Association of metabolic syndrome and its components with thyroid dysfunction in females

S. Shrestha, B. K. L. Das, N. Baral, L. Chandra*

Department of Biochemistry, B. P. Koirala Institute of Health Sciences, Dharan, Nepal, *Maulana Azad Medical College, New Delhi, India

The metabolic syndrome and thyroid dysfunction are commonly associated with type 2 diabetes mellitus and cardiovascular diseases. **AIMS:** 1. To find out the status of metabolic syndrome in females being investigated for thyroid dysfunction. 2. To find out the association of metabolic syndrome and its components with thyroid dysfunction. **METHODOLOGY:** Study was conducted at the Thyroid Clinical Laboratory at B. P. Koirala Institute of Health Sciences, Dharan, Nepal. It was a hospital-based, cross-sectional study. One hundred females subjected to thyroid function tests (fT_3, fT_4 and TSH) were included in this study with their consent. A detailed history was taken and clinical examination done, followed by anthropometric measurement of height, weight, waist circumference and blood pressure. Fasting blood glucose, triglycerides and HDL-C were estimated in all subjects. **STATISTICAL ANALYSIS:** Data was expressed as mean ± standard deviation and analyzed by using one-way ANOVA followed by Student's 't' test. **RESULTS:** The prevalence of metabolic syndrome was 32%, more in euthyroid group (21/48) than hyperthyroid group (5/24) and hypothyroid group (6/28). Age-specific metabolic syndrome was statistically significant ($P < 0.01$). Diastolic blood pressure, waist circumference, triglycerides and HDL-C were statistically significant within and between the metabolic syndrome and thyroid dysfunction groups. **CONCLUSION:** The thyroid dysfunction may be protective for the development of metabolic syndrome.

KEY WORDS: Euthyroid, hyperthyroid, hypothyroid, metabolic syndrome

Correspondence to **Dr. Lal Chandra,** Department of Biochemistry, B. P. Koirala Institute of Health Sciences, Dharan, Nepal.
E-mail: lchandra70@yahoo.com

Nepal is an endemic area with respect to iodine deficiency. Thyroid dysfunction, along with a higher average prevalence of goiter, is a major public health problem among the local population and a matter of national concern. The prevalence of hyperthyroidism and hypothyroidism was reported to be 13.68 and 17.19% respectively. The majority of thyroid dysfunctions were seen in the 21-40 years age group.[1] Thyroid has ubiquitous effects and influences the function of most organs. Thyroid hormones markedly stimulate the basic metabolic rate and the metabolism of carbohydrate, lipids and proteins. This hormone appears to serve as a general pacemaker accelerating metabolic processes and may be associated with metabolic syndrome.[2]

The metabolic syndrome is a cluster of metabolic abnormalities wherein people are obese and have hypertension, high triglyceride level, low high-density lipoprotein cholesterol (HDL-C) and abnormal fasting glucose levels. People with metabolic syndrome are at high risk for developing cardiovascular disease and type 2 diabetes mellitus. Hyperthyroidism is usually associated with low cholesterol and glucose intolerance; whereas hypothyroidism is associated with high cholesterol tendency, and patients are prone to weight gain and cardiac signs like bradycardia. These metabolic disorders associate them with cardiovascular diseases and other abnormalities like diabetes mellitus. There is limited information available in literature regarding status of metabolic syndrome in thyroid diseases. Therefore, the association of metabolic syndrome with thyroid dysfunctions was evaluated in this study.

Methodology

The patients (n = 100) referred for thyroid function tests,

Presented: Annual Scientific Session, B. P. Koirala Institute of Health Sciences, Dharan, Nepal, on 12th September 2005.

visiting Thyroid Clinical Laboratory in the Department of Biochemistry, were included in this study, with their consent. Detailed history, symptoms and signs, history of medication and anthropometric measurements like height, weight, waist circumference of all subjects were noted in a semi-structured pro forma. The thyroid hormone assays (fT_3, fT_4 and TSH) were done using ELISA; and fasting blood sugar, triglycerides and HDL-C were done enzymatically on Vitalab Selectra-MERCK Clinical Chemistry Analyzer.

Statistical analysis

Data was expressed as mean ± standard deviation and was analyzed by using one-way ANOVA followed by Student's 't' test.

Results

All subjects were grouped as 'euthyroid,' 'hyperthyroid' and 'hypothyroid' on the basis of estimation of fT_3, fT_4 and TSH levels in serum; and the diagnosis of metabolic syndrome was made according to National Cholesterol Education Program (NCEP) Adult Treatment Panel III.[3] The number of cases falling in euthyroid, hyperthyroid and hypothyroid groups were 48, 28 and 24 respectively. The association of metabolic syndrome was observed in 21, 6 and 7 cases in euthyroid, hyperthyroid and hypothyroid groups respectively. Collectively, 32 cases (32%) had metabolic syndrome and 68 cases were in the nonmetabolic syndrome group.

The age-specific distribution of metabolic syndrome in euthyroid, hyperthyroid and hypothyroid groups was 49.19 ± 8.53, 39.64 ± 10.15 and 38.17 ± 12.21 years respectively and is statistically significant ($P < 0.01$).

The distribution of components of metabolic syndrome in euthyroid, hyperthyroid and hypothyroid groups is shown in Table 1. The data analysis shows that diastolic blood pressure, waist circumference, triglycerides and HDL-C were statistically significant within and between the euthyroid, hyperthyroid and hypothyroid groups having metabolic syndrome and the group not having metabolic syndrome ($P < 0.01$).

Discussion

Metabolic syndrome is one of the major public health issues of this century. This is a constellation of physical condition and metabolic abnormalities commonly found in association, which increases individual risk for development of type 2 diabetes mellitus, cardiovascular diseases and its sequelae. The reported overall prevalence of metabolic syndrome in adults over the age of 20 years is 24%, but the age-specific rate increases rapidly.[4] In the present study, the prevalence of metabolic syndrome was 32%; and the age-specific distribution of metabolic syndrome in euthyroid, hyperthyroid and hypothyroid groups was 49.19 ± 8.53, 39.64 ± 10.15 and 38.17 ± 12.21 years respectively and it is highly significant statistically ($P < 0.01$). Thyroid dysfunction in the lower age group may be due to the symptoms and signs present in patients belonging to endemic area and being subjected to early thyroid function tests.

The results of the present study revealed a varied effect of thyroid status on the components of metabolic syndrome [Table 1], the diastolic blood pressure, waist circumference, triglycerides and HDL-C. The observed changes were statistically significant within and between the euthyroid, hyperthyroid and hypothyroid groups having metabolic syndrome and the group not having metabolic syndrome.

When compared within and between the groups, there were high serum triglyceride and low HDL-C levels in the hyperthyroid group, and low triglyceride and low HDL-C levels in the hypothyroid group in metabolic

Table 1: Components of metabolic syndrome with thyroid groups

	Euthyroid (n=48)		Hyperthyroid (n=28)		Hypothyroid (n=24)	
	NMS (n=27)	MS (n=21)	NMS (n=22)	MS (n=06)	NMS (n=19)	MS (n=05)
SBP	132.85 ± 16.10	139.76 ± 10.37	135.00 ± 26.32	140.00 ± 12.25	125.84 ± 18.24	135.40 ± 10.29
DBP	88.07 ± 12.52	96.19 ± 12.07*	87.27 ± 8.13	92.83 ± 9.58	84.42 ± 13.23	90.60 ± 6.99
WC	88.15 ± 8.68	94.24 ± 10.91*	88.14 ± 8.46	95.25 ± 14.01	84.76 ± 6.83	93.80 ± 5.02*
TG	122.81 ± 60.52	203.76 ± 80.01*	113.50 ± 57.96	256.50 ± 129.88*	118.89 ± 32.39	103.60 ± 43.63†‡
HDL	43.78 ± 13.68	39.14 ± 8.29	49.18 ± 14.15	31.17 ± 9.56*	44.00 ± 12.25	38.00 ± 8.46
FG	72.41 ± 16.53	79.52 ± 28.43	71.59 ± 12.24	76.83 ± 13.63	77.42 ± 25.14	84.20 ± 32.91

SBP = Systolic blood pressure (mmHg); DBP = Diastolic blood pressure (mmHg); WC = Waist circumference (cm); TG = Triglycerides (mg/dl); HDL = High-density lipoprotein-cholesterol (mg/dl); FG = Fasting blood glucose (mg/dl); NMS = Nonmetabolic syndrome; MS = Metabolic syndrome; *Significant when compared within groups; †Significant when compared with euthyroid MS group; ‡Significant when compared with hyperthyroid MS group

syndrome cases; although the HDL-C levels were closest to normal in the euthyroid group. The combination of deranged triglyceride and HDL-C levels is the hallmark of metabolic syndrome. This can be explained through the metabolic pathway. Thyroid hormone stimulates all aspects of lipid metabolism, including its synthesis, mobilization and degradation. Usually, degradation is affected more than synthesis in states of thyroid hormone excess. This results in a decrease in the stores of most lipids and, usually, an increase in their concentration in plasma. Hepatic synthesis of triglyceride is increased, probably as a result of the increased availability of free fatty acids and glycerol mobilized from adipose tissue. Within the metabolic syndrome cluster, there are several mechanisms through which one abnormality could favor the development of the other. Cholesterol ester transfer protein (CETP) transfers cholesterol from HDL to VLDL in exchange for triglyceride, and this results in fall of HDL-C.[5]

In the Chinese population, it has been observed that there is a twofold decrease in the odds ratio for metabolic syndrome with three or more metabolic features in the patients having higher circulating free thyroxine levels.[6] Similarly, the present study shows that hyperthyroidism is protective for the development of metabolic syndrome. Also, hypothyroid group shows protectiveness due to change in triglyceride levels; this is an important component of metabolic syndrome, although decreased lipolysis and increased deposition leads to increase in waist circumference in spite of being protective metabolically. The study concludes that a larger study will consolidate the observations made in the present study.

Acknowledgment

We sincerely acknowledge the contribution of Dr. G. K. Singh, Govt. of India Advisor to B. P. Koirala Institute of Health Sciences, Dharan, Nepal; and Dr. Anand Kumar, Professor and Head, Department of Surgery, B. P. Koirala Institute of Health Sciences, Dharan, Nepal.

References

1. Baral N, Lamsal M, Koner BC, Koirala S. Thyroid dysfunction in eastern Nepal. Southeast Asian J Trop Med Public Health 2002;33:638-41.
2. Dillmann WH. Mechanism of action of thyroid hormones. Med Clin North Am 1985;69:849.
3. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III). JAMA 2001;285:2486-97.
4. Ford ES, Giles WH Dietz WH. Prevalence of the metabolic syndrome among US adults: Findings from the third National Health and Nutrition Examination Survey. JAMA 2002;287:356-9.
5. Stakkestad JA, Bremer J. The outer carnitine palmitoyltransferase and regulation of fatty acid metabolism in rat liver in different thyroid states. Biochem Biophys Acta 1983;750:244-52.
6. Lin SY, Wang YY, Liu PH, Lai WA, Shew WH. Lower serum free thryoxine level are associated with metabolic syndrome in a Chinese population. Metabolism 2005;54:1524-8.

Source of Support: B. P. Koirala Institute of Health Sciences, Dharan, NEPAL, **Conflict of Interest:** None declared.