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Original Research Article

Impact of Thyroid Dysfunction on Hematological Parameters: A Cross Sectional Study

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Conflict of interest: Nil

Abstract:

Background: Thyroid function disorders are among the most common endocrine diseases, Thyroid hormones have direct effect on blood parameters by stimulating erythrocytes precursors and indirectly by enhancing erythropoietin production.

Aim: This study was done to evaluate the various types of thyroid function abnormalities and their effects on different hematological parameters.

Materials & Methods: This was a cross sectional observational study, which included total 300, subjects who were grouped as hypothyroidism, hyperthyroidism and euthyroid. Two blood samples were collected from all the patients in EDTA tubes and plain tubes for estimation of hematological parameters by cell counter and thyroid hormonal assay by Enzyme linked immuno-sorbent assay (ELISA). The results were analysed using SPSS software.

Results: Out of total 43.3% were euthyroid, 36.7% hypothyroid and 20% were hyperthyroid. Majority of the patients (44%) were 31-45 years age group, the mean age was 48.85+9.62 years, with females dominance comprising about 73.3% of cases. Analysis of data obtained showed that there was a significant statistical difference in Hemoglobin, RBC, PCV, MCV, MCH, MCHC, TLC, RDW, and hematocrit ($p < 0.05$) among hypo, hyper and euthyroid groups. However, there was no significant correlation of platelets count in thyroid groups ($p > 0.05$).

Conclusions: Thyroid dysfunction impacted female more frequently than males. Thyroid dysfunction significantly associated with the all hematological parameters except platelets count.

Keywords: Euthyroid, Hyperthyroidism, Hypothyroidism, Hematological Parameters.

Introduction

Thyroid gland produces hormones such as triiodothyronine (T3) and tetraiodothyronine or thyroxine (T4) and plays an important role in the development, differentiation, physiological functions and metabolic balance of tissues in the human body. Thyroid hormones act as general pacemaker, accelerating metabolic process and associated with metabolic syndrome [1-2]. Thyroid hormones promote the intestinal absorption of glucose, increases glycogenolysis and gluconeogenesis with an effect of increasing the glucose levels in the blood leading to hyperglycemia. Thyroxine produces lipolysis and increases the turnover of lipids [3]. Thyroid function disorders are among the most common endocrine diseases [4]. In India the prevalence of hypothyroidism is 10.95% and hyperthyroidism is 1.3%. Despite a high disease burden, thyroid gland disorders have failed to receive due attention. Even after the promotion of iodized salt since 1983, prevalence rates have failed to reduce to statistically significant levels [5-6]. Hyperthyroidism enhances erythropoiesis, but it also raises the basal metabolic rate. The latter may increase plasma volume, counteracting the effect of erythropoiesis and lowering hemoglobin (Hb) concentration, ultimately causing anemia [7]. In hypothyroidism, a drop in basal metabolic rate and a decrease in cellular oxygen consumption may reduce erythropoietin secretion, which would also

lower Hb concentration and, ultimately, cause either normocytic, microcytic, or macrocytic anemia, depending on co morbidities [8]. According to the World Health Organization (WHO) recommendations, anemia is diagnosed when the Hb level is < 12.0 g/dLfor women and <13.0 g/L for men. Normocytic anemia is defined as a mean corpuscular volume (MCV) between 80 and 100 fl, microcytic anemia is diagnosed as MCV below 80 fl, and macrocytic anemia by an MCV above 100 fl [9]. Thyroid hormones have a direct effect on the blood parameters by stimulating the precursors of the erythrocytes and indirectly by enhancing erythropoietin production [10]. Changes in hematological variables such as hemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW) have also been associated with thyroid gland disorders [11]. Neutropenia, thrombocytopenia and increased levels, normal or slight decrease in total white blood cell count, are all symptoms of hyperthyroidism [12]. In autoimmune thyroid disorders, anemia can be due to co morbid conditions like pernicious anemia, atrophic gastritis, celiac disease and autoimmune hemolytic syndrome [13].

Aims & Objectives: The aim of this study is to evaluate the effect of various types of thyroid function abnormalities on different blood parameters and comparing them.

Material & Methods

This is a case-control descriptive study conducted in a tertiary care hospital, center India. All the participants attending outpatients department in our hospital during the study period were enrolled in this study. All the subjects were grouped as hypothyroidism, hyperthyroidism and euthyroid groups, based on the serum TSH and free T4 level.

Reference range of thyroid hormones: free T3 (0.31–0.65 ng/dl), free T4 (0.7–1.6 ng/dl) and TSH level (0.25–5 mIU/L)).

Euthyroid if all thyroid hormone levels fell within reference range

Hyperthyroid was defined as TSH<0.3 µIU/ml, or FT4>1.8 ng/dl

Hypothyroidism was defined as TSH>5.5 µIU/ml or FT4<0.7 ng/dl

Inclusion Criteria

- All the patients above 18 years of age irrespective of sex.
- Newly diagnosed patients and patients who already using medication for thyroid dysfunction.
- Participants who provide consent for the study.

Exclusion Criteria

- Patients <18 years of age.
- Patients of thyroid malignancy.
- Patients of infectious diseases, history of recurrent infections, asthma, allergy.
- Participants who not willing for the study.

All patients data was collected, thorough detail history taking, socio-demographic data, clinical features and relevant biochemical and hematological investigations were recorded. The thyroid profile was done by the Chemiluminescence immunoassay method (CLIA) by automated-analyzer and CBC was performed by automated cell counter.

Venous blood was aseptically collected using plain and EDTA vacationer tubes for thyroid function tests and CBC measurement. Two blood samples were collected from all the patients, one for thyroid function tests and another for hematological parameters.

The hematological parameters which were studied include the white blood cells (WBC), red blood cells (RBC), hematocrit (HCT), hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW),and Platelet counts. Thyroid function tests including TSH, T3, and T4 were performed.

All the hematological parameters were compared among hyperthyroidism, hypothyroidism and euthyroidism individuals.

Statistical Analysis: Statistical analysis was performed by SPSS software. Results were reported as Mean ± Standard deviation for quantitative variables. Statistical Independent T test was used to evaluate the significance of differences between two groups. P value <0.05 was considered as a statistically significant change.

Results

A total of 300 subjects were enrolled and analysed in our study. Out of total 130 were euthyroid, 110 were hypothyroid cases and 60 were diagnosed as hyperthyroid cases.

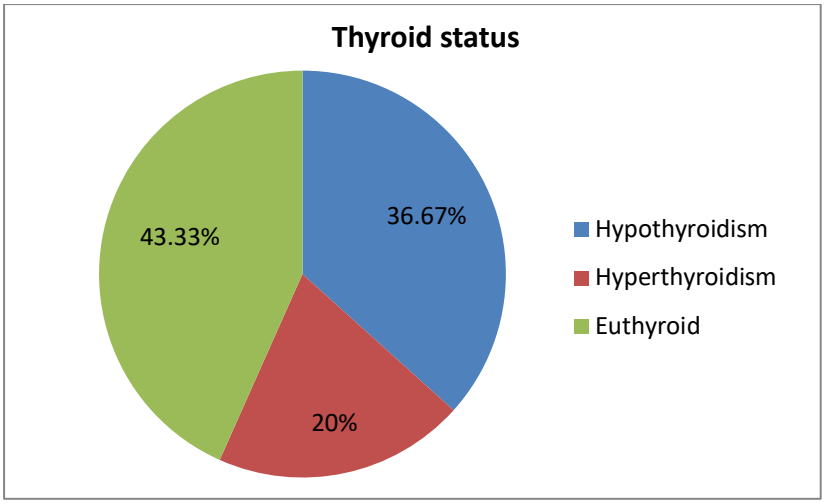

Figure 1: showing distribution of cases according to thyroid status

Table 1: Age and gender-wise distribution among study subjects (n=300)

Variables	Hypothyroid (n=110)	Hyperthyroid (n=60)	Euthyroid (n=130)	Total (n=300)
Age group				
18-30 years	21 (19.1%)	10 (16.6%)	33 (25.4%)	64 (21.3%)
31-45 years	48 (43.6%)	27 (45%)	57 (43.8%)	132 (44%)
46-60 years	29 (26.4%)	13 (21.7%)	29 (22.4%)	71 (23.7%)
60-75 years	10 (9.1%)	6 (10%)	9 (6.9%)	25 (8.3%)
>75 years	2 (1.8%)	4 (6.7%)	2 (1.5%)	8 (2.7%)
Mean age ± SD was 48.85+9.62 years				
Gender				
Male	26 (23.6%)	18 (30%)	35 (26.9%)	79 (26.3%)
Female	84 (76.4%)	42 (70%)	95 (73.1%)	221 (73.7%)

Table 2: Comparison of hematological parameters between hypothyroid, hyperthyroid and euthyroid cases

Hematological parameters	Hypothyroid (Mean±SD)	Hyperthyroid (Mean±SD)	Euthyroid (Mean±SD)	P value
Hemoglobin (g/dL)	10.2 ± 2.4	11.5 ± 2.2	13.3 ± 1.9	0.001
RBC (N x 10^6/µl)	3.6 ± 0.82	4.13 ± 0.76	4.98 ± 0.68	0.001
TLC (Nx10^3/µl)	7.92 ± 2.3	9.14 ± 2.5	10.19 ± 2.7	0.001
PLT (lakh/mm^3)	2.54 ± 0.69	2.65 ± 0.78	2.78 ± 0.83	0.065
PCV (%)	35.4 ± 3.39	36.2 ± 3.69	37.3 ± 3.96	0.004
MCV (fl)	83.5 ± 8.35	82.2 ± 7.62	86.6 ± 9.24	0.001
MCH (pg)	27.7 ± 2.15	26.8 ± 2.23	28.3 ± 2.55	0.003
MCHC(g/dl)	32.4 ± 1.20	33.3 ± 1.81	32.5 ± 1.45	0.003
RDW%	13.3 ± 1.41	12.6 ± 1.22	13.6 ± 1.73	0.002
Hematocrit (%)	28.34 ± 6.38	32.67 ± 6.63	39.25 ± 7.11	0.001

Discussion

Hematological abnormalities are common in thyroid dysfunction especially, hypothyroidism and most patients were improved after thyroid hormone replacement and normalization of the thyroid function. Hypothyroidism constitutes a global health concern in clinical society. The disease varies in symptoms and signs according to the age of patients and ranges from asymptomatic to life-threatening illness mostly due to multiple organ dysfunctions, as thyroid hormones are required for several metabolic activities [14-15].

Based on TSH and FT4 findings, most of the patients were euthyroid (43.33%) followed by hypothyroid (36.67%) and 20% were hyperthyroid observed in current study, our results comparable with the Maheshwari K, et al [16]

In our study average age of patients was 48.85+9.62 years, majority of the patients came under the age group of 31-45 years age group followed by 46-60 years of age group. These findings were very similar to Ghanshyam P, et al [17] and Santhosh Kumar et al [18].

Present study found, females had a higher incidence of hypothyroidism, hyperthyroidism and euthyroidism than males. These findings were similar to the studies done by Gupta, et al [19] and Bashir et al [20].

In current study, mean hemoglobin was low in hypothyroid patients and slightly increased in hyperthyroid patients, but it was lower in both hyperthyroid and hypothyroid patients as compared to euthyroid patients. Statistically significant difference was seen in hemoglobin and thyroid groups ($p<0.05$), consistent with the previous studies, Bodapati et al [21] and Cinemre H et al [22].

In the present study the mean RBC count was lower in hypo and hyperthyroid cases as compared to euthyroid control, there was statistical significance in RBC count and thyroid groups ($p<0.05$). Similar observation was also seen in study done by Carmen et al [23] and Geetha J et al [24].

Red cell distribution width (RDW) represents the degree of RBC anisocytosis, it is increased in patients with iron deficiency anemia, B12 and folate deficiency, and thus it is affected by thyroid function derangement. In our study we detected a significant correlation between thyroid dysfunction and RDW ($P<0.05$), accordance to S.S. Ahmed et al [25].

In the present study, the mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) were statistically significant different among hypo, hyper and euthyroid cases ($p<0.05$), our results were correlates with the Kawa et al [26] and Babhina KT et al [27].

The mean value of total leukocyte count (TLC) showed statistically significance ($p<0.05$) in various thyroid groups, similar observation was seen in studies conducted by Nalini et al [28]. Carmen S.P Lima et al [29], reported their findings in four cases of grave's disease with pancytopenia. They concluded that thyroid evaluation is needed to rule out the causes of pancytopenia.

Dorgalaleh et al [30], conducted study to correlate hematological parameters with thyroid hormones and found out statistically significant difference in Hb, HCT, MCV, MCH, MCHC and RDW but no difference in red cell count, total leucocyte count and platelet count among hypothyroid and hyperthyroid groups when compared with control group.

Platelets are less affected by thyroid function status, there is no significant association between thyroid status and platelets count was found in the current study, these finding have been also found in many other studies this may be due to the fact that platelets are non-nucleated and they have short life span with continuous rapid turnover [31].

Conclusion

We have concluded that females were more commonly affected by thyroid disorders, especially hypothyroidism than males. Thyroid dysfunctions have a significant influence on blood cell count and blood cell indices. There was statistically significant difference in Hemoglobin, TLC, RBC, PCV, MCH, MCV, MCHC, RDW and hematocrit ($p<0.05$) among thyroid groups, revealed a strong link between hematological parameters and thyroid dysfunction in patients. Investigating all the RBC indices in cases of thyroid disorders helps in the management of anemia associated with thyroid disorders which are refractory to treatment with iron supplementation.

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