Chapter 8
Thermography in Biomedicine: History and Breakthrough

Iskra Alexandra Nola
https://orcid.org/0000-0002-8268-210X
School of Medicine, University of Zagreb, Croatia

Darko Kolarić
Ruđer Bošković Institute, Zagreb, Croatia

ABSTRACT

The historical details are important to understand the development and application of thermography with particular emphasis on its application in medicine, explained on breast cancer detection. Today, recommendations for breast cancer include the use of mammography as the gold standard screening method. In public health, the importance of screening women for possible breast cancer is indisputable, especially in light of the fact that the size of the cancer directly corresponds to the success of the cure. A method that will allow early detection of cancer and/or successful follow-up of postoperative or adjuvant treatment is unquestionable. Thermography as a non-invasive method is harmless and therefore enables repetition without harmful radiation to the patient, unlike mammography. These features should be sufficient to empower its application. However, its breakthrough does not proceed as expected. This chapter particularly emphasizes the importance of conducting studies in a uniform manner to enable the collected data to be comparable appropriately with the methods used so far.

INTRODUCTION

Infrared thermography, thermal imaging, infrared radiometry, infrared imaging, IR condition monitoring, (dynamic) digital infrared thermal imagining ((D)DITI) or only digital infrared imagining (DII) and thermovision are all terms used for this growing research field. In simplest terms, thermography means "picture of heat" (thermograms) and utilizes highly resolute and sensitive infrared (thermographic) cameras. Thermal imaging cameras detect radiation in the infrared range of the electromagnetic spectrum (8–14 μm) and produce images of that radiation (thermography).

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Modern term also used for thermography is thermology. Thermology became medical science that could be used in diagnostic using highly detailed and sensitive infrared images of the human body. However, in practice is often used the term thermography.

This equipment usually has two parts, the IR camera and a standard PC or laptop computer with the respective software. This software supports thermal analysis and image presentation in numerical and graphical forms of temperature value of any part of surface inside the thermographic scan. The computer is routinely used to capture and analyze the infrared data (terms: computerized thermography, digital thermography, computerized thermal imaging, computerized infrared imaging, computed thermal imaging, digital infrared thermal imaging, digital infrared imaging, etc.). The addition of the prefix "clinical" or "diagnostic" is used for thermography in the health care field.

Thermal imaging as a diagnostic instrument or inspection tool has potential diverse applications: from thermal environmental studies to medical thermography including monitoring and follow-ups in breast thermography. In this chapter the main historical progresses in thermography development and their relation to thermography breakthrough in some of most interested area of biomedicine, especially breast cancer detection, is presented. This chapter particularly emphasizes the importance of conducting studies in a uniform manner to enable the collected data to be comparable appropriately with the methods used so far.

BACKGROUND

"Thermography should not be relied on for early detection of breast cancer." (Australian Government). And nobody says it should. At least not in scientific community that tries to facilitate breast cancer screening by using solutions that are non-invasive and easy to perform. However, this before mentioned statement of Australian government shows how things could go wrong easily. From FDA approval and classification of thermography as an adjunctive diagnostic screening procedure for the detection of breast cancer to announcement that this methodology is not reliable went barely 40-some years. Enough to "bury" the methodology?

The review of papers published in last 10 years (over 131 of them appeared at PubMed when the search included "thermography" AND "breast cancer" terms) will enlighten the story behind. After getting so many papers, narrowed search included "free full text" and "review" criteria for further work. These criteria are very important while this chapter will discuss the breakthrough of thermography into (bio) medicine and the establishment of any new methodology depends on its reliability which in science is mainly approved by review studies. This narrowed search gave 3 (three!) papers in total:

"Artificial intelligence methods for the diagnosis of breast cancer by image processing: a review" by Sadoughi et al. Breast Cancer (2018);

"Breast Cancer Detection Using Infrared Thermal Imaging and a Deep Learning Model" by Mambou et al. Sensors (2018); and

"The benefits and harms of screening for cancer with a focus on breast screening" by Brodersen Jørgensen and Gøtzsche Pol Arch Med Wewn. (2010).

Even though these articles are reviews, it is visible that two of them are from 2018 and one from 2010. Moreover, in search of 10 years, maybe in another database will results be different, but the most important was to show how small proportion of them one can find in the set of 131 papers related to the thermography and breast cancer.