



**College Of Medicine**  
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# CARDIOVASCULAR MANIFESTATIONS IN PATIENTS WITH PRIMARY HYPOTHYROIDISM

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AL-NAHRAIN UNIVERSITY COLLEGE OF MEDICINE/ Department of  
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## **Dedication**

To all my teachers from the primary school till the college who had spent their time for me, now I'm reaching this step because of them and My family, especially my parents and my Soul mate Nadin.

## Abstract

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**Background** — Hypothyroidism is common endocrine disorder and have effect on cardiovascular system include a decrease in cardiac output and cardiac contractility, a reduction in heart rate, and increase in peripheral vascular resistance.

**Aim** — To evaluate the frequency of cardiovascular manifestations in patients with primary hypothyroidism, and the relationship between these disorders and other factors like Age, Sex, BMI, and thyroid function status.

**Methods** — This cross-sectional study was carried out on 21 patients, from January 2019 to March 2019. They were (2) males and (19) females, and they were chosen randomly from: medical ward, surgical ward and endocrinology unit of Al-Emamain Alkhadhumain medical city-Baghdad. They were involved in the study by filling a questionnaire form. The collected data were statistically analyzed by SPSS and Chi-square test.

**Results and Discussion** — Patients participated in the study were of age ranging from 33-80 years (mean 53) which indicates the occurrence of hypothyroidism in middle age group. They were 2 males and 19 females which suggests that hypothyroidism is a female disorder rather than of male. The patients of the study were of body mass index ranging from 20-49 (mean 29) which refer to the overweight characteristic of the disease. 14.28% of the patients were having bradycardia, while 66.72% were having a normal pulse rate. Hypertension occurred in 52.38% of patients, 38% of them were normotensive. 19.04% of patients were having history of IHD. Regarding the TFT 23.8% of the patients were having mild elevation in TSH level (6.2-7.3 mIU/ L) and 42.85% were having a low T4 levels while 76.2% of them were having a normal TSH levels and 57.15 % were having a normal T4 level, because they were under levothyroxine treatment. By examining the ECG of patients involved in the study, 28.57% of them showed T wave inversion. Echocardiogram examination that 47.61% of them were having LVH and diastolic dysfunction. 76.2 % of the patients were on levothyroxine replacement.

**Conclusion** — Primary hypothyroidism occurred in middle age, overweighted females, and associated with cardiovascular manifestations which may be the only manifestations of thyroid dysfunction.

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## **Introduction**

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Hypothyroidism is common endocrine disorder characterized by a decrease in oxygen and substrate utilization by all the major organ systems of the body. As a result, the demands for cardiac output decrease; in addition, hypothyroidism directly alters cardiac function through changes in myocyte-gene expression [1].

**PATHOPHYSIOLOGY** — The major cardiovascular changes that occur in hypothyroidism include a decrease in cardiac output and cardiac contractility, a reduction in heart rate, and increase in peripheral vascular resistance [2,3].

There are also significant changes in modifiable atherosclerotic risk factors, including hypercholesterolemia, diastolic hypertension, carotid intimal media thickness, and endothelial derived relaxation factor (nitric oxide), which accompany overt hypothyroidism [1-4].

**Cardiac contractility** — All measures of left ventricular performance are impaired in both short- and long-term hypothyroidism, leading to a reduction in cardiac output [4,5]. There is also a decrease in rate of ventricular diastolic relaxation; as a result, compliance and diastolic filling are impaired [6].

**Vascular resistance** — Thyroid hormone relaxes vascular smooth muscle cells, thereby reducing peripheral vascular resistance [3]. Conversely, hypothyroidism causes a decrease in the release of endothelial-derived relaxing factor (EDRF), which in turn promotes contraction of these cells, thereby increasing peripheral vascular resistance [2]. This change results in reductions in cardiac output (in part because the heart cannot increase contractility to compensate) and tissue perfusion. Tissue oxygen utilization is also decreased; thus, arteriovenous (A-V) oxygen extraction is not different from that in normal subjects [4].

**Clinical manifestations** — Symptoms and signs of cardiovascular dysfunction are not common or prominent in patients with hypothyroidism. Those that do occur include [1,3,6]:

- Bradycardia.
- Hypertension resulting from the increase in vascular resistance and the fall in endothelial-derived relaxing factor (EDRF) [3].
- Cardiac dysfunction with poor contractility, dilatation, or pericardial effusion.
- Pericardial effusions, which occur in approximately 25 percent of patients and may be quite large.

**Rhythm disturbances** — In addition to a slow pulse rate, hypothyroid patients may have ventricular premature beats and rarely ventricular tachycardia with a long QT interval (torsade de pointes) [7] can be especially problematic in patients with underlying ischemic heart disease or known ventricular arrhythmias. Treatment with amiodarone can produce hypothyroidism and, in turn, further predispose the ischemic heart to ventricular arrhythmias.

**Blood pressure** — Thyroid hormone plays a role in blood pressure homeostasis. In patients who had undergone total thyroidectomy for thyroid cancer, withdrawal of thyroxine (T4) for six weeks results in an increase in serum norepinephrine and aldosterone concentrations and an increase in blood pressure with a greater rise in diastolic pressure (126/85 compared with 120/76 mmHg at baseline) [8]. Diastolic blood pressure may vary directly with serum thyroid-stimulating hormone (TSH) levels over the entire spectrum of thyroid disease [1,8].

Approximately 20 to 40 percent of hypothyroid patients have hypertension, even though cardiac output is reduced [6,9]. The hypertension is primarily diastolic, and the pulse pressure is diminished. In hypertensive hypothyroid patients, the serum levels of renin are low and there is an increased prevalence of salt sensitivity confirming the importance of the increase in systemic vascular resistance [1,7]. Among large groups of patients with hypertension, however, hypothyroidism is a contributory factor in only a small percentage [9].

**Cardiac dysfunction** — The upstroke of the pulse may be slow and the left ventricular apical impulse weak [5]. The heart may be enlarged and the heart sounds distant. These findings, plus dyspnea, exercise intolerance,

and edema, may make it seem as if the patient has congestive heart failure. While heart failure due solely to hypothyroidism is rare [3], in patients with underlying or preexistent cardiac disease, the presence or development of hypothyroidism leads to more severe heart failure, higher levels of brain natriuretic peptide (BNP), and worse short-term hospital outcomes [10].

Electrocardiograms may show low voltage and nonspecific ST segment and Q wave changes. Occasionally, large pericardial effusion can occur, characterized by a high protein and cholesterol content. These are rarely hemodynamically important and should be managed with thyroid hormone replacement, not by needle or surgical drainage. The latter can lead to hemodynamic worsening [11].

**Coronary artery disease** — Patients with angina pectoris probably have symptoms less often if they become hypothyroid because they are less active and peripheral oxygen demands decrease. The occurrence of anginal-like pain in some hypothyroid patients and the frequent occurrence of hypercholesterolemia diastolic hypertension, and elevated homocysteine levels have led to suggestions that hypothyroidism is associated with accelerated coronary artery disease [1,5].

Potential mechanisms in addition to lipid abnormalities and diastolic hypertension include elevated concentrations of C-reactive protein and endothelial dysfunction [2,12,13].

The potential risk of coronary artery disease in subclinical hypothyroidism is discussed elsewhere.

## The study

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**Aim** — To evaluate the frequency of cardiovascular manifestations in patients with primary hypothyroidism, and the relationship between these disorders and other factors like Age, Sex, BMI, and thyroid function status.

**Patients and method**— This cross-sectional study was carried out on 21 patients, from January 2019 to March 2019. They were (3) males and (18) females with age ranging from (33) to (80) years, and they were chosen randomly from: medical ward, surgical ward and endocrinology unit of Al-Emamain Alkhadhumain medical city-Baghdad. Patients were informed about the study, and their approval to participate was taken.

Patients involved in the study were known to have hypothyroidism. They were involved in the study by filling a questionnaire form that concerned with Age, sex, BMI, history of thyroidectomy, pulse rate, blood pressure, history of IHD, TFT readings, ECG findings, Echo findings and Treatment, as shown in Picture 1.

The image shows a research questionnaire titled "Cardiovascular Manifestations in Patients with Primary Hypothyroidism". The questionnaire is titled "Research Questionnaire" and contains the following items:

- Patient Name: .....
- Age: ..... years old.
- Gender: .....
- Weight: ..... Kg.
- Height: ..... cm.
- BMI: ..... Kg/m<sup>2</sup>.
- Pulse Rate: ..... Beat/Minute.
- Blood Pressure: ..... mm of Hg.
- Past Medical Hx: - IHD (Yes, No)
- Past Surgical Hx: - Thyroidectomy (Yes, No)
- TFT:
  - TSH: .....
  - T4: .....
- ECG Findings:
- Echocardiogram examination findings:
- Treatment:

**Picture 1** Research questionnaire



## Results

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Twenty-one patients were participated in this study; they were chosen randomly from: medical ward, surgical ward and endocrinology unit of Al-Emamain Alkhadhumain medical city-Baghdad from January 2019 to March 2019. Patients were informed about the study, and their approval to participate was taken.

Patients involved in the study were known to have hypothyroidism. They were involved in the study by filling a questionnaire form that concerned with Age, sex, BMI, pulse rate, blood pressure, history of IHD, history of thyroidectomy, TFT readings, ECG findings, Echo findings and Treatment.

### Age, Sex and BMI

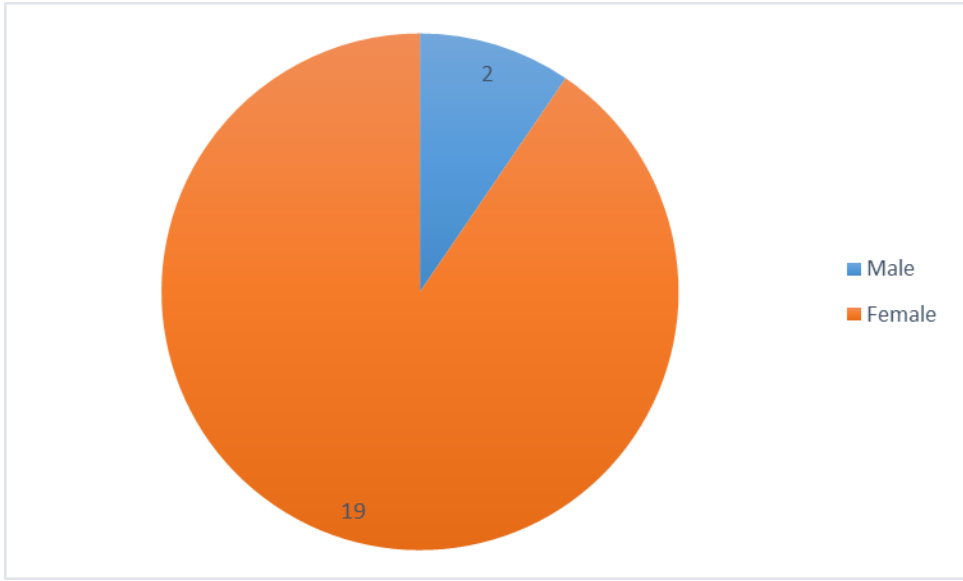
Nineteen females (90.47%) and two males (9.53%) were involved in the study with age ranging from 33 to 80 years and body mass index ranging from 20-49 as seen in tables 1, 2 and figure 1.

**Table 1** Age range of the patients and BMI

	Mean	Range
Age	53 years	33-80
BMI	29	20-49

**Table 2** Gender count and percentage in the study.

Gender type	Count	Percentage	P value
Male	2	9.53%	0.002
Female	19	90.47%	



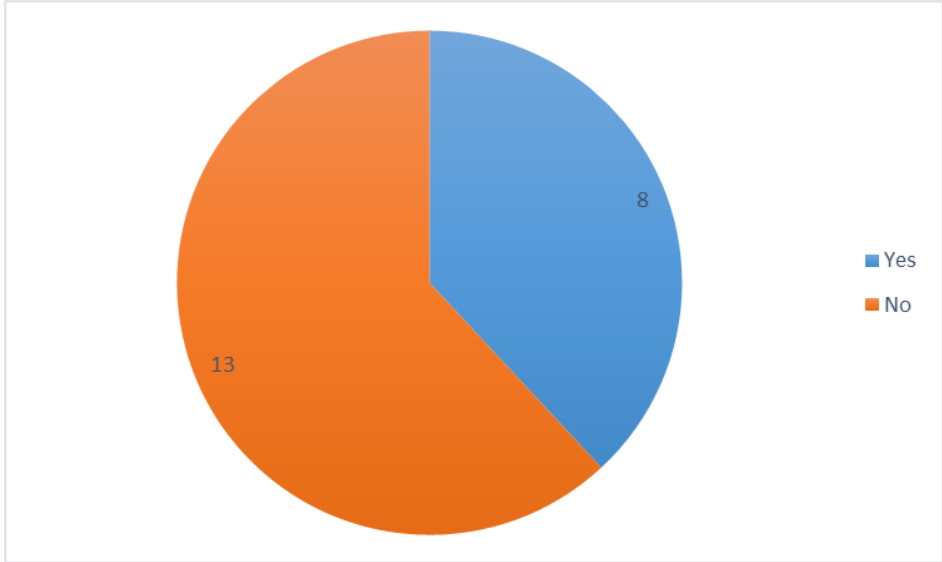
**Figure 1** Gender count in the study.

**History of Thyroidectomy**

8 patients (38%) were having history of Thyroidectomy, while 13 patients (62%) were not have a history of Thyroidectomy as shown in table 3 and Figure 2.

**Table 3** History of thyroidectomy count and percentage in the study.

History of Thyroidectomy	Count	Percentage	P value
Yes	8	38%	< 0.001
No	13	62%	



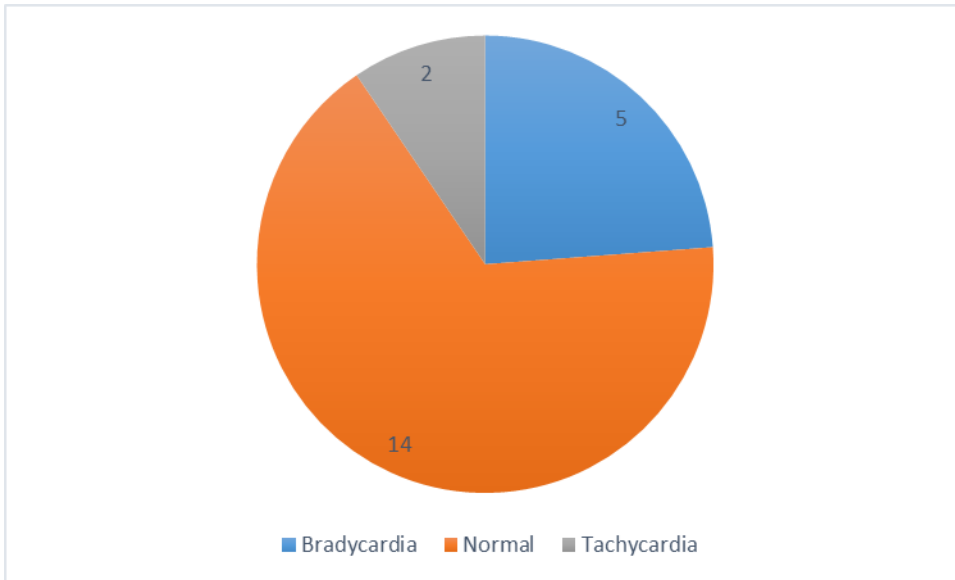
**Figure 2** History of thyroidectomy count in the study.

**Pulse Rate (PR)**

Five patients (23.80%) were having Bradycardia, two patients were having Tachycardia (9.53%) and fourteen patients (66.67%) were have a normal pulse rate as shown in table 4 and figure 3. Bradycardia is defined as a pulse rate of <60 bpm; tachycardia is a rate of >100 bpm [14].

**Table 4** Pulse rate count and percentage in the study.

Pulse Rate	Count	Percentage	P Value
Bradycardia	5	14.28%	0.131
Normal	14	66.72%	



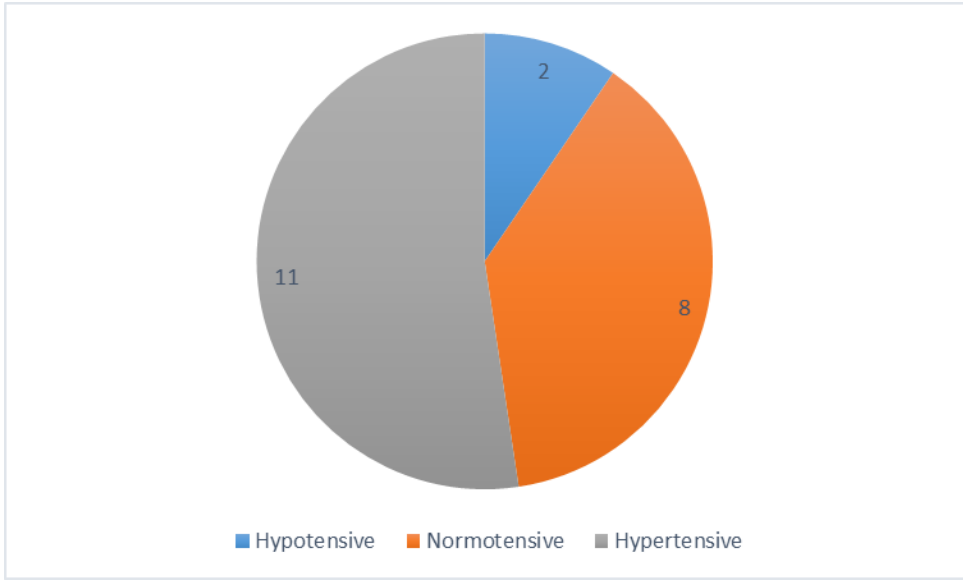
**Figure 3** Pulse rate count in the study.

### Blood Pressure

Eleven patients (52.38%) were have hypertension; 8 patients were of diastolic hypertension, while 3 patients were of systolic type. 38% of the patients (8 patients) were have normal blood pressure, while 9.62% (2 patients) were have hypotension as shown in table 5 and figure 4.

**Table 5** Blood pressure count and percentage in the study.

Blood Pressure	Count	Percentage	P value
Normal	8	38%	< 0.001
Hypertension	11	52.38%	



**Figure 4** Blood pressure count in the study.

**History of IHD**

Only 4 patients (19.04%) were having history of ischemic heart disease, while 17 patients (80.96%) were not having an ischemic heart disease as shown in table 6.

**Table 6** History of IHD count and percentage in the study.

History of IHD	Count	Percentage	P value
Yes	4	19.04%	0.03
No	17	80.96%	

**TFT reading**

TSH level were Elevated in 5 patients (23.8%) ranging (6.2-7.3 mIU/ L), while 16 patients (76.2%) were in the normal range of TSH level. T4 Levels indicate that 9 patients (42.85%) having a low T4 levels and 12 patients (57.15%) having a normal T4 readings. this is also can be shown in table 7 and 8.

**Table 7** TSH readings count and percentage in the study.

TSH reading	Count	Percentage	P value
Elevated	5	23.8%	0.012
Normal	16	76.2%	

**Table 8** T4 Levels in the study.

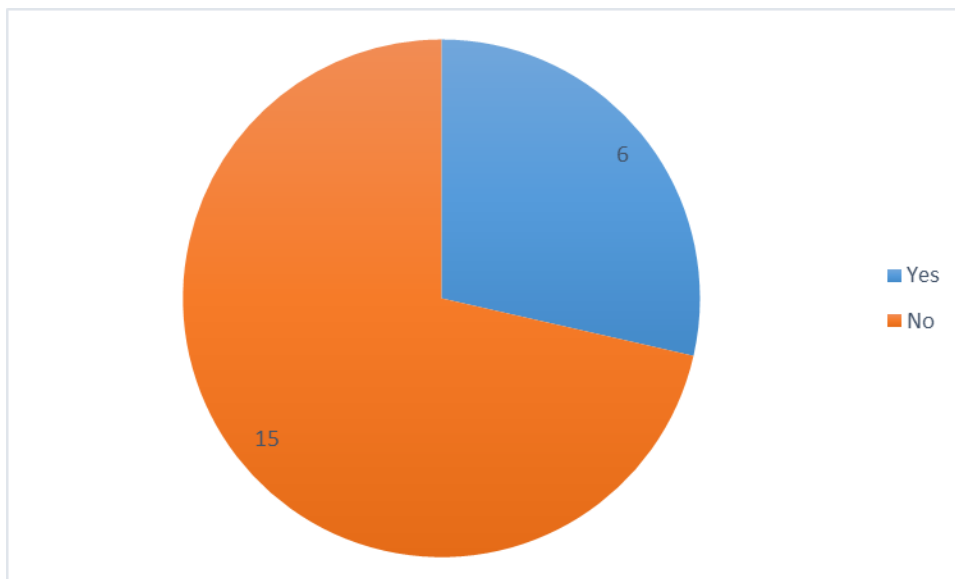
T4 Levels	Count	Percentage	P value
Low	9	42.85%	< 0.001
Normal	12	57.15%	

### ECG findings

6 patients (28.57%) are having T-wave inversion, while 15 patients (71.43%) were having a normal ECG. This can be seen in table 9 and figure 5.

**Table 9** ECG changes count and percentage in the study.

ECG changes	Count	Percentage	P value
Yes	6	28.57%	0.003
No	15	71.43%	



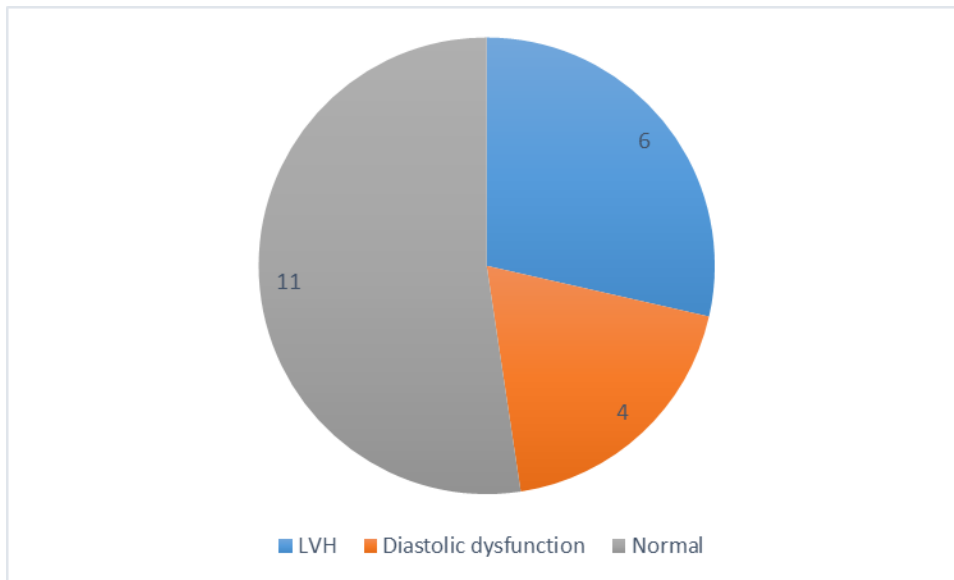
**Figure 5** ECG changes count in the study.

### Echocardiogram Study

Echocardiogram examinations of the patients in the study shows that 4 patients (19.04%) were having diastolic dysfunction, while 6 patients (28.57%) were having left ventricular hypertrophy. None of the patient (0%) were having pericardial effusion, so that 10 patients (47.61%) were having an echocardiogram examination finding and 11 patients (52.39%) were have a normal Echocardiogram examination, As shown in table 10 and figure 6.

**Table 10** Echocardiogram examination findings count and percentage in the study.

Echocardiogram exam findings	Count	Percentage	P value
Yes	10	47.61%	< 0.001
No	11	52.39%	



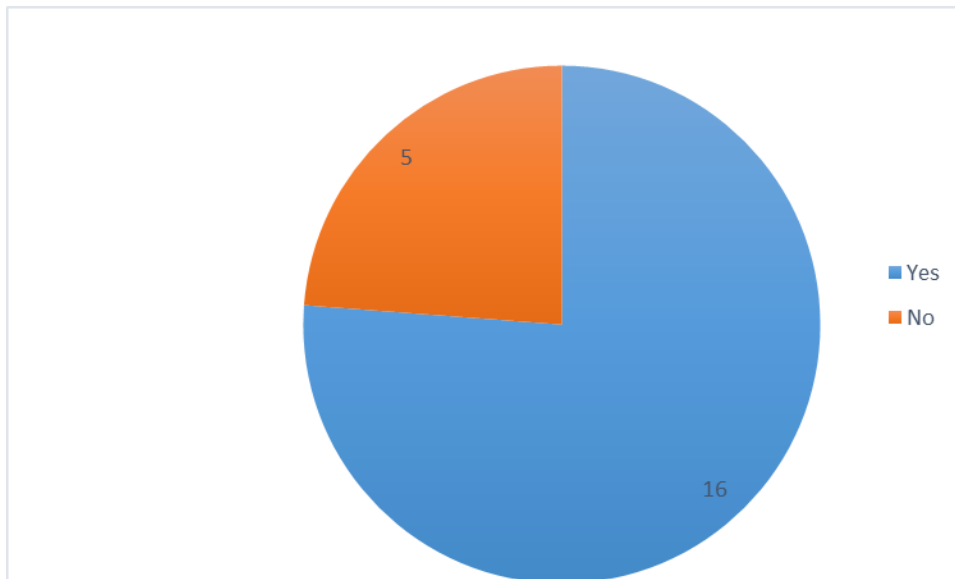
**Figure 6** Echocardiogram examination findings count in the study.

### Treatment

16 patients (76.2%) were on Levothyroxine treatment for Hypothyroidism, and 5 patients (23.8%) were on No treatment, as shown in table 11 and figure 7.

**Table 11** Patients on Levothyroxine treatment count and percentage in the study.

On Treatment	Count	Percentage	P value
Yes	16	76.2%	0.012
No	5	23.8%	



**Figure 7** Patients on Levothyroxin treatment count in the study.



## Discussion

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Twenty-one patients were participated in this study; they were chosen randomly from: medical ward, surgical ward and endocrinology unit of Al-Emamain Alkhadhumain medical city-Baghdad from January 2019 to March 2019. Patients were informed about the study, and their approval to participate was taken.

Patients involved in the study were known to have hypothyroidism. They were involved in the study by filling a questionnaire form that concerned with Age, sex, BMI, pulse rate, blood pressure, history of IHD, history of thyroidectomy, TFT readings, ECG findings, Echo findings and Treatment.

Concerning with Age, Sex and BMI, results in tables 1, 2 and figure 1 showed that the participants were of age ranging from 33 to 80 years with mean of 53 years which refers to the occurrence of hypothyroidism in older age group rather than younger one, as suggested by other studies [15,16]. On the other hand, the presence of 19 females (90.47%) versus 2 males (9.53%), suggests that primary hypothyroidism is a disease of older women rather than men [16, 17]. Also, one can notice the relationship between this disease and the elevated BMI that ranged from 20 to 49 with mean equal to 29 that indicates the overweight factor as a potential risk or as a result of correlation of hypothyroidism and cardiovascular disorders [18, 19].

Regarding the history of thyroidectomy as shown in table 3 and Figure 2, 8 patients (38%) were having history of Thyroidectomy, while 13 patients (62%) were not have a history of Thyroidectomy. Iatrogenic hypothyroidism is a common cause of hypothyroidism [22, 23]

Regarding the pulse rate, results in table 4 and figure 3 showed that 5 patients (23.80%) were having Bradycardia while 14 patients (66.67%) were have a normal pulse rate and 2 patients (9.53%) were having tachycardia. One of the most common cardiac symptoms of hypothyroidism is the bradycardia, as heart rate is modulated by thyroid hormone, so that in hypothyroidism the heart rate is typically 10-20 beats per minute slower than normal. However, hypothyroidism prolongs the cardiac action potential and QT interval which predisposes the patient to ventricular

irritability and may worsen the tendency for premature beats and tachycardias [19,20].

Regarding the blood pressure which were shown in table 5 and figure 4, Eleven patients (52.38%) were Hypertensive; 8 patients were of diastolic hypertension, while 3 patients were of systolic type. While 38% of them (8 patients) were Normotensive, while 9.62% (2 patients) were Hypotensive. One might think that, because a lack of thyroid hormone slows down the metabolism, people with hypothyroidism might suffer from low blood pressure. Usually the opposite is true, as the arteries are stiffer in hypothyroidism, combined with the increase in vascular resistance. The smooth muscles of the blood vessels are contracted forcing the heart to use more force (pressure) to push the blood through smaller openings in the vessels [17,20,21]. This elevation in the cardiac afterload and cardiac work results in raising the diastolic blood pressure [15, 16].

Regarding the history of IHD as shown in table 6, Only 4 patients (19.04%) were having history of ischemic heart disease, while 17 patients (80.96%) were not having an ischemic heart disease. as hypothyroidism can results in worsening of coronary artery disease [24].

Regarding the TFT reading as shown in table 7 and 8, TSH level were Elevated in 5 patients (23.8%) ranging (6.2-7.3 mIU/ L), while 16 patients (76.2%) were in the normal range of TSH level. The fact that hypothyroidism is associated with elevated TSH levels was suggested by other studies [6,7], which indicate that people with moderately elevated TSH levels had elevated risks for subsequent heart disease [25].

T4 Levels indicate that 9 patients (42.85%) having a low T4 levels and 12 patients (57.15%) having a normal T4 readings.

Concerning with ECG findings as show in table 9 and figure 5, six patients (28.57%) are having T-wave inversion, while 15 patients (71.43%) were having a normal ECG. the ECG generally reveals sinus bradycardia and nonspecific ST-T wave abnormalities. [21,22]

Regarding the echocardiogram study as show in table 10, Four patients (19.04%) were having diastolic dysfunction, while 6 patients (28.57%) were

having left ventricular hypertrophy, None of the patient (0%) were having pericardial effusion, so that 10 patients (47.61%) were having an echocardiogram examination finding and 11 patients (52.39%) were have a normal Echocardiogram examination.

Concerning with the treatment of hypothyroidism as shown in table 11 and figure 6, sixteen patients (76.2%) were on Levothyroxine treatment for Hypothyroidism and 5 patients (23.8%) were on No treatment. Patients with hypothyroidism frequently have elevations of cholesterol and triglycerides, resulting in premature atherosclerotic CAD. Before treatment with thyroid hormone, patients with hypothyroidism frequently do not have angina pectoris, presumably because of the low metabolic demands caused by their condition. However, angina and myocardial infarction may be precipitated during initiation of thyroid hormone replacement, especially in elderly patients with underlying heart disease. Therefore, replacement should be done with care, starting with low doses that are increased gradually. [21,22]

### **Conclusion**

we can conclude that hypothyroidism is an important cause of IHD, and Primary hypothyroidism is associated with cardiovascular manifestations as hypertension, nonspecific ECG changes, left ventricular hypertrophy, diastolic dysfunction. Although patients of hypothyroidism are usually old aged, overweighted females, cardiovascular manifestations may be the only manifestations of thyroid dysfunction.

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