormones. Due to negative feedback effect, TSH level becomes high. Daily oral supplementation of levothyroxine maintains constant thyroid hormone levels in the body. As per the recent reports, more than 71 million people suffer from goiter and other iodine deficiency disorders.[3] One of the studies states that agricultural and industrial contaminants can be the cause of increased incidence of hypothyroidism in India. Inland cities are affected compared to coastal areas.[4] Hypothyroidism causes bradycardia, mild hypertension, diastolic dysfunctions, increased peripheral vascular resistance and cardiac failure.[5-7] Thyroid hormone increases the rate of metabolism, so the utilization of oxygen and release of carbon dioxide are increased. This increases rate and depth of respiration. T3 binds on specific nuclear receptors in cardiac myocytes and has direct effect on cardiac gene expression. It also influences the sensitivity of sympathetic system. It further modifies the hemodynamic functions and increases cardiac filling which influence cardiac contraction.[8,9] Hypothyroidism is the disease which causes silent emergence and complications in the population. Correct diagnosis and timely intervention can prevent these complications. Risk stratification and follow-up are also necessary.

Hence the present study is designed with the purpose of revealing the changes in physiological parameters of cardiovascular and respiratory systems in newly detected patients with hypothyroidism or those who are on treatment for less than 6 months. The study also analyses the effects of the above parameters with age, sex and BMI.

METHODS

The present study was done in the Department of Physiology in a Tertiary Care Center. Protocol of the study was approved by Institutional Ethics Committee (45/14/IEC/JMMC and RI). Study was conducted in the period of October 2015-June 2016. Study population included 60 hypothyroid patients who were recruited from Endocrinology Outpatient Department.

Inclusion criteria

- Hypothyroid patients in the age group of 18-45 years, both newly detected and on treatment for less than 6 months.

Exclusion criteria

- Patients with hyperthyroidism, COPD, history of smoking, heart diseases, diabetes mellitus and pregnancy were excluded from the study.

A complete general examination, measurement of anthropometric parameters and system examination were conducted. Pulse was examined over the radial artery. With the patient's forearm slightly pronated and the wrist slightly flexed, the artery was palpated with the tips of three fingers compressing the vessel against the lower end of radius. For blood pressure measurement, the patient was seated in a room for 5 minutes. Then BP was measured in right arm using mercury sphygmomanometer. Measurement of respiratory rate was done by counting the breathing frequency by observing the lower half of the chest and the epigastric region of the abdominal movements for a full minute.

The collected data was tabulated and analyzed statistically. Results were expressed as Mean±standard deviation (Mean±SD). Statistical analysis was done by employing the paired t-test, chi-square test and ANOVA (Analysis of Variance). Statistical significance is expressed as 'probability value' (p value), 'p value is <0.05 is considered significant and <0.01 is highly significant. SPSS software version 22 is used for statistical analysis and Microsoft Office Excel for generation of tables and charts.

RESULTS

Based on the inclusion and exclusion criteria, 60 hypothyroid patients, newly detected or on treatment for less than 6 months were included in the study. Of this, 49 were females and 11 males. TSH value of >4.25 m IU/L is considered as hypothyroidism and mean TSH value of the present study group is 26.87±39.58 (standard error is 5.11). The mean duration of illness is 3.13±1.54 months. The anthropometric parameters assessed were height, weight and Body Mass Index (BMI). BMI was calculated by the formula-

BMI = weight in kg/ (height in meter)^2

Table 1: Demographic profile of study group.

Variables	Mean± SD
Age (years)	35.75±7.3
Height (cm)	159.3±6.58
Weight (kg)	70.63±14.6
BMI (kg/m^2)	27.71±5.05

The demographic profile of study group is described in (Table 1). BMI of the study group was found to be high.

Figure 1 depicts the gender distribution in the study group, 49(82%) in females has been probed into by researchers and the probable explanation is the presence of Skewed X chromosome Inactivation (XCI).[10]

Of the 60 patients included in the study, 65% had positive family history and 35% had negative (Figure 2).

Thyroid diseases, both hypothyroidism and hyperthyroidism have strong genetic predisposition. In those with positive family history, periodic assessment of thyroid hormone status is essential to avoid ill-effects of these disorders. Studies also support the strong genetic predisposition of hypothyroidism especially from maternal relatives than paternal.[11]

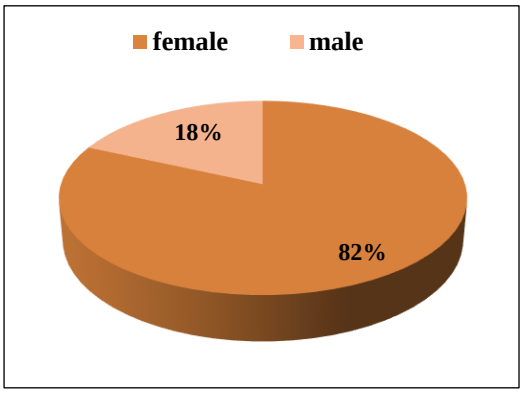

Figure 1: Gender distribution of study group.

Physiological parameters included in this study were pulse rate, systolic BP, diastolic BP and Respiratory rate.

The mean values of each of these parameters were described in (Table 2). Mean pulse rate 67.7±7.42/min, Systolic BP (mm Hg) was 119.43±13.72, Diastolic BP (mm Hg) 78.9±8.84 and respiratory rate was 13.8±1.75/min. Researchers have found that there are significant changes in physiological parameters in hypothyroidism which was not found in this study.[12,13]

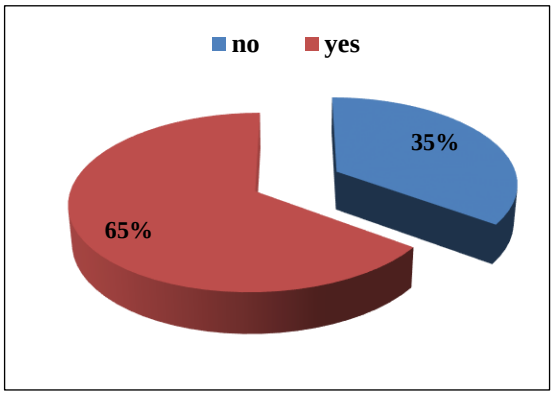

Figure 2: Distribution of family history of thyroid disease in the study group.

Table 2: Physiological parameters of study group.

Variables	Mean±SD
Pulse rate (beat/min)	67.7±7.42
Systolic BP (mm Hg)	119.43±13.72
Diastolic BP (mm Hg)	78.9±8.84
Respiratory rate (no. of breaths/min)	13.8±1.75

Table 3: Variations of physiological parameters in different age groups of hypothyroid patients.

Parameters	Age groups			F value	p value
	18-25	26-35	36-45		
Pulse rate	66±8.64	68.64±8.07	67.24± 6.73	0.404	0.669
Systolic BP	107.33±14.2	118.16±10.75	123.03±14.67	3.76	0.029*
Diastolic BP	75±8.36	76.64±6.62	81.65±9.95	2.99	0.05*
RR	14.16±2.04	13.68±1.79	13.86±1.7	0.200	0.819

* p value <0.05- significant, **p value <0.01- highly significant

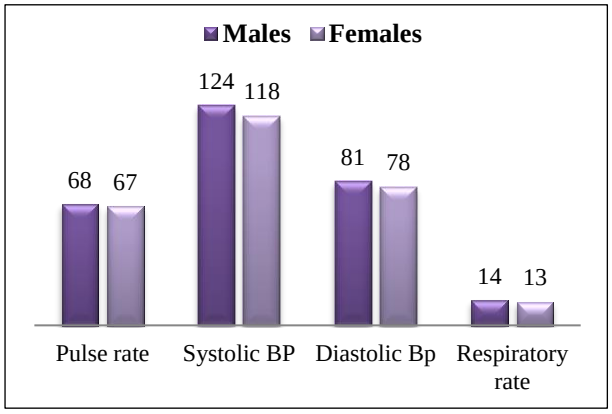

Figure 3: Distributions of mean values of physiological parameters in males and females.

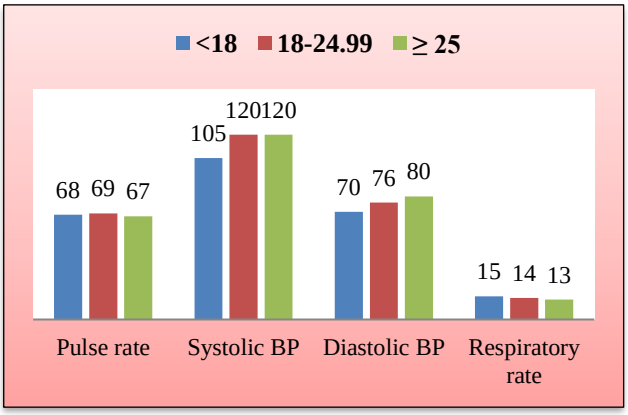

Figure 4: Distribution of physiological parameters in different groups of BMI.

The p value doesn't show any significance in physiological parameters with respect to gender. No significant variation was observed in physiological parameters of hypothyroid patients with respect to BMI. (Figure 3 and 4).

DISCUSSION

The change in physiological parameters in hypothyroid patients according to age, sex and BMI was analyzed. It was observed that pulse rate and respiratory rate had no significant difference with age groups while both systolic and diastolic blood pressures show significant variations (p value<0.05) with higher blood pressure in 36-45 years age group.[14] (Table 3) T3 has direct vasodilator action on vascular smooth muscle cells, so in hypothyroidism due to reduced T3 levels, vascular smooth muscle tone increases and systemic vascular resistance increases.[8] Endothelial dysfunction also affects systemic vascular resistance. Myxoedematous changes of arterial wall leads to arterial stiffness. This causes diastolic hypertension in most of the patients which can be normalized by thyroxine replacement therapy.[15]

T3 binds on specific nuclear receptors on cardiac myocytes and has direct effect on cardiac gene expression. It modifies the hemodynamic functions and increases cardiac filling which influence cardiac contraction. Release of calcium and reuptake into sarcoplasmic reticulum are the major factors affecting contraction in systole and relaxation in diastole. Thyroid hormones increase the expression of SERCa 2 gene activity. The m RNA coding of ryanodine calcium channels which are the channels for sarcoplasmic reticulum are also upregulated by thyroid hormones. This increases calcium pumping in systole which accounts for good contractile activity of heart. Many ion transporters such as Na^+ -K^+ ATPase, Na^+ -Ca^{++} ATP exchanger, voltage gated potassium channels are also regulated by thyroid hormone levels, thus controlling the electrochemical and mechanical properties of the cardiac cell plasma membrane. In hypothyroidism, these mechanisms are down regulated and the low calcium availability accounts for lesser contractile activity of heart.[9,16,17] Cardiac pacemaker activity is also regulated by thyroid hormones. β adrenergic receptors are positively regulated by thyroid hormones causing increased cAMP, which in turn enhances diastolic depolarization and increased heart rate. In hypothyroidism, these effects are reversed so that heart rate decreases.[8] Respiratory symptoms can range from mild dyspnea to respiratory failure in hypothyroid patients.[18]

The cause can be deposition of glycosaminoglycans in interstitial tissues and reduced metabolic activities.[19] Decreased thyroid hormones also cause reduced elasticity of respiratory muscles and increased work of breathing. Levels of thyroid hormones correlate linearly with the strength of inspiratory and expiratory muscles.

The present study does not show any statistically significant variation in physiological parameters with respect to gender and BMI. Research has proved that thyroid hormones play a crucial role in regulating the physiological parameters like pulse rate, blood pressure and respiratory rate. This study concludes by highlighting the importance of early diagnosis and treatment of hypothyroidism. There are studies in which levothyroxine treatment for 6 months reverses the effects of hypothyroidism on respiratory and cardiovascular systems.[18] But some studies point out that the already established pulmonary abnormalities are not fully reversible by levothyroxine even after 3 months of euthyroid state, but the moderate grade of restrictive abnormality changed to milder ones and some patients turned to normal.[20] This emphasizes the need of early administration of treatment which restores the normal quality of life and to prevent complications.

CONCLUSION

Physiological parameters (pulse rate, Blood pressure and respiratory rate) showed variation in newly detected hypothyroid patients but they were not statistically significant. Even though pulse rate, blood pressure and respiratory rate varied with age, systolic and diastolic blood pressures showed significant increase with age. There were variations of these parameters with gender and BMI but didn't show any statistical significance. It has already been established that early administration of levothyroxine treatment can reverse the morbidity in hypothyroidism to a great extent and prevent complications in future. So early diagnosis and treatment are mandatory.

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