REVIEW ARTICLE

Association Of Visceral Fat With Pulmonary Function And Haematological Changes In Hypothyroidism

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ABSTRACT

Hypothyroidism is a clinical state resulting from decreased secretion of thyroid hormone from thyroid gland due to functional or structural impairment of production of thyroid hormone and affects most the organ systems. Major clinical findings are weight gain, decreased thermogenesis and metabolic rate, dyslipidaemia and increased atherosclerotic vascular disease. Extreme obesity leads to increased TSH due to hypothalamic-pituitary-thyroid axis abnormality. Visceral fat is implicated in the pathogenesis of the metabolic syndrome (MS). Visceral and subcutaneous fat (SF) expresses thyroid hormone receptors as well as TSH receptors that may also directly influence various functions of adipose cells. Therefore, a need arises to study the deterioration of pulmonary function and haematological changes in hypothyroidism and its correlation with the visceral fat

Keywords: Hypothyroidism, TSH, Visceral fat, Obesity, Anaemia

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INTRODUCTION

Hypothyroidism is a relatively common disease in world wide. It is characterised by a clinical findings include an end organ effects, cold intolerance, weight gain, swelling of extremities, hair loss, bradycardia, hoarseness of speech, menorrhagia, neurological symptoms, hearing disorders, dry skin and fatigue. The prevalence of hypothyroidism in the developed world is about 4-5%.[1,2] In India, hypothyroidism was usually categorized under the cluster of iodine deficient disorders (IDDs), which were represented in terms of total goiter rates and urinary iodine concentrations, typically assessed in school-aged children[3-5] in 1983 India adopted the universal salt iodization program,[6] there has been a decreased in goiter prevalence in several countries, which were previously endemic.[7-9] The prevalence of hypothyroidism was high, affecting approximately one in 10 adults in the study population.[10] Female gender and older age were found to have significant association with hypothyroidism. Metabolic abnormalities associated with hypothyroidism include anemia.[11] The prevalence of anemia and haematological abnormalities in patients with hypothyroidism has been shown to be 20-60%.[12] Thyroid dysfunction is usually associated with body weight and subclinical hypothyroidism is more frequently associated with weight gain.[13] Studies focused mainly on investigating whether an increase of body weight might be related to an underlying thyroid disturbance. An elevated serum concentration of TSH, suggesting subclinical hypothyroidism, was frequently reported in human obesity. Several investigations, mostly represented by cross-sectional population studies, demonstrated a positive correlation between serum levels of TSH and BMI. Thyroid hormones are potent modulators of adaptive thermo genesis. Overt hypothyroidism leads to increased body weight by increasing mucin deposits and by salt

and water retention. Extreme obesity also leads to increased TSH due to hypothalamic-pituitary-thyroid axis abnormality. Leptin produced by adipocytes directly stimulates TRH neurons in the paraventricular nucleus, thus increasing TSH. Increased body weight has been associated with deterioration of pulmonary functions. Weight and body mass index (BMI) as measures of overall adiposity are used as predictors of pulmonary function in many epidemiologic studies. While these measures are widely accepted as determinants of pulmonary function, high visceral fat may influence pulmonary function through a mechanism that is distinct from that of overall adiposity. Visceral fat is implicated in the pathogenesis of the metabolic syndrome (MS). Visceral and subcutaneous fat (SF) expresses thyroid hormone receptors[14-16] as well as TSH receptors that may also directly influence various functions of adipose cells.[17] However, it is not known whether the type of fat could be implicated in the associations of thyroid function parameters with deterioration of pulmonary function and anaemia.

Clinical presentation

Thyroid receptors regulates many physiologic functions. Consequently, hypothyroidism may result in a large number of clinical signs and symptoms. The severity of these manifestations generally reflects the degree of thyroid dysfunction and the time course of development of hypothyroidism. Symptoms are commonly associated with hypothyroidism are nonspecific (Table I). It includes depression, menstrual irregularities, muscle pain, Weight gain, fatigue, dry skin, and cold intolerance. Symptoms with high specificity for hypothyroidism include weakness, and hair thinning or loss.[18] Symptoms of hypothyroidism may difference in age and sex. Infants and children may have more tiredness, paleness and un healthy. Women who have hypothyroidism may present with infertility and menstrual irregularities. In older patients, cognitive decline may be the sole manifestation. Examination findings associated with hypothyroidism include but are not limited to goitre, delayed relaxation phase of deep tendon reflexes, thin or brittle hair, dry skin, and peripheral oedema (Table II). In ECG Common findings are flattened T waves, bradycardia and low voltage. Severe hypothyroidism patients may present with megacolon, haemodynamic instability pleural effusion, pericardial effusion and coma. The clinical presentation is often confused with septic shock. Myxoedema coma, which represents severe physiologic decompensation resulting from hypothyroidism, occurs rarely, with an annual incidence of 0.22 per million.[19] Laboratory findings in hypothyroidism may include hypoxia, hyponatraemia, hypercapnia, Normocytic anaemia, hyperprolactinaemia, hyperlipidaemia and elevated creatine kinase.[20]

Hypothyroidism

It is defined as decreased levels of serum thyroid levels, due to failure of the thyroid gland. Untreated hypothyroidisum can contribute to the cardiovascular dysfunctions are prominent. These include hypertension, bradycardia, narrow pulse pressure, cold extremities, increased systemic vascular resistance, decreased cardiac contractility and output, atherosclerosis and coronary artery disease, cold intolerance and fatigue.[21] In ECG prolongation of the QT interval that predisposes to ventricular irritability.[22] There is prolongation of the isovolumic diastolic relaxation. Many patients can develop pericardial or pleural effusion. Managing hypothyroidism in the presence of cardiac disease in young adults is easy and a full replacement dose can be initiated. Some cases of chest pain, particularly the elderly will remain challenging and thyroid replacement therapy might exacerbate angina.[23] Treatment should be started with a very low dose (25–50μg/day) with a very slow increase (every 6–8 weeks); this will usually improve cardiac function.[24]

Low T3 syndrome

Up to a third of patients with heart failure have low T3levels with normal T4 and TSH levels. [25]. In this setting a reduced T3 is a strong predictor of mortality. There might be a place for physiological T3 replacement in such cases. [26] Placebo controlled trials suggest benefits of short term T3 replacement in neuroendocrine profile, stroke volume and cardiac output without increase in cardiac workload .[27]

Common symptoms of hypothyroidism

- Arthralgias
- Cold intolerance*
- Constipation
- Depression
- Difficulty concentrating
- Menorrhagia
- Myalgias
- Weakness
- Weight gain
- Dry skin
- Fatigue*
- Hair thinning/hair loss
- Memory impairment

*Most common

Clinical signs of hypothyroidism

- Bradycardia
- Coarse facies
- Cognitive impairment
- Delayed relaxation phase of deep tendon reflexes
- Diastolic hypertension
- Oedema
- Goitre
- Hypothermia
- Laboratory results
    - Elevated C-reactive protein
    - Hyperprolactinaemia
    - Hyponatraemia
    - Increased creatine kinase
    - Increased low-density lipoprotein cholesterol
    - Increased triglycerides
    - Normocytic anaemia
    - Proteinuria
- Lateral eyebrow thinning
- Low-voltage electrocardiography
- Macroglossia
- Periorbital oedema
- Pleural and pericardial effusion

*Most common

Effects on Respiratory System

In hypothyroid patients several abnormalities in the respiratory functions have been described,[28] such as decreased maximal breathing capacity and a lower diffusing capacity for carbon monoxide. In severe hypothyroidism, hypoxic ventilatory drive can be greatly depressed, showing almost no increase in minute ventilation even at low alveolar oxygen tension. Hypercapneic ventilatory drive is also often severely impaired.[29] The presence of hypothyroidism with muscular dysfunction together with increased size of the muscles has been called Hoffmann's syndrome.[30] Hypothyroidism is associated with sleep apnea and all its complications, which can adversely influence surgical outcome or make postoperative extubation problematic. Direct obstruction to the upper airway may occur due to obesity and increased tongue size seen in hypothyroidism. However, improvement in symptoms with levothyroxine replacement is possible even in the absence of weight loss. Reduced ventilatory drive related to muscle weakness and obesity may result in atelectasis, reduced lung volumes and reduced exercise capacity.

DISCUSSION

Joseph G, Hollowell. et al, calulated mean concentrations of TgAb, TPOAb, T4 and TSH levels in 16,533 subjects with normal thyroid function were included. Subjects are selected from the disease-free population. Subjects with history of hyperthyroidism, hypothyroidism, pregnant females and taking androgen pills were excluded in this study. The influence of demographics on TSH, T4, and antibodies were examined. TSH and the prevalence of antithyroid antibodies are greater in females, increase with age, and are greater in whites and Mexican Americans than in blacks. TgAb alone in the absence of TPOAb is not significantly associated with thyroid disease. The lower prevalence of thyroid antibodies and lower TSH concentrations in blacks need more research to relate these findings to clinical status. A large proportion of the U.S. population unknowingly have laboratory evidence of thyroid disease, which supports the usefulness of screening for early detection.[1] Elizabeth H.H, and Ad R. Hermus et al, randomly selected 9371 inhabitants of the eastern part of the Netherlands, received a postal questionnaire on lifestyle and medical history, of which serum TSH, FT4 and TPOAbs are measured from 6434

responders. 5167 individuals were selected by excluding those at risk for thyroid disease. Overt thyrotoxicosis (0.4%), subclinical thyrotoxicosis (0.8%), overt hypothyroidism (0.4%) and subclinical hypothyroidism in 4.0% was found in total population. The present study concludes that serum FT4 concentrations increased due to the development of thyroid autonomy after longstanding borderline sufficient iodine intake and mean TSH decreased with age. In total population, 8.6% of males and 18.5% of females had positive TPOAbs. The presence of TPOAbs was associated with abnormally high and low TSH concentrations.[2] Umesh Kapil, Nandini Saxena, e.tal, conducted a cross sectional study for, assessment of IDD by following WHOUNICEF-ICCIDD guidelines. A total of 30 clusters were selected and in each, one primary school was selected using random sampling. A total of 6911 school children's in the age group of 8-10 years were included. The total goiter prevalence rate was 8.6% and the median urinary iodine excretion was 17 mcg /dl. Salt with nil iodine content was consumed only by 1.4% of the beneficiaries. 41% of families consumed salt with an iodine content of less than 15 ppm. This study concludes that there is a need of strengthening the existing monitoring system for the quality of iodised salt.[4] Ambika Gopalakrishnan et al, the cross sectional study was carried out in 8 cities to study the prevalence of hypothyroidism. About five thosunad three hundred seventy six (5376) subjects adult non pregent women or adult men participants (≥18 years), of which 5360 (mean age: 46±14.68 years; 53.70% females) were evaluated. The overall prevalence of hypothyroidism was 10.95% (n=587) of which 7.48% (n=401) patients self reported the condition, whereas 3.47% (n=86) were previously undetected. Inland cities showed a higher prevalence of hypothyroidism as compared to coastal cities. A significantly higher (P<0.05) proportion of females vs. males (15.86% vs 5.02%) and older vs. younger (13.11% vs 7.53%), adults were diagnosed with hypothyroidism. Additionally, 8.02% (n=430) patients were diagnosed to have subclinical hypothyroidism. Anti – ab TPO were detected in 21.85% (n=171) patients. This study concludes that the prevalence of hypothyroidism was high, affecting approximately one in 10 adults in the study population. Female gender and older age were found to have significant association with hypothyroidism. Subclinical hypothyroidism and anti-TPO antibody positivity were the other common observations.[10] Nils Knudsen, Peter Laurberg et al conducted a cross-sectional population study to investigate the association between thyroid function and BMI or obesity in a normal population. Results showed a positive association between BMI and category of serum TSH and a negative association between BMI and category of serum free T4. No association was found between BMI and serum free T3 levels. The difference in BMI between the groups with the highest and lowest serum TSH levels was 1.9 kg/m2, corresponding to a difference in body weight of 5.5 kg among women. Similarly, the category of serum TSH correlated positively with weight gain during 5 yr (P=0.04), but no statistically significant association was found with weight gain during 6 months (P = 0.17). There was an association between obesity (BMI > 30 kg/m2) and serum TSH levels (P = 0.001). The study concluded that thyroid function could be one of several factors acting in concert to determine body weight in a population. Even slightly elevated serum TSH levels are associated with an increase in the occurrence of obesity.[13] Nathalie. V, Laurence. M, et al, investigated the effects of T3 on gene expression in human adipocytes, primary cultures of human sc adipose tissue explants after treating with T3. 32P-labeled cDNA probes prepared from isolated adipocyte total RNA were hybrid- ized to cDNA arrays representing 1,176 genes. Among the statistically significant variations in mRNA levels with more than 1.3-fold difference, 13 and 6 genes were positively and negatively regulated, respectively (n= 3). The genes encoded proteins that were involved in signal transduction, lipid metabolism, apoptosis, and inflammatory response. Using RT competi- tive PCR, showed a down-regulation of phospho- diesterase 3B, α 2A-adrenergic receptor, and G protein αi2 subunit mRNAs, and an up-regulation of α2-adrenergic receptor mRNA. These regulations explains the T3-mediated increase in catecholamine-induced lipolysis. The down-regulation of sterol regulatory element binding protein-1c, a transcription factor controlling lipogenic gene

expression, may constitute a link between thyrotoxicosis and insulin resistance. Thus, these data suggest that T3 modulates expression of genes with a wide range of function in human adipose tissue.[16,31]

CONCLUSION

Visceral and subcutaneous fat (SF) expresses thyroid hormone receptors as well as TSH receptors that may also directly influence various functions of adipose cells. Therefore, a need arises to study the deterioration of pulmonary function and haematological changes in hypothyroidism and its correlation with the visceral fat.

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