LETTER to the EDITOR

Role of Digital Infrared Thermal Imaging in Radiation Therapy Planning and Toxicity

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Dear Editor

All material objects whether low or high emit infrared radiation so called thermal energy according to their structure. This energy level varies depending on the temperature of object and it is part of a large spectrum of energy invisible to human eye. Infrared light intensity is directly proportional to tissue temperature and blood flow. Changes in Photon flux can be analyzed to measure tissue blood flow and to understand physiology of various diseases (Kolarić et al., 2013; Rassiwala et al., 2014).

Thermal cameras are used to detect temperature difference by catching different waveforms that human eye is insensitive. These waves are converted into electrical signals after detection by sensitive sensors. By analyzing these signals' differences in the color spectrum, thermal images of the human body named thermogram are acquired. Thus, it can be used to show physiological change and metabolic processes by using surface temperature distribution (Fitzgerald and Berentson-Shaw, 2012; Rassiwala et al., 2014).

Thermography is usually performed in an examination room which is kept between 20°-25° Celcius ambient temperature with lack of air flow and direct light. Patients are sit on a chair with clothes took off, both arms are held at uprise position away from body for 15 minutes to adapt to room temperature. Because human body is thermally symmetrical, abnormal temperature distribution can be easily recognized. This asymmetry aids in identfiying suspicious areas and better understanding of physiological and functional disorders. It is mostly used as an adjunct tool to strengthen clinical suspicion with these properties (Gautherie and Gros, 1980; Gamagami, 1996; Kolarić et al., 2013).

Although thermal imaging devices have being used nearly for half a century, first devices were too simple to use and their performance could not achieve the desired results. Currently, evaluation process of thermal images in parallel with technological developments allow a lot of functionality on researches and therefore they have become popular again. Today, in such areas either civil, industrial or health, thermal applications show a high level of technical performance. Lack of catheter use, contrast agent injection and ionizing radiation and being a good indicator of physiological changes, it is now being questioned that if alternative diagnostic methods such as thermal cameras are useful in oncology (Gautherie and Gros, 1980; Gamagami, 1996; Fitzgerald and Berentson-Shaw, 2012; Kolarić et al., 2013; Rassiwala et al., 2014). It has been shown that assessing the extent of inflammation and location of lesion has aided clinicians to decide best treatment method. In addition to physical or radiological examination of the breast, it has been reported to be useful in the early diagnosis of lesions that remains inconclusive (Kolarić et al., 2013). Gautherie and Gros (1980) stated that from surface to deep breast, there is a steady temperature increase in normal breast tissue and if the measured temperature is inconsistent, angiogenesis, endocrine changes, inflammation, and tumoral lesion presence should be considered. Gamagami (1996) evaluated angiogenesis with thermal imaging and reported that in 86 % of non-palpable breast cancers showed hypervascularity and hyperthermia. In the study of Yahara et al. (2003) it was indicated that in women group at high-risk for breast cancer, there was temperature elevation in tissue surrounding the tumor. In the recent studies, it is known that the physiological changes in tissue trigger pathological changes and these studies are in support of thermography's ability to show abnormalities before they become cancer (Kolarić et al., 2013; Zore et al., 2013; Rassiwala et al., 2014).

Considering the literature, despite thermal imaging was shown to be a guide for the determination of diagnostic and treatment decisions, there are a lack of studies on the role of digital infrared thermal imaging in radiotherapy planning and follow-up care of radiation therapy toxicity. In breast cancer patients, breast ultrasound, mammography and magnetic resonance imaging allow Radiation Oncologists to determine the volume of tumor and critical organs more precisely. Thermography can be used during radiotherapy planning to identfy tumor volume/ tumor bed ratio and lymph nodes. Also, it can be used to follow radiation induced toxicity especially in acute state. For this purpose, routine thermographic examination can be done once a week or bi-weekly. Because local inflammatory changes begin 2 weeks before clinical signs and these changes are thermographically detectable, this method can aid to identify acute side effects when they are in subclinical stage and it may help to avoid more severe inflammatory reactions. Thus, it may play role in preventing the occurrence of subacute and chronic toxicity due to radiation therapy especially in patients with comorbidities such as diabetes mellitus, connective tissue disorder.

As a result, in the radiation oncology field, thermography may be an alternative tool in radiation therapy simulation and identfying radiotherapy induced toxicity while being non-invasive. Also it is hygienic for lack of contrast use and direct contact with patients. Another advantages are that it is portable and repeated shots can be made. When compared to the ultrasound, mammography and magnetic resonance imaging, it is a quite cost-effective solution.

References

Fitzgerald A, Berentson-Shaw J (2012). Thermography as a screening and diagnostic tool: a systematic review. *N Z Med J*, **125**, 80-91.

Gamagami P (1996). Indirect signs of breast cancer: Angiogenesis study. Atlas of mammography. *Cambridge, Mass: Blackwell Science*, 321-6.

Gautherie M, Gros CM (1980). Breast thermography and cancer risk prediction. *Cancer*, **45**, 51-6.

Kolaric D, Herceg Z, Nola IA, et al (2013). Thermography--a feasible method for screening breast cancer? *Coll Antropol*, **37**, 583-8.

Rassiwala M, Mathur P, Mathur R, et al (2014). Evaluation of digital infraered thermal imaging as an adjunctive screening method for breast carcinoma: A pilot study. *Int J Surg,* **12**, 1439-43.

Yahara T, Koga T, Yoshida S, et al (2003). Relationship between microvessel density and thermographic hot areas in breast cancer. *Surgery Today*, **33**, 243-8.

Zore Z, Boras I, Stanec M, Oresić T, Zore IF (2013). Influence of hormonal status on thermography findings in breast cancer. *Acta Clin Croat*, **52**, 35-42.

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