

Thyroid dysfunction and risk to coronary heart disease based on serum cholesterol level: A laboratory based study in Kathmandu, Nepal

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Abstract

Thyroid dysfunction is one of the major global public health problems. It arises from the abnormalities in the synthesis, storage or release of thyroid hormone. Fluctuations in the level of thyroid hormone on certain molecular pathways in the heart and vasculature causes relevant cardiovascular derangements. Hence, the aim of this study was to explore the prevalence of thyroid dysfunction and risk to coronary heart disease based on serum cholesterol level among suspected cases. A laboratory based cross sectional study was carried out (n=80, male=23, female=57) in Kathmandu Model Hospital, Nepal during January to April 2010. Blood samples were collected after taking the consent of participants and analyzed for FT₃, FT₄, TSH, and total cholesterol. Data were analyzed using SPSS version 13.0 applying appropriate statistical tools. The median age of the participants was 51 years (range 25-75 years). About 7.5 % (6/80) comprised of hypothyroidism, 38.75% (31/80) subclinical hypothyroidism and 11.25% (9/80) subclinical hyperthyroidism. The mean value of serum levels of FT₃, FT₄ and TSH were determined to be 1.51±0.67pg/ml, 2.23±1.04pg/ml and 20±3.98 µIU/ml respectively in hypothyroid patients followed by subclinical hypothyroidism; 3.0±0.87pg/ml, 12.43±2.60pg/ml & 8.39±2.07µIU/ml), subclinical hyperthyroidism; 3.96±1.31pg/ml, 15.73±0.81pg/ml & 0.15±0.09 µIU/ml), hyperthyroidism; 26 pg/ml, 40 pg/ml and 0.01 µIU/ml and euthyroid; 2.73±0.87 pg/ml, 12.19±2.8 pg/ml & 2.77±1.03 µ IU/ml. There was strong positive correlation with TSH Vs SCL among subclinical hypothyroidism (r=0.88). Nearly three-fifth of the participants were found to be suffered from different thyroid dysfunctions. About 7.5% comprised hypothyroidism, 11.25% subclinical hyperthyroidism and 38.75% subclinical hypothyroidism. Awareness on modification of sedentary life style and frequent medical examination with thyroid function tests will support to reduce the risk of CHD.

Key words : Coronary heart disease, hyperthyroidism, hypothyroidism, risk, serum cholesterol level, thyroid dysfunction

INTRODUCTION

Thyroid dysfunction is one of the major global public health problems including Nepal. It is quite common in general population and this disturbance of normal functioning of thyroid gland occurs more frequent in the elderly age.^[1] It arises from the abnormalities in the synthesis, storage or release of thyroid hormone. Thyroid hormones influence all aspects of lipid metabolism including synthesis, mobilization, and degradation as well as some cardiovascular disease (CVD) risk factors, thus influencing overall CVD risk.^[2-5] Increased or reduced action of thyroid hormone on certain molecular pathways in the heart and vasculature cause relevant cardiovascular derangements. Subclinical hypothyroidism (SHT) is an elevated Thyroid Stimulating Hormone (TSH) with normal thyroid hormones (FT₃, & FT₄). Overt hyperthyroidism and hypothyroidism is the established risk factor for CVD but the relation between SHT and hypercholesterolemia related to cardiovascular risk is still controversial^[6-7] The main purpose of the study was to identify the prevalence of thyroid dysfunction and risk to CHD based on serum level of Cholesterol among the patient attending in the Kathmandu model hospital.

MATERIAL AND METHODS

This is the laboratory based cross sectional study which was conducted in the department of clinical biochemistry, Kathmandu Model Hospital (KMH), during January to April 2010. The study was approved by the institutional review board of Purbanchal University, Nepal. All the 80 suspected patients of thyroid disorder attending in the KMH and referred by the general

physician during the study period were selected as participants. Prior verbal consent was taken from the participants before drawing the blood sample. All the 80 samples collected from suspected patients during the period were analyzed for FT₃, FT₄, TSH, and total cholesterol. Serum level of FT₃, FT₄ and TSH were determined by enzyme immunoassay technique and using serozyme photometer and total cholesterol was measured by CHOD-PAP method using human diagnostic kit in automated analyzer. Reference ranges according to the manufacturer were 1.1 to 4.1 pg/ml, 6.6-17.1 pg/ml and 0.6 to 4.3µIU/ml, respectively for FT₃, FT₄, and TSH.^[8] Different thyroid dysfunctions were categorized as; hypothyroidism, subclinical hypothyroidism, subclinical hyperthyroidism, hyperthyroidism with comparing to the normal reference value of thyroid hormone level. The reference level of cholesterol in different sex and age group was compared with the value provided by National Cholesterol Program (NCEP). Data were analyzed by using computer based software SPSS version 13.0 applying appropriate statistical tools (Percentage, mean, median and standard deviation). Correlation of thyroid dysfunctions with serum lipid level was measured by the value of correlation coefficient (r).

RESULTS

Age and sex wise distribution of the Participants

All together Eighty patients (n=80) were included in the study with median age 51 years (range 25-75 years). Twenty three patients (28.75%) were male and 57 (71.25%) patients were female. Study of the frequency revealed that the patients of the age group ranging from 45-55 (42.5%) years were most frequent to

check thyroid dysfunction and least (5%) were in the age group of 65 and more. Similarly among the male most frequent cases (39.13%) were seen in the age group of 45-54 years which is proportionately fewer than the female (43.84%) of same age group. Furthermore among the least cases of age group above 65 years, 4.35% were male and 5.26% were female (Table: 1).

Prevalence of Thyroid dysfunction in different age group of the patients

Out of 80 patients, 7.5% (6/80) comprised of hypothyroidism, 38.75% (31/80) comprised of subclinical hypothyroidism and about 11.25% (9/80) comprised of subclinical hyperthyroidism. One out of eighty (1.25%) patients was found to be affected by hyperthyroidism whereas 41.25% (33/80) were found as euthyroid patients. All the patients with hypothyroidism were more than 50 years of age (range; 55-64). Sub clinical hypothyroidism was most frequently seen in 45-55 years whereas only one patient with hyperthyroidism was the age of 37 years, (Table: 2)

Biochemical findings of different clinical condition of Thyroidism

In hypothyroid patients the mean \pm SD values of serum levels of FT₃, FT₄ and TSH were determined to be 1.51 \pm 0.67pg/ml, 2.23 \pm 1.04pg/ml and 20 \pm 3.98 μ IU/ml respectively. Similarly serum level of FT₃, FT₄ and TSH in other clinical conditions were found as subclinical hypothyroidism (3.0 \pm 0.87 pg/ml, 12.43 \pm 2.60pg/ml and 8.39 \pm 2.07 μ IU/ml), subclinical hyperthyroidism (3.96 \pm 1.31pg/ml, 15.73 \pm 0.81pg/ml and

0.15 \pm 0.09 μ IU/ml), hyperthyroidism (26 pg/ml, 40 pg/ml and 0.01 μ IU/ml) and euthyroid (2.73 \pm 0.87 pg/ml, 12.19 \pm 2.8 pg/ml and 2.77 \pm 1.03 μ IU/ml); (Table: 3).

Serum cholesterol level in different clinical conditions

Out of six hypothyroid patients, hypercholesterolemia (Mean \pm SD: 365 \pm 57.59) was seen in all cases having high risk (>240 mg/dl) of coronary heart disease. As comparing to the reference value of cholesterol level according to sex and age variations, the elevated level of cholesterol above the upper reference limit was found in 83.33% of hypothyroid patient. All of them had serum TSH above 15 μ IU/ml and FT₄ below 3.2 pg/ml; (Table:3). Similarly hypercholesterolemia (Mean \pm SD: 231 \pm 54 mg/dl) was seen in 38.0% of the patient with subclinical hypothyroidism. The average increase of serum cholesterol above 95th percentile was found in 9.75% of the patients. About 51.61% of the patients were found with the normal serum level of cholesterol. In an average, 3.54 % decrease in cholesterol level below lower reference limit (according to sex and age variation) was observed in patient with subclinical hypothyroidism who were under thyroid hormone medication for 5-8 months. Likewise 8.25% of euthyroid patients were also found to be risk of CHD; (Table: 4).

Correlation of thyroid hormones with Serum Cholesterol Level (SCL)

The study showed that the negative correlation between FT₃ and cholesterol level among hypothyroid patients ($r=-0.75$) and subclinical hypothyroid patient ($r=-0.36$) where as there was positive correlation found among subclinical hyperthyroid

Table 1. Age and sex wise distribution of the Participants (N=80)

Age wise distribution	Count		
	Male; (N, %)	Female; (N, %)	Total (N, %)
25-34	3 (13.04)	7(12.28)	10 (12.5)
35-44	8(34.78)	16(28.07)	24(30.0)
45-54	9(39.13)	25(43.86)	34(42.5)
55-64	2(8.70)	6(10.53)	8(10.0)
65 ⁺	1(4.35)	3(5.26)	4(5.0)
Total	23(28.75)	57(71.25)	80(100.0)

Table 2. Prevalence of Thyroid dysfunction in different age group of the patients

Clinical condition	Age distribution					Total
	25-34	35-44	45-54	55-64	65 and +	
Hypothyroidism	0 (0.00)	0 (0.00)	1 (16.66)	4 (66.66)	1 (16.66)	6 (100.00)
Subclinical Hypothyroidism	3(9.67)	8(25.80)	20(64.52)	0(0.00)	0(0.00)	31(100.00)
Subclinical Hyperthyroidism	2(22.22)	6(66.66)	1(11.11)	0(0.00)	0(0.00)	9(100.00)
Hyperthyroidism	0(0.00)	1(100.00)	0(0.00)	0(0.00)	0(0.00)	1(100.00)
Euthyroid	5(15.15)	9(27.27)	12(36.36)	4(12.12)	3(9.09)	33(100.00)
Total	10(12.50)	24(30.00)	34(42.50)	8(10.00)	4(5.00)	80 (100.00)

Table 3. Biochemical findings of different clinical condition of thyroidism

Clinical condition	Findings of Biochemical parameters					
	FT ₃ value		FT ₄ value		TSH value	
	Range Pg/ml	Mean± SD	Range Pg/ml	Mean value ± SD	Range μIU/Ml	Mean value ± SD
Hypothyroidism	0.7-2.4	1.51±0.67	0.8-3.3	2.23±1.04	14.8-25.0	20±3.98
Subclinical Hypothyroidism	1.1-4.5	3.0±0.87	7.3-16.2	12.43±2.60	4.7-11.0	8.39±2.07
Subclinical Hyperthyroidism	2.4-5.5	3.96±1.31	14.6-17.0	15.73±0.81	0.06-0.3	0.15±0.09
Hyperthyroidism	--	26±0.00	--	40±00	--	0.01±0.00
Euthyroid	1.1-4.1	2.73±0.87	6.6-17.1	12.19±2.8	0.6-4.3	2.77±1.03

Table 4. Measurement of cholesterol level in different clinical condition

Clinical condition	No. of cases	Serum cholesterol level		Risk of CHD	
		Range (mg/dl)	Mean value±SD	High	Low
Hypothyroidism	6	253- 416	365±57.59	6 (100.00)	0(0.00)
Subclinical Hypothyroidism	31	146-318	231±54	11(33.70)	20(67.3)
Subclinical Hyperthyroidism	9	122-256	205±57.11	2 (22.22)	7(77.78)
Hyperthyroidism	1	--	131	0 (0.00)	1 (100.00)
Euthyroid	33	158-280	231±27.5	3 (8.25)	30 (91.75)

Table 5. Correlation of thyroid hormones with blood cholesterol at different condition of thyroidism

Clinical condition	Correlation coefficient (r)		
	FT ₃ & Cholesterol	FT ₄ & Cholesterol	TSH & Cholesterol
Hypothyroidism	-0.75	-0.60	-0.75
Subclinical Hypothyroidism	-0.36	-0.82	0.88
Subclinical Hyperthyroidism	0.12	0.72	0.71
Hyperthyroidism	--	--	--
Euthyroid	0.20	0.05	0.10

patients ($r=0.12$) and euthyroid patients ($r=0.20$). Similarly it was found to be the negative correlation of FT₄ and cholesterol level among hypothyroid patients ($r=-0.60$) and subclinical hypothyroidism patient ($r=-0.82$) where as there was positive correlation found among subclinical hyperthyroid patients ($r=0.72$) and euthyroid patients ($r=0.05$). Furthermore the study revealed that the negative correlation of TSH and cholesterol level among hypothyroidism patients ($r=-0.75$) whereas it showed the positive correlation with TSH and cholesterol level

with the patients of subclinical hypothyroid patient ($r=0.88$), subclinical hyperthyroidism ($r=0.71$) and Euthyroid patients ($r=0.10$).

DISCUSSION

Nearly three-fifth of the total suspected cases were found to be affected by the different types of thyroid dysfunctions comprising the most prevalent with subclinical hypothyroidism (nearly two-fifth) and least (One out of eighty) with hyperthyroidism in this

study, which was nearly two times more than the study finding reported from Kathmandu University, Dhulikhel hospital^[9]. The difference might be due to the process of selecting the cases. Our study revealed that the most frequent cases of hypothyroidism were above the age of 50 years and females were most common than male which was in line with some study from USA^[10-11].

This study showed the mean \pm SD values of serum levels of FT₃, FT₄ and TSH in hypothyroid patients were determined to be 1.51 \pm 0.67pg/ml, 2.23 \pm 1.04pg/ml and 20 \pm 3.98 μ IU/ml respectively. Similarly in other clinical conditions the different serum level was found as; subclinical hypothyroidism (3.0 \pm 0.87 pg/ml, 12.43 \pm 2.60pg/ml and 8.39 \pm 2.07 μ IU/ml), subclinical hyperthyroidism (3.96 \pm 1.31pg/ml, 15.73 \pm 0.81pg/ml and 0.15 \pm 0.09 μ IU/ml), hyperthyroidism (26 pg/ml, 40 pg/ml and 0.01 μ IU/ml) and euthyroid (2.73 \pm 0.87 pg/ml, 12.19 \pm 2.8 pg/ml and 2.77 \pm 1.03 μ IU/ml). This finding was somehow matched with the study from Kathmandu University, Nepal^[9].

Regarding to risk of CHD, all the hypothyroid patients were found in hypercholesterolemic (Mean \pm SD: 365 \pm 57.59) condition and vulnerable to the high risk (>240 mg/dl) of CHD. Similarly, nearly two-fifth of the patients with subclinical hypothyroidism were found to be in hypercholesterolemic (Mean \pm SD: 231 \pm 54 mg/dl) condition. The average increase of serum cholesterol above 95th percentile was found in 9.75% of the patients. About 51.61% of these patients were found with the normal serum level of cholesterol. In an average of 3.54 % decrease in cholesterol level below lower reference limit (according to sex and age variation) was observed in patient with subclinical hypothyroidism. Meanwhile 8.25% of euthyroid patients were also found to be at risk of CHD. Similar study conducted in Sudan showed the level of serum cholesterol; hypothyroidism (163 \pm 6mg/dl) and hyperthyroidism (152.0 \pm 11.5mg/dl) which was lower than our study findings.^[12]

The study prevailed the strong positive correlation of FT₄ Vs. SCL among subclinical hyperthyroidism (r=0.72) and THS Vs. SCL among subclinical hypothyroidism (r=0.88) and subclinical hyperthyroidism (r=0.71). It was slightly positive correlation of TF₃ Vs. SCL in subclinical hyperthyroid patients (r=0.12) and euthyroid patients (r=0.20), TF₄ Vs. SCL with euthyroid patients (r=0.05) and THS Vs. SCL with euthyroid patients (r=0.10). In another hand, it was found the strong inverse correlation of TF₄ Vs. SCL with subclinical hypothyroidism patient (r=-0.82), TF₃ Vs. SCL in hypothyroid patients (r=-0.75) and THS Vs. SCL hypothyroid patients (r=-0.75). This finding was supported by the similar study from Kathmandu University^[9].

CONCLUSION

Nearly three-fifth of the suspected patients had suffered from different types of thyroid dysfunctions. The most frequent dysfunction was seen among the age group of 45-55 years. Nearly one out of every ten patients comprised of hypothyroidism and subclinical hyperthyroidism whereas two out of five comprised of subclinical hypothyroidism. More than half of the patients were found with the normal serum level of cholesterol and one out of every ten patients of euthyroid condition was also found to be at risk of CHD. There was moderately reverse correlation of FT₄ Vs serum cholesterol level (SCL) among subclinical hyperthyroidism (r= -0.72) and strong positive correlation with TSH Vs SCL among subclinical hypothyroidism (r=0.88). Awareness on modification of sedentary life style and frequent medical examination with thyroid dysfunctions tests will support

to reduce the risk of CHD.

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