

Study of Cardiovascular Manifestations in Patients with Thyroid dysfunction at Tertiary Care Center

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Abstract

Introduction: Thyroid hormones have effects on virtually every organ system. The heart is the major target organ for thyroid action. It was thought that thyroid disorder is a circulatory disorder and manifestations of thyroid disorders are due to changes in cardiac work. Over the period it has become clear that the explanation for the altered circulatory hemo-dynamics of thyroid disease is because of involvement of cardiovascular system. **Aims and Objectives:** To find out the incidence of overt and subclinical cardiac manifestations in patients with thyroid dysfunction and to compare the prevalence of overt and subclinical cardiac manifestations in two subsets of patients belonging to hyperthyroid and hypothyroid groups respectively. **Materials and Methods:** It was an observational study carried out at the Department of Medicine for the period of August 2017 to December 2019. In total, 230 newly diagnosed patients with thyroid dysfunction were included in the study. Focused clinical and detailed cardiovascular system examination, necessary biochemical investigations were done. All patients underwent detailed 12 lead electrocardiogram and 2D Echo-cardiography procedure. Incidence of overt and subclinical cardiac manifestations in Hyperthyroid and Hypothyroid cases was calculated; and the Prevalence of overt and subclinical manifestations in the two subsets of patients belonging to Hyperthyroid and Hypothyroid groups respectively was compared and data was analysed. **Results:** Total hypothyroid patients were 115 and that of hyperthyroid were 115. Incidence of thyroid is much more common in females as compared to males (81% in hyperthyroidism and 92% in hypothyroidism). In hyperthyroid group, 92% patients showed cardiac involvement either in the form of ECG, CXR, 2D ECHO abnormalities and in hypothyroid patients it was 93%. Statistically significant patients presented with symptoms of congestive cardiac failure in hyperthyroid group (73%) but not in hypothyroid group. In the both groups, fatigue was the most commonest presenting symptom related to cardiovascular system. In hypothyroid group, most common cardiac sign was Pulse, Pressure < 40 mm of Hg (73%) whereas in hyperthyroidism it was sinus tachycardia (73%). 73% hyperthyroid patients showed sinus tachycardia as the most common ECG finding where again 73% hypothyroid patients showed ST-T changes as a most common ECG finding. Nearly 70% hyperthyroid patients had ejection fraction more than 60% on Echocardiography the procedure and almost all patients of hypothyroidism had ejection fraction less than 60%. **Conclusion:** Thyroid dysfunction was found to be more common in the females with 41-50 years of age group in hypothyroidism group and 21-30 years in the hyperthyroidism group. Cardiovascular manifestations were the major presenting factors in both the groups pointing towards the adverse effects of thyroid dysfunction, Dyspnea and fatigue were the major cardiac symptoms in the hypothyroidism group. While chest pain and fatigue were the major cardiac symptoms in the hyperthyroidism group. The ECG and 2D ECHO findings in the current study also suggested that in both the groups of thyroid dysfunction, cardiac manifestations are likely to have higher incidence.

Keywords: Echocardiography, Electrocardiography, Hyperthyroidism, Hypothyroidism

1. Introduction

Thyroid gland produces thyroid hormones, which are associated with every organ of the body and carry out different metabolic activities. Thyroid stimulating hormone works in coordination with anterior pituitary gland. It works in synchronisation with the modulators and maintains a proper feedback with the body's mechanism and homeostasis state of the body. Thyroid regulator acts as an important mediator for thyroid hormone functions and is correlated with iodine maintenance in the diet as well.

Thyroid gland produces thyroxine (T4) and triiodotyronine (T3) which play critical role for thermogenic as well as metabolic homeostasis in adults. If the nature of illness is obscure, the disorder with thyroid functions and marked changes of cardiac functions with patients suffering with hypothyroidism as well as hyperthyroidism should be kept in mind^{2,3}. Underproduction of thyroid hormones with thyroid stimulating hormone is responsible for the major symptoms of hypothyroidism with fatigue, cold intolerance, and joint as well as muscle pain⁴. Hyperthyroidism deals with excess thyroid hormone production. Synthetic thyroxine in context with patient's history and symptoms assists in handling of TSH level with monitoring the patient with effects of iodine, history of autoimmune disease, iron supplements and consumption of iodine is involved in treatment of hyperthyroidism⁵.

2. Aims and Objectives

1. To find out the incidence of overt and subclinical cardiac manifestations in patients with thyroid dysfunction.
2. To compare the prevalence of overt and subclinical cardiac manifestations in two subsets of patients belonging to hyperthyroid and hypothyroid groups respectively.

3. Material and Methods

3.1 Operational Definitions

1. Hyperthyroidism- Hyperthyroidism is defined as a state of excessive thyroid gland function.

2. Hypothyroidism – Hypothyroidism is defined as a state of decreased thyroid gland function.

It was an observational study carried out at the Department of Medicine at Dr. Vasant Rao Pawar Medical College and Hospital for a period of August 2017 to December 2019 with due permission from the ethics committee. In total, 230 newly diagnosed patients with thyroid dysfunction were included in the study after giving written informed consent. It was planned to include same number of hypothyroid as well as hyperthyroid patients.

$$\text{Formula for sample size} = n = \frac{z^2 \times p \times q}{l^2}$$

Z= 1.96(critical value).

P= prevalence of disease—3.9%

q= 100-p

L= Margin of error/allowable error---2.5%

n= 230

3.2 Inclusion Criteria

1. All patients between ages of 18 years to 60 years attended Medicine OPD or IPD, and newly diagnosed as hyperthyroidism or hypothyroidism.
2. Sex – patients of both genders.

3.3 Exclusion Criteria

1. Patients less than 18 years of age and more than 60 years of age.
2. Patients with ischemic heart disease, diabetes mellitus, dyslipidemia.
3. Pregnant, lactating females.
4. Patients with prior history of drugs, surgery.
5. Patients who did not give consent.

Focused clinical and detailed cardiovascular system examination, necessary biochemical investigations done in all included patients by above mentioned criteria. All included patients underwent detailed 12 lead electrocardiogram and 2D Echocardiography examination. All patients who were having cardiac involvement in the form of ECG, CXR or 2D ECHO were grouped into 2 groups namely hyperthyroidism and hypothyroidism.

Incidence of overt and subclinical cardiac manifestations in Hyperthyroid and Hypothyroid cases was calculated; and the prevalence of overt and subclinical

manifestations in the two subsets of patients belonging to Hyperthyroid and Hypothyroid groups respectively was compared and data was analysed.

4. Results

This study included total 230 patients having thyroid dysfunction:

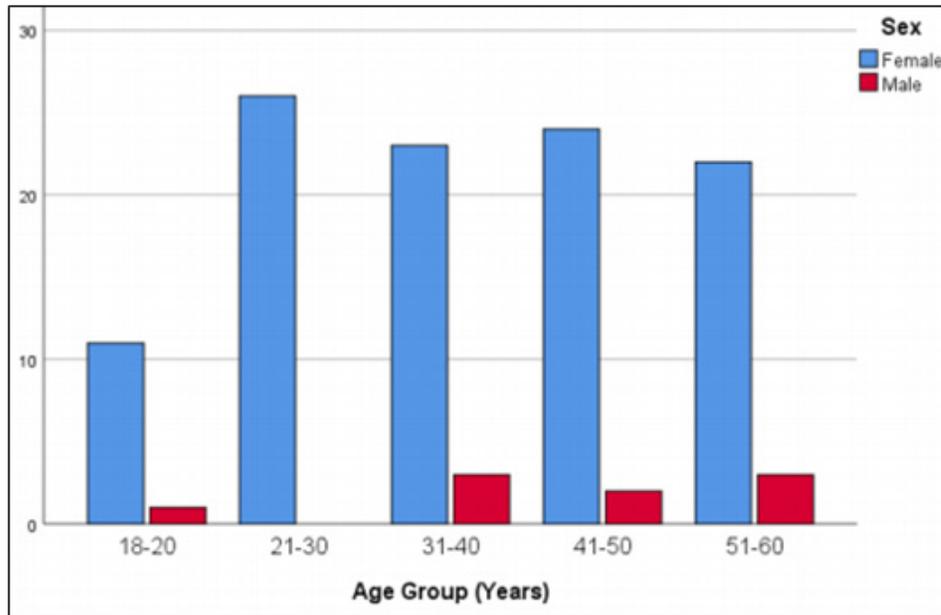


Figure 1. Age and Sex-wise distribution of Hypothyroidism ($N_1 = 115$).

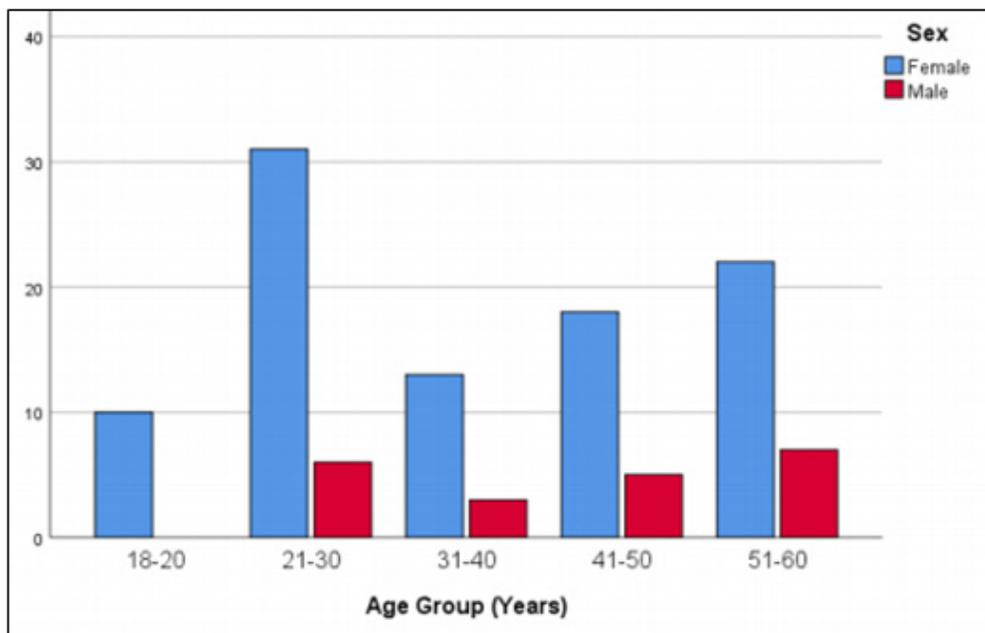


Figure 2. Age and Sex-wise distribution of Hyperthyroidism ($N_2 = 115$).

Total no. of hypothyroid patients = $N_1 = 115$

Total no. of hyperthyroid patients = $N_2 = 115$

In the hypothyroidism group, majority of the patients belonged to the 21-30 years of age group. Similarly in the

hyperthyroidism group, majority of the patients belonged to 21-30 years of age group (Figure 1 & 2).

In both groups significant no. of patients showed cardiac involvement (Figure 3).

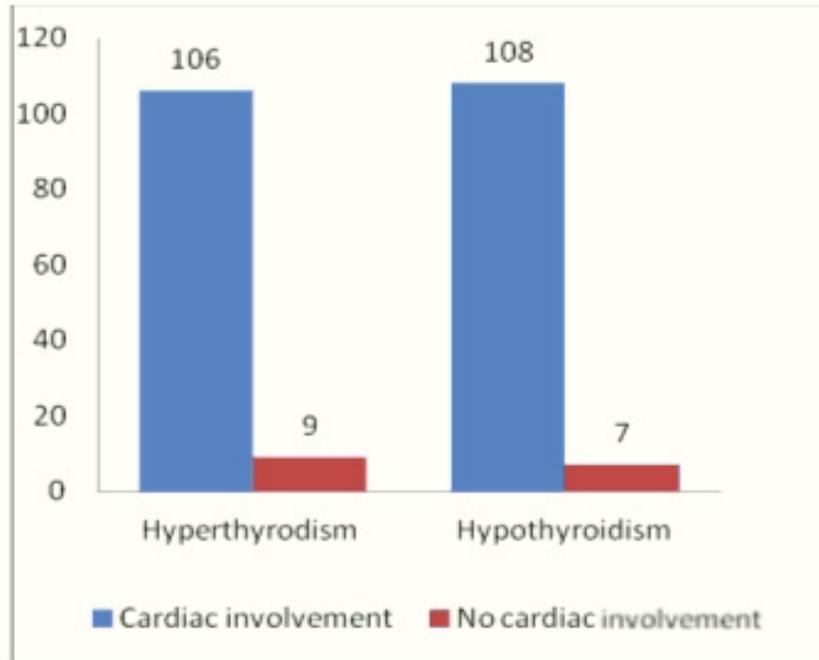


Figure 3. Comparison of cardiac involvement in patients with Thyroid dysfunction.

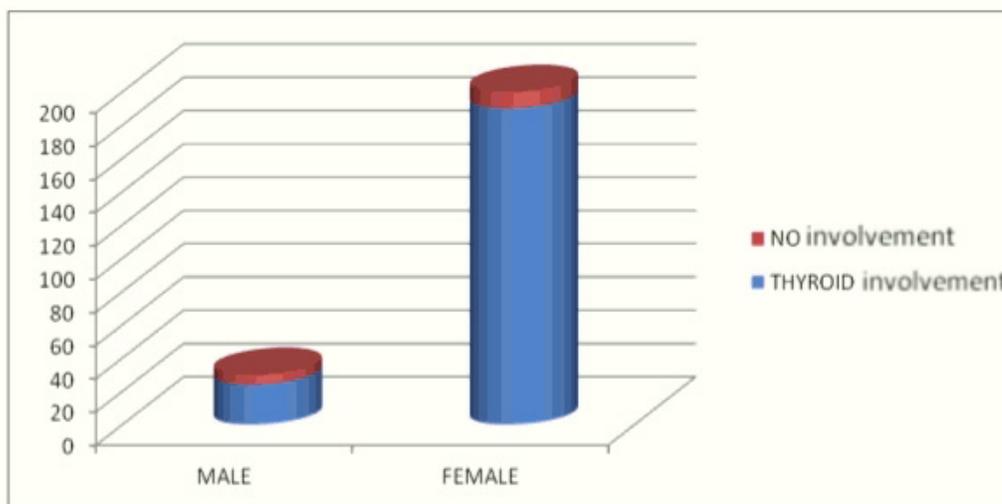


Figure 4. Comparison of cardiac involvement in males and females with thyroid disorder (N = 230).

Out of 30 male patients, 24 patients had cardiac involvement. On the other hand, out of 200 female patients, 190 patients had cardiac involvement (Figure 4). In the hypothyroidism group, 16.5% patients had symptoms of cardiac failure. In the hyperthyroidism group, 73.9% patients had symptoms of cardiac failure (Table 1).

In the hypothyroidism group, in male patients dyspnea was the commonest cardiac symptom followed by fatigue followed by chest pain. On the other hand, in female patients fatigue was the most commonest cardiac symptom followed by dyspnea and chest pain (Table 2).

In the hyperthyroidism group, in male patients, chest pain was the most commonest cardiac symptoms followed by dyspnea and palpitations followed by fatigue.

Table 1. Comparison of symptoms suggestive of cardiac failure in patients with thyroid disorder

Category	Hypothyroid		Hyperthyroid	
	Yes (%)	No (%)	Yes (%)	No (%)
Symptoms Suggestive in Cardiac Failure	16.5	83.5	73.9	26.1

Table 2. Frequency of cardiac symptoms among Hypothyroid patients

Category	Male (n=9)	Female (n=106)
Dyspnea	100%	53.7%
Chest pain	44.4%	46.2%
Fatigue	55.5%	57.5%

Table 3. Frequency of cardiac symptoms among Hyperthyroid patients

Category	Male (n=21)	Female (n=94)
Dyspnea	61.9%	42.5%
Chest pain	71.4%	46.8%
Fatigue	47.6%	54.2%
Palpitations	61.9%	45.7%

On the other hand, in female patients, fatigue was the most commonest cardiac symptoms followed by chest pain and palpitations (Table 3).

In the hypothyroidism group, maximum patients had PP <40 mm of Hg as cardiac sign and almost half of the patients had diastolic hypertension.

Table 4. Incidence of cardiac signs among hypothyroidism

Cardiac signs	Female	Male	Total
Pulse pressure <40 mm of Hg	78	6	84
Soft H.S.	61	4	65
Diastolic HTN	60	1	61
Sinus Bradycardia	24	2	26
Pericardial Effusion (PE)	5	1	6

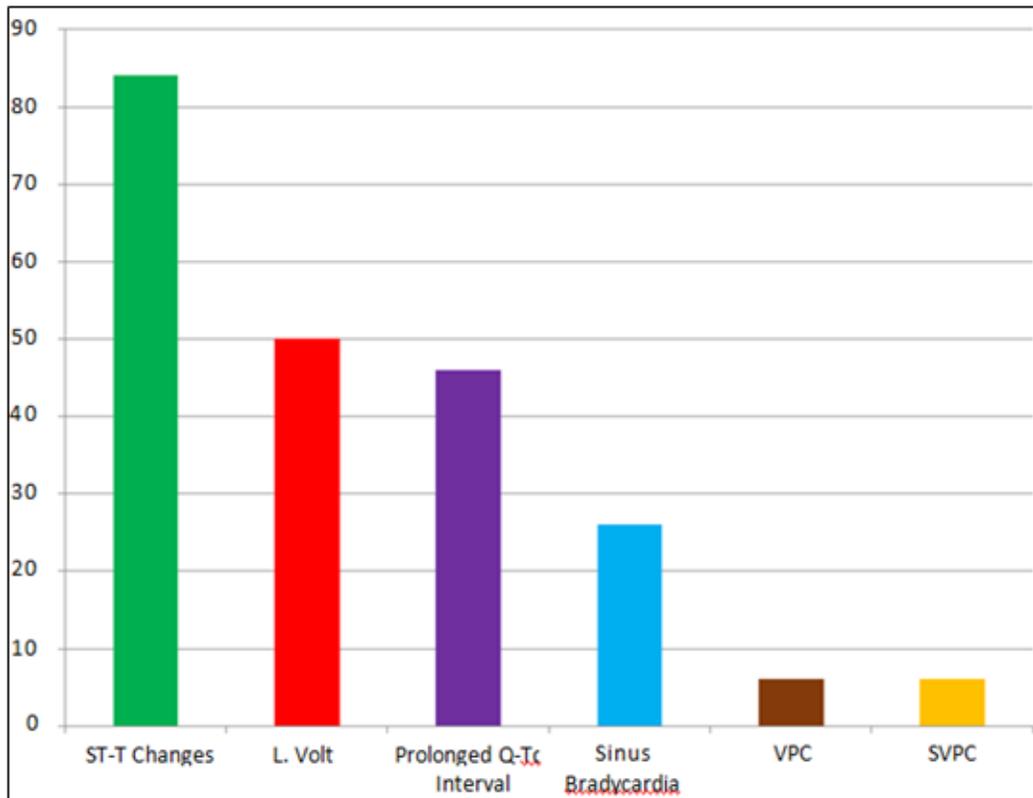


Figure 5. ECG findings in hypothyroidism.

Table 5. Incidence of cardiac signs among hyperthyroidism

Cardiac signs	Female	Male	Total
Pulse pressure >40 mm of Hg	67	17	84
Loud S1	51	14	65
Sinus Tachycardia	72	12	84
Hyperdynamic Precordium	56	9	65
Ejection Systolic Murmur	58	8	64
Carotid Bruit	64	13	77
DBP <70 mm of Hg	34	5	39
Prolonged Q-Tc Interval	28	7	35
Precordial Thrill	29	6	35
SBP>160mm of Hg	23	3	26
Mid Systolic Click	6	0	6
Raised JVP	25	3	28
Loud S2	9	0	9
Left Ventricular Hypertrophy	23	3	26
ST-T Changes	8	0	8
Ectopics	23	3	26
Atrial Fibrillation	6	0	6
S3	23	3	26

Incidence of pericardial effusion was very low (Table 4).

In the hyperthyroidism group, sinus tachycardia as well as pulse pressure > 40 mm of Hg were the most common cardiac signs (Table 5).

1. In hypothyroidism group, ST-T Changes were the commonest ECG finding.

2. Sinus bradycardia was seen in only 26 patients (Figure 5).

1. In hyperthyroidism group, sinus tachycardia was the most frequent ECG finding.
2. Atrial fibrillation was seen in 27 patients whereas LBBB pattern of ECG was present only in 12 patients (Figure 6).

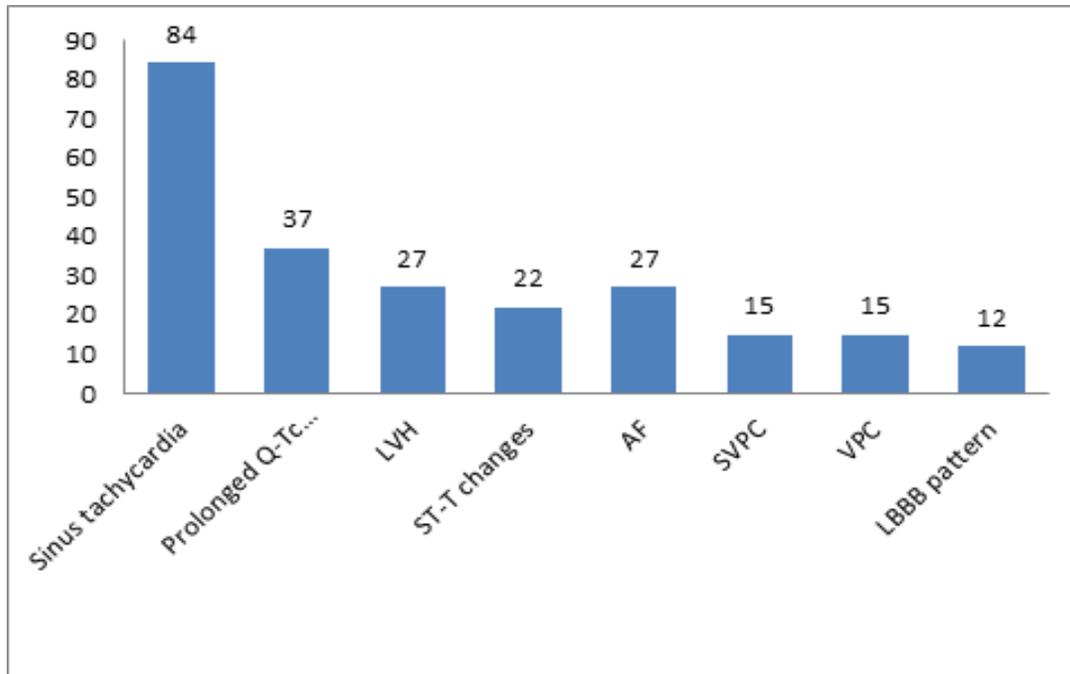


Figure 6. ECG findings in hyperthyroidism.

Table 6. Ejection Fraction in hypothyroidism

Ejection fraction	No. of patients	Percentage (%)
31-40	16	13.9
41-50	50	43.5
51-60	49	42.6
Total	115	100.0

Table 7. Ejection Fraction in hyperthyroidism

Ejection fraction	No. of patients	Percentage (%)
41-50	10	8.69
51-60	25	21.73
61-70	35	30.43
71-80	45	39.13
Total	115	100.0

Almost all patients of hypothyroidism had ejection fraction less than 60% (Table 6).

Nearly 70% hyperthyroid patients had ejection fraction more than 60% (Table 7).

5. Discussion

In the current study, there was female preponderance in the hypothyroidism and hyperthyroidism group. Similarly, according to the study of Ravishankar, *et al.* (2018)⁶ also, there was female predominance.

5.1 Sex and Age

In the present study, the hypothyroidism group showed majority of the patients in 21-30 years of age group. Similarly, the hyperthyroidism group showed majority of the patients in 21-30 years of age group. The study of Ravishankar, *et al.* (2018)⁶ showed that majority of the patient were aged >50 years. This result was in contrast with the current study.

5.2 Symptoms

In the current study the results in the hypothyroidism group showed that majority of the male patients presented with dyspnea (100%) followed by fatigue (55.55%) and chest pain (44.44%) whereas majority of female patients in the hypothyroidism group presented with fatigue (57.54%) as

a most common symptom followed by dyspnea (53.77%) and chest pain. Satpathy, *et al.* (2015)⁷ also found that in the hypothyroidism group majority of male and female patients had fatigue as most common cardiac symptom. The result for the male patients was contradicting with the current results. However, the results for the female patients were similar with the current study.

The presence of anemia may also contribute to increased fatigability and dyspnea⁸. Anemia is the commonest finding in hypothyroidism.

The results showed that male patients in the hyperthyroidism group had chest pain (71.42%) as a most common symptom followed by dyspnea (61.90%) and the fatigue (47.61%) whereas majority of female patients in the hyperthyroidism group had fatigue (54.25%) followed by chest pain (46.80%) and dyspnea (42.55%).

Further, as per the study of Kandan, *et al.* (2016)¹⁰, in hyperthyroidism group palpitations (95%) was present in majority of the male patients followed by breathlessness (40%). Furthermore, the study also stated that among the female hyperthyroidism patients the majority of them had palpitations (66.7%) followed by breathlessness (16.7%) and chest pain (6.7%). These results were in contrast with the current study.

Chest pain may be due to underlying coronary artery disease aggravating the mismatch between the oxygen supply to the myocardium and its oxygen requirement⁹.

5.3 Clinical Examination

In the current study, it was observed that 73.58% of the female hypothyroid patients had PP <40mm of Hg. Moreover, the study also found that 66.66% of males from the hypothyroidism group also showed PP <40 mm of Hg. Furthermore, in the current study 57.54% of the female patients had soft HS followed by 56.60% of the patients with diastolic HTN. Similarly, in the male group 44.44% had soft H.S. followed by 22.22% of the patients who had Sinus bradycardia and diastolic HTN.

Similarly, as per the results of the study carried out by Satpathy, *et al.*, (2015)² majority of female patients showed PP<40 mm of Hg. In addition, similar results were obtained for males in the hypothyroidism group as well. This study showed similar results with the current study.

In the current study sinus tachycardia was the most common cardiac sign found in 76.59% of the female hyperthyroid patients followed by pulse pressure >40mm Hg in 71.27% female patients suggested that there were broad signs of cardiac manifestations. However, 80.95% male patients also showed pulse pressure>40mm Hg.

5.4 ECG Findings

It was found that ST-T changes were found in majority of hypothyroid patients (73.04%) as a ECG finding followed by low voltage pattern (43.47%). On the contrary in the study of Ravishankar, *et al.* (2018)⁶ majority of the hypothyroid patients showed bradycardia (29.27%) on ECG followed by abnormal LVC (24.39%).

In the current study, Sinus Tachycardia was the major ECG findings in 73.04% of hyperthyroid patients followed by Prolonged Q-Tc Interval with 32.17%. Similarly, as per the study of Kandan, *et al.* (2016)¹⁰ majority of the patients showed Sinus tachycardia (46%) followed by AF (28%).

5.5 2D Echo Findings

In present study, 5(4%) hypothyroid patients showed pericardial effusion which is contradict to the studies of kerber, *et al.* (1975) who found that pericardial effusion was present in 30% patients. In present study none of our patient had evidence of dilated cardiomyopathy.

In our study we also found that the mean ejection fraction of our hypothyroid patients was low (40-50%).

In our study we found that the mean ejection fraction of hyperthyroid patients was high (60-70%). Other studies also found ejection fraction more than 60% in hyperthyroid patients¹¹.

6. Conclusion

From this study, we concluded that both hyperthyroidism and hypothyroidism were much common in females than in males. In the hypothyroidism group, majority of the patients belonged to the age group of 21-30 years. Similarly in the hyperthyroidism group, majority of the patients belonged to the age group of 21-30 years. In the hypothyroidism group, cardiac involvement was present in majority of patients belonging to 41-50 years of age group. On the other hand, in the hyperthyroidism group, cardiac involvement was present in majority of patients belonging to 51-60 years of age group. In the hypothyroidism group, 16.5% patients had symptoms suggestive of cardiac failure. In the hyperthyroidism group, 73.9% patients had symptoms suggestive of cardiac failure. Dyspnea and fatigue were the major cardiac symptoms in the hypothyroidism group. While chest pain and fatigue were the major cardiac symptoms in the hyperthyroidism group. It suggested that the patients suffering from thyroid dysfunction are at an increased risk of having cardiovascular manifestations. The ECG and 2D Echo findings in the current study also suggested that in both the groups of thyroid dysfunction cardiac manifestations are likely to have higher incidence.

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