ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

ORIGINAL RESEARCH

Hypothyroidism associated Hypertension

[1]Abhishek Kumar, [1]Abhishek Kumar Verma, [2]Shadab Samad, [3]Karan Dang

[1]Assistant Professor (Department of General Medicine, NCR Institute of Medical Sciences, Meerut), [2]Assistant Professor (Department of General Medicine, GS Medical College & Hospital, Hapur), [3]Consultant Cardiology (Artemis ASCOMS Heart Center, Sidhra, Jammu, J& K)

Correspondence:
Karan Dang
Consultant Cardiology (Artemis ASCOMS Heart Center, Sidhra, Jammu, J& K)

Abstract

Introduction/ Background: Hypertension is not a typical sign of hypothyroidism, however, hypothyroidism is potentially important but often overlooked cause of hypertension and restoration of euthyroidism with thyroxine therapy usually brings in a substantial reduction in blood pressure. This study describes the relation of thyroid function and blood pressure, compares the age-related increase in blood pressure in euthyroid patients with that of hypothyroid patients, and assesses the effect of thyroid hormone replacement therapy on blood pressure in hypertensive hypothyroid patients.

Objective: To study the association between hypertension and hypothyroidism and to assess the response of adequate thyroid hormone replacement therapy on blood pressure in hypothyroid hypertensive subjects.

Material and Method: Prospective observational study was undertaken in NCR Medical College and Hospital, Meerut including 241 female patients aged 19-69years admitted in the medical wards from 1st June 2021 to 31st May 2022. Detailed clinical examination including measurement of blood pressure and routine investigations including thyroid profile were done. The data was expressed as means ± SEM and was statistically analyzed.

Results: On the basis of thyroid profile out of 241 cases, 87 were hypothyroid and 154 were euthyroid. Adiposity, age and sex related factor that could influence blood pressure were excluded. Diastolic, rather than systolic blood pressure was significantly higher in hypothyroid patients over 50 years than in euthyroid patients of corresponding age groups. 9 hypertensive hypothyroid patients who received adequate thyroid replacement therapy for 6 ± 2 months had reduction in blood pressure. In the remaining 5 patients who did not receive adequate thyroid replacement therapy due to poor compliance, blood pressure and thyroid function tests remained unchanged.

Conclusion: Hypertension is more often associated with hypothyroidism than euthyroidism in patients over 50 years old. Diastolic blood pressure of hypothyroid patients was significantly higher than that of euthyroid patients. Blood pressure is often reduced in response to adequate thyroid hormone replacement therapy.

Introduction

Hypothyroidism is recognized as a cause for hypertension since a long period, however is often ignored or overlooked. Many textbooks on hypertension have mentioned hypothyroidism as a cause for hypertension. Many textbooks of hypertension have mentioned hypothyroidism as a cause for hypertension; however, there appears to be less correlation about the prevalence of hypertension.(Table 1)

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

Table 1: Many textbooks of hypertension have mentioned hypothyroidism as a cause of hypertension; however, there appears to be less correlation about the prevalence of hypertension.

Sr.No.	Textbook of hypertension	Prevalence reported
1.	Kaplan's Clinical Hypertension[1]	26%
2.	Genest's Hypertension, Physiology and Treatment[2]	50%
3.	Skelton and Sonnenblick[3]	Low to normal

Previous studies on the prevalence of hypertension in subjects with hypothyroidism have demonstrated that prevalence widely varied from 0% to 50%. (Table 2). These differences reflect the different criteria employed for diagnosis of both hypertension and hypothyroidism, differing degrees of hypothyroidism and varying ages of patients.

In the present study, the age-related increase in blood pressure in euthyroid patients was compared with that of hypothyroid patients and assessment of the effect of thyroid hormone replacement therapy on blood pressure in hypertensive hypothyroid patients was done.

Table 2: Previous studies on the prevalence of hypertension in subjects with hypothyroidism have demonstrated that prevalence widely varied from 0% to 50%.

Survey	Date	Country	n	Prevalence of hypertension or hypothyroidism	Notes
Endo et al [4]	1979	Japan	81	0-60%[a]	Age 30-60yrs
Saito et al[5]	1983	Japan	477	30%[b]	Age over 50yrs
Streeten et al [6]	1988	USA	688	3.6%[c]	Age 20-69yrs
Anderson et al [7]	1994	USA	1061	3.0%[d]	

Material and methods

In the present study 241 patients who visited NCR Medical College and Hospital, Meerut aged 19-69years admitted in the medical wards from 1st June 2021 to 31st May 2022 were included. Only female patients (to avoid sex-related factor that could influence blood pressure) were include in this study between age group of 19-69 years.

It was ensured that none of the patients was previously treated for hypertension or hypothyroidism. Hypertension was defined as Blood pressure 140/90mmHg. Blood pressure was measured after 30min of rest in a quiet room with a sphygmomanometer (Brachial arterial pressure). Serum T3, T4 and TSH were determined by ELISA techniques. Values are expressed as means ± SEM. Statistical analysis was done by Student's t test for paired and unpaired data as appropriate and chi square test. Correlations were calculated by the method of least squares.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

Results

Age-Matched Comparisons between Euthyroid and Hypothyroid Patients Clinical characteristics of patients are shown in table 3. Weight, height, and body mass indexes (BMI) were similar in both groups whereas euthyroid patients had higher serum T4 and T3 and lower TSH values than hypothyroid patients. 11 out of 154 patients (7.14%) in euthyroid patients and 14 of 87 (16.09%) in hypothyroid patients had hypertension .

The number of patients and prevalence of hypertension by age was shown in table 4.

Blood pressure increased with age in both euthyroid and hypothyroid patients. (figure 1) Hypothyroid patients had significantly higher diastolic blood pressure than euthyroid patients in the 5th and 6th decades. Heart rate in euthyroid patients was higher than in hypothyroid patients; however, the difference did not reach statistical significance in the 40- to 49-year and 60- to 69-year groups.

Table 3: Weight, height and BMI were similar in both groups whereas euthyroid patients had higher serum T4 and T3 and lower TSH values than hypothyroid patients

	Euthyriod n=154	Hypothyroid n=87	Signific ance
Weight (kg)	51.1±1.2	52.9±1.0	Ns
Height (cm)	152.1±0.8	153±0.9	Ns
BMI	22.1±0.5	22.6±0.4	Ns
T4 ng/dL	1.25±0.4	0.35±0.3	<0.001
T3 pg/mL	2.45±0.95	0.85±0.5	<0.001
TSH mIU/mL	2.60±1.05	95.1±7.8	<0.001

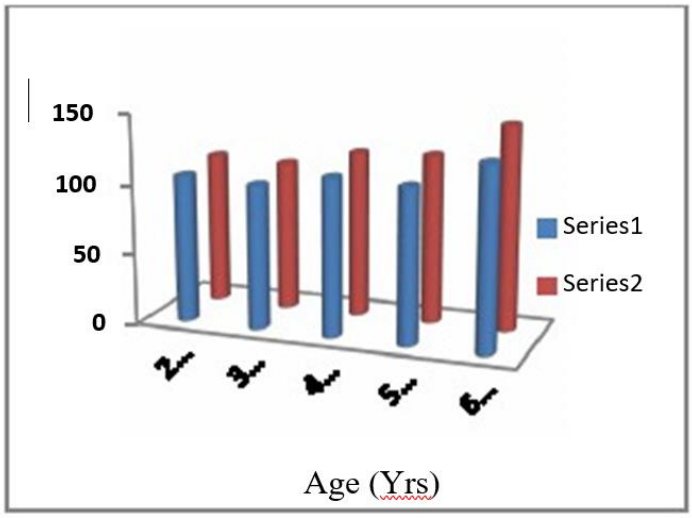
Blood Pressure Response to Thyroid Hormone Replacement 14 hypertensive hypothyroid patients aged 29 to 69 years were followed for 6± 2 months. In 9 patients (Group 1) who received sodium-Lthyroxine, 100 to 150mg/daily, treatment suppressed TSH and increased serum T3 and T4 into normal range and therefore considered adequate. All except one exhibit significant reductions of blood pressure. In the rest of 5 patients (Group 2) who did not receive adequate amounts of sodium-Lthyroxine due to poor compliance, blood pressure and thyroid function tests remained unchanged.

Table 4: Number of patients and prevalence of hypertension in euthyroid and hypothyroid patients

Age in years	Patients with Hypertension		Signif icnce
	Euthyroid	Hypothyrid	
20-29	0/28	0/17	Ns
30-39	1/25	1/16	Ns
40-49	3/37	3/19	Ns
50-59	4/44	6/21	<0.01
60-69	3/20	4/12	<0.01
Total	11/154 (7.14%)	14/87 (16.09%)	<0.01

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

Figure 1: Blood pressure in euthyroid (blue bar) and hypothyroid (red bar) patients by age. Hypothyroid patients had significantly higher blood pressure than euthyroid patients in the 5th and 6th decades.



Discussion

Hypothyroidism is common, recent data have described the lifetime incidence of spontaneous hypothyroidism in women as 4.1 per thousand survivors per year, and 0.6 per thousand male survivors per year. [8] In the present study, only female subjects were included in order to avoid sex-related factors that could influence blood pressure. Adiposity could also influence blood pressure [9,10] that was excluded as there were no significant differences in weight, height, and body mass index between euthyroid and hypothyroid patients in our study.

In subjects over 50 years old, diastolic blood pressure of hypothyroid patients was significantly higher than that of euthyroid patients whose age-related change in blood pressure was similar to that of normal subjects. The finding suggests that the hypothyroid state accelerates the age-related increases in blood pressure. The prevalence of hypertension in the subjects over 50 years old is approximately 30% in our study.

The mechanism of increased blood pressure in hypothyroidism is not known; various mechanisms proposed are described below:

1. An acceleration of structural change of vascular tissue by thyroid hormone deficiency may be a local factor in causing a higher total peripheral resistance leading to hypertension.[11]
2. Alteration of autonomic nervous function by thyroid hormone deficiency could cause Increases in hemodynamic changes. plasma norepinephrine concentration, mainly due to increased secretion rate, rather than decreased metabolism of norepinephrine have been demonstrated in hypothyroid patients.[12] Further evidence in favour of the role of noradrenaline is provided by a report that plasma noradrenaline levels return to normal once euthyroidism (and normotension) has been restored by thyroxine therapy. [13]
3. Thyroid hormones are important for the synthesis and regulation of adrenergic receptors[14] and changes in the distribution of these receptors could contribute to the development of hypertension in hypothyroid patients. The increase in α-adrenergic receptor responsiveness may account for the increase in peripheral vascular resistance leading to hypertension (confirmed by rat experiment).[15]
4. Several reported studies an have association and low consistently between hypothyroidism plasma aldosterone and renin activity levels.[16–18] Correction of hypothyroidism results in a normalisation and of aldosterone concentration plasma renin activity.[17]

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

5. There is an increase in total body water in hypothyroidism, but a relative decrease in intravascular volume and hyponatraemia (yet increased total body sodium) frequently occurs. Thyroid hormones usually suppress ADH by a central mechanism possibly due to a receptor or post-receptor defect.[19]
6. High serum prolactin and TSH concentration, seen in patients with hypothyroidism, system [20,21] suggest a reduced dopaminergic activity in central nervous that could contribute to the development of hypertension by enhancing norepinephrine release.[22]
7. Thyroid hormones may also alter red blood cell sodium content and transport.[23] This is achieved partly by altering the lithium–sodium (Li–Na) counter transport mechanism, which also has functional importance in regulating sodium transport in vascular smooth muscle and in the kidney. Essential hypertension is associated with increased red blood cell Li–Na countertransport.[24]
8. The brain is an important site of thyroxine metabolism.[25] and triiodothyronine The precise mechanism by which thyroid hormones may cause hypertension centrally has yet to be shown, but administration of thyroxine intrathecally in rats has demonstrated that thyroid hormones within the brain are involved in the regulation of peripheral autonomic nervous system .[26]

To summarize, hypertension that accompanies hypothyroidism is likely to have a multifactorial etiology, like alteration of autonomic nervous function, acceleration of structural change of vascular tissue, low plasma aldosterone and renin activity levels, changes in total body water and sodium transport and and central nervous system effects all playing a part.

In a study by Bjorn O Asvolt , Trine Bjorn, Tom I.L. Nilsen and Laras J. Vtten in 1995-97 in Norway on on 30,728 subjects found that within a reference range of TSH there was a linear positive association between TSH and blood pressure that may long term implicate for cardiovascular health.[27] In one other study, the number of patient under the age of 40 years required no additional anti-hypertensive therapy once euthyroidism had been restored, in contrast to 50% in the age group 40–49 years, to 75% in 50–59 year olds and to 100% in 60–69 year olds.

Conclusion

Hypertension is more often associated with hypothyroidism than euthyroidism in patients over 50 years . Diastolic blood pressure of hypothyroid patients was significantly higher than that of euthyroid patients. Blood pressure is often reduced in response to adequate thyroid hormone replacement therapy.

Bibliography

1. Kaplan NM. Hypothyroidism //; Clinical Hypertension, edited by Kaplan NM Baltimore The Williams and Wilkins Company. 1978. p 362.
2. Strong CG. Northcutt RC. Sheps SG Clinical examination and investigation of the hypertensive patients In Hypertension, edited by Gcnest J. Koiw E. Kuchcl O. New York McGrawHill Book Company. 1977. p 659.
3. Skelton CL. Sonnenblick EH. Hypothyroidism. cardiovascular system. In The Thyroid, edited by Werner SC. Ingbar SH Hagerstown: Harper and Row. 1977. p 659.
4. Endo T et al. Re-evaluation of a possible high incidence of hypertension in hypothyroid patients. Am Heart J 1979; 98: 684–688..
5. Saito I, Ito K, Saruta T. Hypothyroidism as a cause of Hypertension. Hypertension 1983; 5: 112–115.
6. Streeten DHP et al. Effects of thyroid function on blood pressure : recognition of hypothyroid hypertension. Hypertension 1988; 11: 78–83

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

7. Anderson GH Jr, Blakeman N, Streeten DHP. The effect of age on prevalence of secondary forms of hypertension in 4429 consecutively referred patients. J Hypertens s 1994; 12: 609–615.
8. Vanderpump MP et al. The incidence of thyroid disorders in the community: a twenty-year follow-up of the Whickham survey. Clin Endocrinol 1995; 43: 53– 68.
9. Chiang BN. Perlman LV. Epstein FH: Overweight and hypertension. A review. Circulation 39: 403, 1969. \
10. Johnson AL, Cornoni JC. Cassel JC, Tyroler HA. Hayden S. Hames CG Influence of race, sex and weight on blood pressure behavior in young adults Am J Cardiol 35: 523. 1975.
11. Guyton AC: The relationship of cardiac output and arterial pressure control Circulation 64: 1079. 1981.
12. Coulombe P, Dussault JH. Walker PPlasma catecholamine concentrations in hyperthyroidism and hypothyroidism Metabolism 25: 973. 1976.
13. Richards AM et al. Hypertension in hypothyroidism: arterial pressure and hormone relationships. Clin Exp Hypertens A 1985; 7: 1499–1514.
14. Fcek CM. Sawers JSA. Brown NS. Seth J. Irvine SW, Toft AD: Influence of thyroid status on dopaminergic inhibition of thyrotropin and prolactin secretion. Evidence for an additional feedback mechanism in the control of thyroid hormone secretion J Clin Endocrinol Metab 51: 585. 1980.
15. Snyder PJ, Jacobs LS. Utiger RD. Daughaday WH. Thyroid hormone inhibition of the prolactin response to thyrotropinrcleasing hormone. J Chn Invest 52: 2324, 1973.
16. Kolloch R. Kobayashi K, DeQuattro V Dopaminergic control of sympathetic tone and blood pressure Evidence in primary hypertension. Hypertension 2: 390, 1980.
17. Kohrle J, Brabant G, Hesch R-D. Metabolism of thyroid hormones. Horm Res 1987; 26: 58–78.
18. Williams RS, Lefkowitz RJ. Thyroid hormone regulation of a -adrenergic receptors: studies in the rat myocardium. J Cardiovasc Pharmacol 1979; 1: 181– 189.
19. Bing RF et al. Reversible hypertension and hypothyroidism . Clin Endocrinol 1980; 13: 339–342.
20. Elias AN, Kyaw T, Valenta LJ, Meshkinpour H. The renin-angiotensin system in hypothyroidism of short duration. Horm Metab Res 1986; 18: 349–3513.
21. Hauger-Klevene JH, Brown H, Zavaleta J. Plasma rennin activity in hyper and hypothyroidism: effect of adrenergic blocking agents. J Clin Endocrinol Metab 1972; 34: 625–629.
22. Cole CH, Waddell RW. Alteration in intracellular sodium concentration and ouabain-sensitive ATPase in erythrocytes from hyperthyroid patients. J Clin Endocrinol Metab 1976; 42: 1056–1063.
23. Canessa M et al. Increased sodiumlithium countertransport in red cells of patients with essential hypertension. N Engl J Med 1980; 302: 772–776.
24. Kaplan MM. The role of thyroid hormone deiodination in the regulation of hypothalamo-pituitary function. Neuroendocrinology 1984; 38: 254–260.
25. Dratman MB, Goldman M, Crutchfield FL, Gordon TJ Nervous system role of iodocompounds in blood pressure regulation. Life Sci 1982; 30: 611–619.
26. Moses AM, Schieinman SJ. The kidneys and electrolyte metabolism in hypothyroidism. In: Braverman LE, Utiger RD (eds), Werner and Ingbar's The Thyroid: a Fundamental and Clinical Text. 7th Edition. Philadelphia, 1996, pp 812–815.
27. Asvolt B O, Bjorn T, Nilsen T and Vatten LJ The Journal of Clinical Endocrinology & Metabolism, Volume 92, Issue 3, 1 March 2007, Pages 841– 845.