Clinical THYROIDOLOGY

AMERICAN THYROID ASSOCIATION
FOUNDED 1923

Thyroidal Secretion Is Increased in Cold-Exposed Populations

Andersen S, Kleinschmidt K, Hvingel B, Laurberg P. Thyroid hyperactivity with high thyroglobulin in serum despite sufficient iodine intake in chronic cold adaptation in an Arctic Inuit hunter population. Eur J Endocrinol 2012;166:433-40. Epub December 14, 2011.

SUMMARY

Background

It has recently been demonstrated that brown adipose tissue (BAT) can be activated by cold exposure (1, 2). The activation of this tissue depends on the sympathetic innervation as well as on the saturation of its nuclear T_3 receptors. BAT deiodinase type II activity plays a crucial part in this process by generating high local T_3 concentrations under sympathetic stimulation (3). Studies on U.S. Army personnel stationed in the Antarctic had previously indicated that in people exposed to a cold environment T_3 turnover and T_3 production are considerably enhanced, approximately 40%, and that serum thyroglobulin levels increase during their stay in the Antarctic. These findings point to an overall increase of thyroid activity (4, 5). The study reported here comes from Greenland where thyroid parameters of a local population exposed to a very cold climate were studied.

Methods and Results

The researchers studied a population of Inuits residing in eastern Greenland in remote settlements without modern comforts. These Inuits had been living in isolation until recently, and a large proportion of the them still earn their living by hunting at sea all year round. These subjects were compared with a population living in the capital in western Greenland, where many Danes live. The subjects were selected using the national civil registration system for the district of Ammassalik. The clinical examination of the subjects was performed by the authors. The selected individuals were between 50 and 69 years old. Thyroid hormones and thyroglobulin were measured in the serum, and iodine excretion was assessed in the urine. Besides finding increased thyroglobulin levels, the authors confirm a slightly lower FT_3, with no change in serum TSH in hunters and settlement dwellers. In this group of subjects, the iodine excretion was, if anything, slightly higher than in the residents of the capital, and it was considered to be largely sufficient. Therefore, iodine deficiency was not the cause of the increased thyroglobulin levels found in the residents of eastern Greenland. Other parameters, such as alcohol consumption and tobacco use, could also be excluded as critical factors in explaining the increased thyroglobulin levels. The increase was not large, but it was still highly significant. For Inuit hunters, the mean was 20.3 μg/L, for Inuit- nonhunters 17.2 μg /L, and for Caucasian men 13.9 μg/L. In the same samples, the differences in serum TSH were not significant, even though TSH was slightly lower in Inuit hunters.

Conclusions

The eastern Greenland population, which is largely of Inuit origin with all-year hunting as a traditional occupational activity, has slightly but significantly higher thyroglobulin levels than the more westernized population in the capital. There was no obvious explanation for this difference. Most importantly, insufficient iodine intake was excluded. Despite the absence of any significant change in serum TSH, there was a slight decrease of FT_3. However, this is not synonymous with a decreased T_3 production (see below). The authors conclude that the increased thyroglobulin levels are an indication of increased thyroid gland activity, consistent with an increased thyroid activity in the cold.

continued on next page

ANALYSIS AND COMMENTARY

It is interesting to compare the studies performed at the Antarctic base McMurdo, where American soldiers lived during the austral winter under highly protected camp conditions. Their exposure to extreme cold was not more than half an hour per day and was limited to the face. In Greenland, the climate is less cold but cold exposure was clearly more sustained. Both studies report increased serum thyroglobulin levels. In the Antarctic, kinetic studies were performed in addition. They indicated an increased volume of distribution and turnover of T_3, pointing to an increased T_3 production, despite a slight decrease of circulating FT_3 (6). These findings are also known as "polar T_3 syndrome." The kinetic data can be explained, for instance, by an increased production and turnover of T_3 in one or several organs. Since we now know that even in adult humans BAT and its deiodinase type II activity can be activated by cold exposure, it is tempting to speculate that this tissue may contribute to the observed changes in thyroid function. Thyroid hormones may also play a role in nonshivering thermogenesis of skeletal muscle. A caveat: So far it has been shown by positron-emission tomography (PET) scan that the activity of BAT disappears in western societies with age. Thus, in the age group studied in Greenland, the presence of BAT would have to be demonstrated (7). The clinical relevance is becoming evident if one realizes that BAT, at least in animals, can also be activated by excessive feeding of a favorite food (8). It could, therefore, play a role in obesity and insulin resistance. The future will show whether thyroid hormones are significant contributors to BAT activity.

— Albert G. Burger, MD

References

1. Nedergaard J, Bengtsson T, Cannon B. Unexpected evidence for active brown adipose tissue in adult humans. Am J Physiol Endocrinol Metab 2007;293:E444-52. Epub May 1, 2007.

2. van Marken Lichtenbelt WD, Vanhommerig JW, Smulders NM, Drossaerts JM, Kemerink GJ, Bouvy ND, Schrauwen P, Teule GJ. Cold-activated brown adipose tissue in healthy men. N Engl J Med 2009;360:1500-8.

3. Virtanen KA, Lidell ME, Orava J, Heglind M, Westergren R, Niemi T, Taittonen M, Laine J, Savisto NJ, Enerback S, Nuutila P. Functional brown adipose tissue in healthy adults. N Engl J Med 2009;360:1518-25. [Erratum, N Engl J Med 2009;361:1123.

4. Reed HL, Silverman ED, Shakir KM, Dons R, Burman KD, O'Brian JT. Changes in serum triiodothyronine (T_3) kinetics after prolonged Antarctic residence: the polar T_3 syndrome. J Clin Endocrinol Metab 1990;70:965-74.

5. Burger AG. Environment and thyroid function. J Clin Endocrinol Metab 2004;89:1526-8.

6. Do NV, Mino L, Merrian GR, LeMar H, Case HS, Palinkas LA, Reedy K, Reed HL. Elevation in serum thyroglobulin prolonged Antarctic residence: effect of thyroxine supplement in the polar 3,5,3′-triiodothyronine syndrome. J Clin Endocrinol Metab 2004;89:1529-33.

7. Ouellet V, Routhier-Labadie A, Bellemare W, Lakhal-Chaieb L, Turcotte E, Carpentier AC, Richard D. Outdoor temperature, age, sex, body mass index, and diabetic status determine the prevalence, mass, and glucose-uptake activity of 18F-FDG-detected BAT in humans. J Clin Endocrinol Metab 2011;96:192-9. Epub October 13, 2010.

8. Cannon B, Nedergaard J. Brown adipose tissue: function and physiological significance. Physiol Rev 2004;84:277-359.

Back to Contents