

Neck thermography in the differentiation between diffuse toxic goiter during methimazole treatment and normal thyroid

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A 49-year-old woman consulted her general practitioner for typical symptoms of hyperthyroidism. Thyroid function evaluation showed suppressed TSH and elevated FT4 plasma levels. Thyroid ultrasound described mild goiter, with patchy echostructure and a 18×6 mm isoechoic nodule at the lower pole of the left lobe, showing intranodular and peripheral vascularization. Treatment with methimazole 5 mg t.i.d. was started and after twenty days the patient required an endocrinological consultation at our Department. At admission patient history and physical examination were typical for Graves' disease. Nonetheless, although the TSH-receptor stimulating antibodies had not been evaluated yet, thyroid scintigraphy could have been of help to differentiate Graves' disease from toxic nodular goiter, an important distinction for further clinical procedures and treatment. Unfortunately thyroid scintigraphy was not indicated due to methimazole treatment.

Thus, we screened the patient's neck region using a handheld infrared thermal imaging camera (FLIR T450sc, FLIR Systems Inc.) and the neck region of a healthy woman as control. Digital infrared thermal imaging detected many merging large hot spots in the skin overlying the thyroid of the patient (Fig. 1a) that were not present in the healthy subject (Fig. 1b).

Different conditions, including Graves' disease, toxic adenoma, toxic multinodular goiter, and thyroiditis, can cause hyperthyroidism. Generally the clinical diagnosis is confirmed by thyroid function evaluation and morpho-functional characterization. Imaging methods such as radionuclide imaging and ultrasounds are important tools

to characterize the different pathologies causing hyperthyroidism [1]. In our patient clinical and hormonal data were typical for hyperthyroidism, although the presence of a vascularized nodule within the left lobe of the thyroid did not allow the differentiation between Graves' disease or toxic adenoma. Graves' disease is characterized by diffuse hypervascularized thyroid inducing local high temperature on the overlying neck skin [2]. We evaluated the patient's neck region with a thermal camera hypothesizing that the increased vascular flux characterizing Graves' disease could be still present given the short period of treatment with methimazole. Digital infrared thermal imaging of the neck region of the patient revealed a diffuse patchy temperature elevation of the neck skin overlying the thyroid gland, with a mean increase of 1.9°C with respect to a healthy control. This observation is suggestive for Graves' disease then a toxic adenoma as confirmed by successive measurement of thyroid stimulating hormone receptor antibodies.

Digital infrared thermal imaging is able to map the thermal pattern of different body regions. It has gained acceptance to investigate different inflammatory processes and neoangiogenetic phenomena such those observed in cancer, although a clinical application has yet to be clearly realized [3]. Nonetheless, infrared thermography can detect thermal differences of skin overlying the thyroid and may help to discriminate different thyroid pathological conditions [2, 3].

Infrared imaging is a non-invasive, safe technique allowing the visualization of skin temperature [3]. Its use for investigating thyroid hyperfunction could offer a safe and reliable diagnostic alternative to radionuclide imaging above all when investigating pregnant women and children, or when radionuclide imaging cannot be performed as in the present case report.

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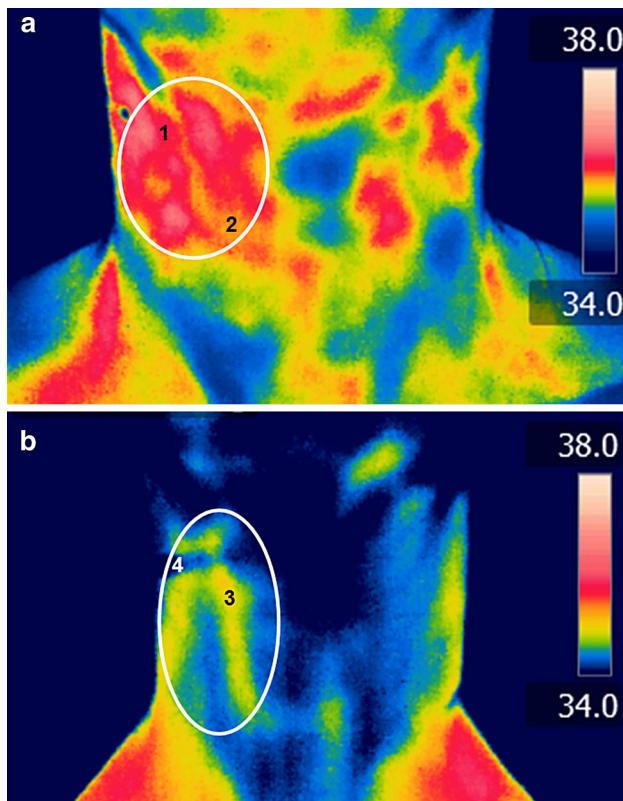


Fig. 1 **a** Thermographic aspects of the thyroid overlying skin in the patient with hyperthyroidism as detected by digital infrared thermal imaging. Many different and merging large *hot spots* are clearly visible above all in the right lateral neck region over the thyroid (*circle*) where mean temperature was 36.7 °C, with maximal temperature of 36.9 (1) and minimum 35.2 °C (2). **b** Thermographic aspects of the skin overlying thyroid in an age matched healthy woman of control. The temperature of the skin appears lower than that of the patient with hyperthyroidism with no *hot spots* detectable, and maximal temperature localized at the right lobe (*circle*) with a mean temperature of 34.9 °C, with maximum of 35.0 (3) and minimum of 34.1 °C (4). The resolution of the thermal imaging camera was 320 × 240 pixels and the thermal sensitivity was 0.02 °C. Images were taken in the same environmental conditions in a temperature and humidity controlled room

Conflict of interest The authors declare that they have no conflict of interest.

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