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EFFECT OF TREATING HYPOTHYROIDISM ON ELECTROCARDIOGRAPHIC AND ECHOCARDIOGRAPHIC PROFILE OF THE PATIENTS

Internal Medicine

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ABSTRACT

Introduction: Thyroid dysfunction disorders are known to influence the cardiovascular system in a variety of ways. The purpose of this investigation was to determine the incidence of various cardiovascular problems in newly diagnosed hypothyroid individuals. **Methodology:** This was a prospective observational study, in which we included patients more than 18 years of age with recently (within 6 months) confirmed diagnosis of hypothyroidism by thyroid profile and not taking any treatment. At presentation, demographic information and a comprehensive medical history were recorded for all patients. Thyroid function testing, 12-lead ECG and echocardiography reports. In addition, the requisite lipid profile, complete blood count, and other tests were scheduled for the patients. **Results:** At baseline, we observed that 46% had bradycardia, 53% had normal pulse and only one patient had tachycardia. After treatment, only 10% of the patients had bradycardia, and 88% had normal pulse (p value < 0.01). We observed that proportion of patients with normal serum cholesterol levels, low density lipoprotein levels and triglyceride levels increased significantly 6 months post-treatment as compared to that at baseline (p value < 0.05). Overall, 44% of the patients had normal ECG pre-treatment, which increased significantly to 82% in the post-treatment period (p value < 0.01). Similarly, 51% of the patients had normal echocardiographic findings pre-treatment, which increased significantly to 75% in the post-treatment period (p value < 0.01). **Conclusion:** Our findings indicate that hypothyroidism is related with a mild and transient impairment of the heart's diastolic performance.

KEYWORDS

hypothyroidism; cardiology; electrocardiography; echocardiography

INTRODUCTION

The thyroid gland plays a crucial role in tissue metabolism and development, influencing several organ systems as a result. Thyroid dysfunction disorders (hyperthyroidism and hypothyroidism) are known to influence the cardiovascular system in a variety of ways. While the acute consequences of thyroid dysfunction on the cardiovascular system are more clearly visible, particularly in cases of hyperthyroidism, the data regarding the long-term effects of thyroid dysfunction on the heart and cardiovascular outcomes is less clear. In hypothyroidism, the key circulatory alterations include a decrease in cardiac output and cardiac contractility, a drop in heart rate, and an increase in peripheral vascular resistance.

Manifest hypothyroidism is accompanied by considerable alterations in modifiable atherosclerotic risk factors, such as hyper cholesterolemia, diastolic hypertension, carotid intimal media thickness, and endothelium generated relaxation factor (nitric oxide). In addition, all measures of left ventricular function are diminished in both short-term and long-term hypothyroidism, resulting in a decrease in cardiac output. In addition, the rate of ventricular diastolic relaxation decreases, resulting in decreased compliance and diastolic filling. Reduced ventricular function is likely due to many factors. Possible processes include increases in afterload and changes in cardiac calcium regulating protein gene expression. In addition, thyroid hormone relaxes vascular smooth muscle cells, resulting in a decrease in peripheral vascular resistance. Hypothyroidism, on the other hand, decreases the release of endothelium-derived relaxation factor, which enhances the contraction of endothelial cells and increases peripheral vascular resistance.

The majority of heart anomalies return to normal after euthyroidism is attained. Thus, earlier detection and treatment of cardiac problems in hypothyroid individuals may minimise morbidity and death. The purpose of this investigation was to determine the incidence of various cardiovascular problems in newly diagnosed hypothyroid individuals.

METHODOLOGY

Study Design and sample size

This was a prospective observational study, in which we included patients more than 18 years of age with recently (within 6 months) confirmed diagnosis of hypothyroidism by thyroid profile and not taking any treatment. We excluded patients with known heart diseases like congenital heart disease, rheumatic heart disease, ischemic heart disease etc, taking iodine containing drugs e.g. amiodarone or on treatment for their known hypothyroid disease in the past, or with known disease which may alter the total serum thyroid hormones level or CVS manifestations e.g. chronic liver disease, chronic renal disease, hypoproteinemia, severe anaemia and pregnancy. The study was conducted in the Department of Medicine, DY Patil School of Medicine, Navi Mumbai from November 2018 till April 2020. The sample size was calculated as: $n = (Z_{\alpha/2})^2 * (PQ) / E^2$, where n = Sample size, $Z_{\alpha/2}$ – Z value at 5% error (1.96), P = Taken as 0.57 [Saxena et al reported ECG abnormalities in 57% of the patients with hypothyroidism], Q= 1-P and E = Allowable error (taken as 10%). $n = (1.96)^2 * (0.57*0.43) / (0.1)^2 = n = 94.15$, rounding off, we included 100 patients in the present study. The study was approved by the Institutional Ethics Committee and an informed written consent was obtained from the patients before enrolment.

Data Collection and Data Analysis

Using a pre-designed semi-structured research proforma, data were gathered. At presentation, demographic information and a comprehensive medical history were recorded for all patients. Additionally, past medical history and medication history were recorded. The vital signs and results of a general physical examination were recorded. Thyroid function testing was estimated by a Solid Phase, competitive Chemiluminescent enzyme immunoassay using IMMULITE/IMMULITE 1000. Ultracentrifuge samples were used for detection. A 12-lead ECG equipment was used to assess the electrical changes in the heart's function. The reports were then carefully reviewed using a magnifier. The Philips Hd11xe machine was used for all echocardiogram reports. In addition, the requisite lipid profile, complete blood count, and other tests were scheduled for the patients.

Descriptive analysis of quantitative parameters was expressed as means and standard deviation. Ordinal data were expressed as absolute number and percentage. To compare before treatment and after treatment patient variables, cross tables were generated and chi square test was used for testing of associations. Student t test was used for comparison of quantitative parameters. P-value < 0.05 is considered statistically significant. All analysis were done using SPSS software, version 25.0.

RESULTS

In the present study of 100 patients, mean age of the patients was 38.5 ± 6.25years, ranging from18 to 68 years and 78% were females (Table 1). The most common presenting symptom of the patients was fatigue,

reported by 66% of the patients and weight gain, which was reported by 61%. On examination, hair loss was the most common sign (36%), limb swelling (32%) and dry skin (30%). Less common examination findings were decreased tendon reflexes (19%) and cool extremities (12%). At baseline, we observed that 46% had bradycardia, 53% had normal pulse and only one patient had tachycardia. After treatment, only 10% of the patients had bradycardia, and 88% had normal pulse (p value < 0.01) (Figure 1). Baseline and after treatment TSH levels are described in figure 2 and the difference in the proportion of patients having normal TSH level increased significantly after 6 months of treatment (p value < 0.001). We observed that proportion of patients with normal serum cholesterol levels, low density lipoprotein levels and triglyceride levels increased significantly 6 months post-treatment as compared to that at baseline (p value < 0.05) (Table 2). Overall, 44% of the patients had normal ECG pre-treatment, which increased significantly to 82% in the post-treatment period (p value < 0.01) (Table 3). Similarly, 51% of the patients had normal echocardiographic findings pre-treatment, which increased significantly to 75% in the post-treatment period (p value < 0.01).

DISCUSSION

This prospective observational research was conducted on individuals diagnosed or suspected of suffering from hypothyroidism based on clinical assessment and verified by measurement of blood TSH, T3 and T4 levels. In the current research, 6% of participants had normal TSH levels before therapy, which climbed to 66% after treatment (p < 0.001). In a comparable trial, Kweon et al. observed that the mean TSH level decreased from 40.2 ± 9.8 microU/ml before to therapy to 3.6 ± 0.6 microU/ml (p value 0.01). Denic et al. also observed that after 24 weeks of treatment, 34 of the 42 recruited participants had TSH levels within the reference range (0.3–4.2 mU/L), whereas 8 did not. Five individuals had modestly increased TSH readings above the reference range (up to 6 mU/L), however only one patient had a TSH value more than 10 mU/L. There was a statistically significant change in the TSH value after 6 and 12 weeks of thyroid replacement medication (p < 0.05) and a very statistically significant difference after 24 weeks (p < 0.01) compared to the original TSH values.

Both overt and subclinical hypothyroidism may impair lipid metabolism. Since 1930, this association has been well-described in the literature, and it is involved in the elevated CV risk seen in these individuals. Treatment with L-T4 greatly diminishes the above-mentioned effects on the lipids in circulation. 4–6 weeks are required for L-T4 treatment to ameliorate or correct dyslipidemia. Substitution therapy decreases the levels of LDL-C, total cholesterol, HDL, and triglycerides by an increase in the activity of lipoprotein lipase and hepatic triglyceride lipase that is mediated by thyroid hormone. Lipoprotein A levels reduced in individuals who attained euthyroidism with L-T4, according to certain studies. In other investigations, there was no difference in lipoprotein A levels before and after L-T4 therapy. Highly atherogenic residual lipoprotein concentrations, such as chylomicron remnants and very-low-density lipoprotein remnants, were decreased in individuals who achieved euthyroidism after therapy. In a recent research by Denic et al, blood concentrations of total cholesterol and LDL-C reduced statistically significantly (p < 0.01) after six and twenty-four weeks of treatment, whereas serum values of HDL-C rose statistically significantly (p < 0.01). However, there was no statistically significant change (p > 0.05) between the sixth and twelfth weeks and the twelfth and twenty-fourth weeks of treatment for total cholesterol, HDL-C, and LDL-C blood concentrations.

Pre-treatment, 44% of patients had normal ECGs; post-treatment, this rose dramatically to 82% (p < 0.01) In the research by Kweon et al., the average heart rate rose from 69 10 bpm before therapy to 72 ± 11 bpm after treatment. Additionally, QT prolongation was identified in 6 participants (33%) at the study's start. Five cases were normalised after L-thyroxine therapy. Comparing untreated and treated hypothyroid individuals, Ohal et al. discovered a substantial change in heart rate. Untreated individuals had a heart rate of 54.9 ± 4.5 beats per minute compared to 83.23 3.72 beats per minute (p < 0.01). In addition, 26% of untreated patients were found to have LV complexes, but none of the treated individuals did (p < 0.01).

In the current research, 51% of patients exhibited normal echocardiographic results before to therapy, compared to 75% after treatment (p < 0.01). At 12 months of treatment with levothyroxine, Monzani et al. detected a substantial rise in the E/A ratio (p value < 0.05) and a significant reduction in IVRT (p value < 0.05). In comparison, none of these characteristics changed significantly in the placebo-treated group. In their study, Denic and colleagues found that hypothyroid subjects had a statistically highly significant (p < 0.01) increase in E wave velocity and increase in transmitral flow ratio (E/A), but a statistically highly significant (p < 0.01) decrease in A wave velocity after six, 12 and 24 weeks of therapy. During L-thyroxine treatment, there was a tendency for the E/A ratio to rise with subsequent assessments.

In 32.5% of instances in a comparable research by Ramesh et al., echocardiographic results were normal. Next most prevalent was pericardial effusion, which was seen in 27.5% of patients. Diastolic dysfunction was seen in 27.5% of patients, with the majority exhibiting moderate dysfunction. No patients with significant diastolic dysfunction were identified. IVS thickness was only detected in 5% of instances. Another research by Saxena et al. revealed that echocardiography revealed normal results in 62% of patients.[5] 70 Abnormal results were observed in 38%. Moderate pericardial effusion was the most prevalent aberrant finding (18%), followed by LVDD Grade 1 (16%), LVDD Grade 1 with mild pericardial effusion (2%) and LVDD Grade 2 correspondingly.

This research has a few drawbacks. First, since this was a single-centre research, the findings may not be relevant to other geographic regions. Second, long-term monitoring of the patients was not possible.

CONCLUSION

Our findings indicate that hypothyroidism is related with a mild and transient impairment of the heart's diastolic performance. In order to avoid both the progression of hypothyroidism and the onset of clinically severe cardiovascular dysfunction, we propose prescribing levothyroxine replacement treatment to these individuals.

Table 1. Baseline characteristics of the patients included int the study

Age groups (years)	Number	Percent
Up to 20	17	17%
21 to 30	27	27%
31 to 40	29	29%
41 to 50	12	12%
51 to 60	12	12%
More than 60	3	3%
Gender		
Females	78	78%
Males	22	22%
Symptoms		
Fatigue	66	66%
Weight gain	61	61%
Poor memory	56	56%
Constipation	35	35%
Shortness of breath	28	28%
Feeling of cold	22	22%
Puffiness below the eyes	16	16%
Irregular menstruation	15	15%
Hoarseness of voice	14	14%
Signs		
Hair loss	36	36%
Limb swelling	32	32%
Dry skin	30	30%
Decreased tendon reflexes	19	19%
Cool extremities	12	12%

Table 2. Comparison of lipid profile parameters before and after treatment

	Baseline		After 6 months of treatment		P value*
Total cholesterol (mg/dl)	Number	Percent	Number	Percent	
< 200 (normal)	33	33%	78	78%	< 0.01
≥ 200 (high)	67	67%	22	22%	
LDL (mg/dl)					
< 100 (normal)	24	24%	69	69%	< 0.05
≥ 100 (high)	76	76%	31	31%	
Triglyceride (mg/dl)					

< 150 (normal)	33	33%	45	45%	< 0.05
≥ 150 (high)	67	67%	55	55%	
Total	100	100%	100	100%	

Table 3. Comparison of ECG and echocardiographic findings before and after treatment

ECG changes	Baseline		After 6 months of treatment		
	Number	Percent	Number	Percent	P value*
Bradycardia	46	46%	10	10%	< 0.001
QT prolongation	10	10%	3	3%	< 0.05
Decreased p waves	14	14%	3	3%	< 0.01
Low voltage complexes	30	30%	7	7%	< 0.01
Heart block	0	0%	0	0%	NA
Right bundle branch block	4	4%	0	0%	NA
Normal	44	44%	82	82%	< 0.01
Echocardiographic changes					
Raised interventricular septal dimensions	40	40%	18	18%	< 0.001
Increased left ventricular PW thickness	24	24%	18	18%	0.29
Pleural effusion	5	5%	1	1%	< 0.01
Diastolic dysfunction	34	34%	14	14%	< 0.001
Normal	51	51%	75	75%	< 0.01

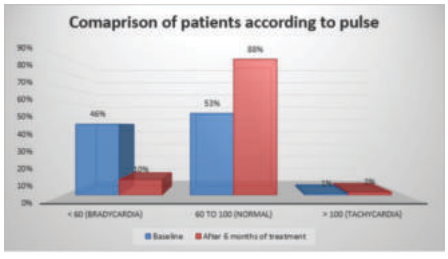

Figure 1. Comparison of pulse rate before and after treatment

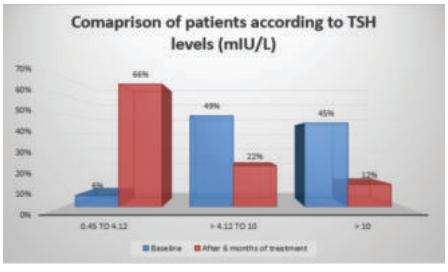

Figure 2. Comparison of thyroid stimulating hormone levels before and after treatment

REFERENCES

1. Klein, I. and K. Ojamaa, Thyroid hormone and the cardiovascular system. N Engl J Med, 2001. 344(7):501-9.
2. Taddei S, Caraccio N, Virdis A, et al. Impaired endothelium-dependent vasodilatation in subclinical hypothyroidism: beneficial effect of levothyroxine therapy. J Clin Endocrinol Metab 2003; 88:3731.
3. Gumieniak O, Perlstein TS, Hopkins PN, et al. Thyroid function and blood pressure homeostasis in euthyroid subjects. J Clin Endocrinol Metab 2004; 89:3455.
4. Santos AD, Miller RP, Mathew PK, Wallace WA, Cave Jr WT, Hinojosa L. Echocardiographic characterization of the reversible cardiomyopathy of hypothyroidism. The American journal of medicine. 1980 May 1;68(5):675-82.
5. Saxena P, Kumar A, Dwivedi NC. A study of cardiac dysfunction in patients of hypothyroidism. International Journal of Contemporary Medical Research 2020;7(3):C10-C12.
6. Al-Khatib SM, LaPointe N, Kramer JM, Califf RM. What clinicians should know about the QT interval. JAMA 2003;289:2120-7.
7. Kweon KH, Park BH, Cho CG. The effects of L-thyroxine treatment on QT dispersion in primary hypothyroidism. Journal of Korean medical science. 2007 Feb;22(1):114.
8. Đenić A, Obrenović-Kirćanski B. Thyroid replacement therapy effects on cardiac function in patients with hypothyroidism. Srpski arhiv za celokupno lekarstvo. 2020(00):107-.
9. Rizos CV, Elisaf MS, Liberopoulos EN. Effects of thyroid dysfunction on lipid profile. Open Cardiovasc Med J. (2011) 5:76–84
10. Ito M, Takamatsu J, Matsuo T, Kameoka K, Kubota S, Fukata S, et al. Serum concentrations of remnant-like particles in hypothyroid patients before and after thyroxine replacement. Clin Endocrinol. (2003) 58:621–6
11. Tzotzas T, Krassas GE, Konstantinidis T, Bougoulia M. Changes in lipoprotein(a) levels in overt and subclinical hypothyroidism before and during treatment. Thyroid. (2000) 10:803–8.
12. Klausen IC, Nielsen FE, Hegedus L, Gerdes LU, Charles P, Faergeman O. Treatment of hypothyroidism reduces low-density lipoproteins but not lipoprotein(a). Metabolism. (1992) 41:911–4.
13. Ohal SS, Bhagchandani RA, Phatak MS. Electrocardiographic changes in hypothyroidism–A cross-sectional study. National Journal of Physiology, Pharmacy and Pharmacology. 2019;9(5):459-63.
14. Monzani F, Di Bello V, Caraccio N, Bertini A, Giorgi D, Giusti C, Ferrannini E. Effect of levothyroxine on cardiac function and structure in subclinical hypothyroidism: a double blind, placebo-controlled study. The Journal of Clinical Endocrinology & Metabolism. 2001 Mar 1;86(3):1110-5.
15. Ramesh K, Nayak BP. A study of cardiovascular involvement in Hypothyroidism. IAIM, 2016; 3(5): 74-80.