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Original Article

Correlation between Hypothyroidism and Systemic Arterial Blood Pressure: A Case–Control Study

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Abstract

Background: Hypothyroidism has been known to be associated with changes in systemic arterial blood pressure. Diastolic blood pressure (DBP) is known to be elevated causing proportionate reduction in pulse pressure.

Aim: The aim of the study is to find out the correlation between systolic blood pressure (SBP), DBP, pulse pressure (PP), and mean arterial pressure of hypothyroid patients and normal individuals.

Materials and Methods: This case–control study was conducted in Government Rajaji Hospital attached to Madurai Medical College, Madurai. Twenty-five hypothyroid subjects were enrolled for the study (study group) from the department of endocrinology and metabolism. Twenty-five normal subjects who were age and sex matched with the study group were enrolled for the study (control group). Serum thyroid-stimulating hormone (TSH) levels were estimated in all the subjects. Arterial blood pressure was recorded in all the subjects in the sitting posture and the results obtained. The results are tabulated and analyzed by applying unpaired "*t*" test.

Results and Conclusion: Among the blood pressure parameters, only PP showed a positive correlation between the study group and control group. SBP, DBP, and mean arterial blood pressure showed no significance.

Keywords: Diastolic blood pressure, Hypothyroidism, Mean arterial pressure, Pulse pressure, Serum thyroid-stimulating hormone level, Systolic blood pressure

INTRODUCTION

The prevalence of hypothyroidism is between 4% and 10% of the population.[1] Hypothyroidism is diagnosed when low levels of the thyroid hormones result in elevated levels of thyroid-stimulating hormone (TSH).[2] Arterial hypertension is known to be frequently associated with thyroid dysfunction, with a particularly high prevalence in chronic hypothyroidism.[3] Hypertension may be the initial clinical presentation for at least 15 endocrine disorders,[4] including overt and subclinical hyperthyroidism and hypothyroidism. Subclinical hypothyroidism has also been associated with arterial hypertension, mostly diastolic,[5-7] as well as with atherosclerosis[8,9] and coronary heart disease[10,11] in both sexes. Thyroid hormones play an important role in the normal function of heart and vascular physiology and hypothyroidism produces profound cardiovascular effects. It alters diastolic blood pressure (DBP) more than normal level and as a result of which pulse pressure (PP) is narrowed in an individual. This study tries to clarify this fact.

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Aims and Objectives

This aim of the study was to estimate serum TSH level and to measure the arterial blood pressure in the arm using mercurial sphygmomanometer in both the study and control population. Correlation was made between hypothyroid subjects and normal individuals in terms of systolic blood pressure (SBP), DBP, PP, and mean arterial pressure to find out statistical significance.

MATERIALS AND METHODS

This study was done in the Institute of Physiology, Madurai Medical College, Madurai, in association with the Department of Endocrinology and Metabolism,

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Government Rajaji Hospital attached to the Madurai Medical College.

The study group consists of 25 subjects who were newly diagnosed hypothyroid subjects in the age group of 20–40 years, of which 20 were female and 5 were male, who were free from any other diseases and disorders known to affect systemic arterial blood pressure. The control group consists of 25 subjects who were age- and sex-matched normal and euthyroid individuals. Written consent was obtained from the subjects before procedures.

Inclusion Criteria

Normal healthy adults in the age group of 20–40 years willing to participate in our study had been included in the study.

Newly diagnosed hypothyroidism patients based on clinical diagnosis and laboratory confirmation in the age group of 20–40 years willing to participate in our study had been enrolled.

Exclusion Criteria

Subjects with any history of thyroid illness or those were on treatment for thyroid illness had been excluded.

Any patient with chronic liver disease, chronic renal disease (CRD), pregnancy, or taking any drug altering serum TSH levels (octreotide, somatostatin, opiates, dopamine, glucocorticoids, growth hormone, L-dopa, bromocriptine, pimozide, phentolamine, thioridazine, methysergide, cyproheptadine, iodine, dopamine antagonists, and amiodarone) have been excluded.[5]

Patients having disorders known to affect blood pressure were excluded from the study.

Estimation of T3, T4, and TSH

Serum levels of TSH, total circulating T4, and total circulating T3 are measured by radioimmunoassay. Radioimmunoassay technique is a type of antibody-based competitive immunoassay.

Blood Pressure Measurement

Arterial blood pressure was recorded using mercurial sphygmomanometer and stethoscope. The individual was seated in a chair with back support and arm support. BP cuff was tied in the left arm and kept at the heart level and then recording was done. When the BP was taken, the cuff was inflated to a pressure approximately 30 mmHg greater than systolic, as estimated from the disappearance of the pulse in the brachial artery by palpation. Initial estimation of the systolic pressure by palpation avoids potential problems with an auscultatory gap. Korotkoff sounds transiently disappear as the cuff is deflated. Once the cuff is adequately inflated, the following steps were followed:

The stethoscope was placed lightly over the brachial artery, since the use of excessive pressure can increase turbulence and delay the disappearance of sound. The net effect may be that the diastolic pressure reading may be artifactually reduced by up to 10–15 mmHg.[12]

The BP was taken with patient's arm supported at the level of the heart. Allowing the arm to hang down when the patient is sitting or standing, will result in the brachial artery being 15 cm below the heart. As a result, the measured BP will be elevated by 10–15 mmHg due to the added hydrostatic pressure induced by gravity.[13]

The cuff was deflated slowly at the rate of 2–3 mmHg/heartbeat. The systolic pressure was equal to the pressure at which the brachial pulse can first be palpated as blood flow gets restored through the previously compressed vessel; the systolic pressure is also equal to the pressure at which the pulse is first heard by auscultation. Then, disappearance of sounds was taken as DBP value. The value was recorded close to the nearest 2 mmHg graduation in the manometer scale.

The BP was measured initially in both arms. If there was a disparity due to a unilateral arterial lesion, the arm with higher pressure was used for measurement.

The BP was taken at least twice, with the measurements separated by 1 or 2 min to allow the release of trapped blood. If the second value varied more than 5 mmHg from the first, continued measurements were made until a stable value was attained. The recorded value on patients chart was the average of the last two measurements.[14]

Calculation of PP: PP =SBP–DBP

Calculation of mean arterial pressure: Mean arterial pressure (MAP) = DBP + 1/3 PP

Observation

Statistical analysis was done by applying unpaired "*t*" test using SPSS software version 16.0.
The following are the results for SBP [Table 1].
The following are the results for DBP [Table 2].
The following are the results for PP [Table 3].
The following are the results for mean arterial pressure [Table 4].

DISCUSSION

Nitric oxide (NO) is an endothelium-derived relaxing factor, which is critical for cardiovascular homeostasis.[15-17] Various

hormones, including thyroid hormones,[18-22] regulate the activity of nitric oxide synthase and NO production, while altered NO level is associated with thyroid dysfunction.[23,24]

Ittermann *et al.*[25] did a study involving more than 10,000 children and adolescents found a positive correlation betw een elevated serum TSH levels and both systolic and DBP; however, this correlation was not established with hypertension as shown in Table 1. In our study, the mean value of SBP of the study group is 110.40, whereas the value of the control group is 112.00. Moreover, "*P*" value after applying unpaired "*t*" test and its results show that 0.4846 is more than 0.05. Hence, no statistical significance is present.

Table 1: Comparison of systolic blood pressure

Statistical parameters	Group 1 (study group)	Group 2 (control group)
Mean	110.40	112.00
SD	8.41	7.64
SEM	1.68	1.53
N	25	25

SD: Standard deviation, SEM: Standard error of mean, N: Numbers, Intermediate values used in calculations: t=0.7044, df=48. Standard error of difference = 2.272. 95% confidence interval of this difference in mean = from –6.17 to 2.97. "*P*" value = 0.4846

Table 2: Comparison of diastolic blood pressure

Statistical parameter	Group 1 (study group)	Group 2 (control group)
Mean	74.80	72.80
SD	6.53	4.58
SEM	1.31	0.92
N	25	25

95% confidence interval of this difference in Mean = from – 1.21 to 5.21. Intermediate values used in calculations: t=1.2533, df=48. Standard error of difference = 1.596. "*P*" value = 0.2162

Table 3: Comparison of pulse pressure

Statistical parameter	Group 1 (study group)	Group 2 (control group)
Mean	35.60	39.20
SD	7.12	4.93
SEM	1.42	0.99
N	25	25

95% confidence interval of this difference in mean = from –7.08 to –0.12. Intermediate values used in calculations: T=2.0785, df=48. Standard error of difference = 1.732. "*P*" value = 0.0430

Table 4: Comparison of mean arterial pressure

Statistical parameter	Group 1 (study group)	Group 2 (control group)
Mean	86.66	85.86
SD	6.38	5.29
SEM	1.27	1.05
N	25	25

95% confidence interval of this difference in mean = from –2.53 to 4.13. Intermediate values used in calculations: *t*=0.4829, df=48. Standard error of difference = 1.658. "*P*" value = 0.6314

Udovcic *et al.* showed that in hypothyroid state, DBP increases and PP narrows.[1]

A study by Berta *et al.* showed that elevated DBP is present in ~30% of patients with overt hypothyroidism. Cardiac contractility and output decrease leading to a narrowed PP as shown in Table 2.[26] In our study, the mean value of DBP of Group 1 (or) study group is 74.80, whereas the value of Group 2 (or) control group is 72.80. Moreover, "*P*" value after applying unpaired "*t*" test and its result shows that 0.2162 is more than 0.05 and hence no statistical significance is present.

As shown in Table 3 the mean value of PP of the study group is 35.60, whereas the value of the control group is 39.20. Moreover, "*P*" value after applying unpaired "*t*" test and its results show that 0.0430 is <0.05 and hence statistical significance is present. This is in accordance with the study done by Udovcic *et al.*[1]

As shown in Table 4 the mean value of mean arterial pressure of the study group is 86.66, whereas the value of the control group is 85.86. Moreover, "*P*" value after applying unpaired "*t*" test and its results show that 0.6314 is more than 0.05. Hence, statistical significance is not present.

CONCLUSION

In our study, we found out that there was no statistical significance between normal individuals and hypothyroid patients when comparing SBP, DBP, and mean blood pressure. However, PP was found to be narrowed in hypothyroid patients compared to normal individuals. However, the sample size is minimal, and hence, an elaborate study is needed to further strengthen our findings.

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