**Abnormal breast temperature and cortical enlargement of the axillary lymph nodes through the thermography**

Francisco-J Renero-C1, Tania-Cristell Martínez-Azmitia2

1Instituto Nacional de Astrofísica, Óptica y Electrónica (INAOE), Biofotónica

Luis Enrique Erro No 1. Tonantzintla, Puebla

72840

México

[paco@inaoep.mx](mailto:paco@inaoep.mx)

<https://orcid.org/0000-0003-1273-4725>

2Instituto de Seguridad Social al Servicio de los Trabajadores del Estado de Puebla (ISSSTEP)

Imagenología diagnóstica y terapéutica

Avenida Emiliano Zapata 4730. San Baltazar Campeche, Puebla

72550

México

[criss\_mazt@hotmail.com](mailto:criss_mazt@hotmail.com)

**Key clinical message**

The breast thermography for early detection of breast sickness in women younger than 50 years. The breast thermogram of a woman, in her 20s, showed average temperature difference of about 1°C, while the ultrasound reported a simple cyst with enlarged and vascularized lymph node in both axillae.

**Introduction**

In all over the world, it was reported that in the 2020, the number of deaths and new cases for breast cancer were 684,996 and 2,262,419, respectively. According to the age, the deaths were 131,322 of women younger than 50 years, and 553,674 of older than 50 years. For the year 2040, it is expected that the number of deaths increase to above 50%, while for the new cases 40%.1

The goal of the health professionals is to prolong life quality. This can be done, identifying, as early as possible, those signs and symptoms that may diminish the health condition of the human being. For the breast cancer, for the women under the 50 years or younger, to whom the mammography is not recommended, and to increase the chance the early detection of abnormalities in the breast, and to reach most of the target population, qualitative and quantitative non-invasive technology is required.

For the present case, the abnormality was recognized by the thermography of the breast [Appendix A]. It is a non-invasive technology, which promises, by quantitatively comparing physiologically equivalent regions of interest, to identify early manifestations of the abnormal heat conservation/dissipation on the study tissue.

To follow the health of the breast, independently of the women age, the thermography of the breast may be incorporated into the different visit to the health professionals.

**Case history**

A woman in her 20s signed the informed consent to participate in a campaign for breast thermography. She received all the information about her participation in the campaign, furthermore, all her questions were answered. The thermography was acquired according to the protocol of the American Academy of Thermology.2 From her thermogram, it was showed that average temperature difference, between the right and the left breast, was more than 1°C, which is considered abnormal.2

**Method**

A second thermogram was acquire seven weeks later which results were likely to those of the previous one. In both thermograms, the right breast was hotter than the left one. Under these findings, a breast ultrasound was required. The results showed, in the left breast, a simple cyst of 2.4-millimeter diameter predominant on the superior external quadrant. The lymph nodes on both axillae were abnormal, with diffuse cortical enlargement of 8 and 3 millimetre for the right and the left, respectively. Furthermore, rim blood vessel was observed on both lymph nodes.

**Conclusions and results**

The thermography study is directed to compare the heat conservation/dissipation between the right and left breasts, which is done by computing the average temperature on the regions of interest (ROI). In this study, the average temperatures were computed on seven ROI, all-over the breast, covering the four quadrants of the breast, the axilla, and the Nipple together with the Aureole (N+A).

The results are despite on table 1. The first column shows the name of ROI, the second and third columns contain the average temperature of each ROI; The average temperature difference (ATD), between the right and left ROI, is shown on the fourth column. It is shown, that the ATD from all-over breast was 0.8°C, which is not statistically significant. However, the ATD from the quadrants Q1, Q3, Q4, and the N+A were equal-greater than 1.0°C, which is considered abnormal.2

**Table 1.** Results from first breast thermogram. The seven regions of interest where the average temperature (AT) was computed. The fourth column shows the average temperature difference between right and left breasts on the seven regions of interest.

|  |  |  |  |
| --- | --- | --- | --- |
| Skin tissue | AT Right (°C) | AT Left (°C) | AT Difference ATD(°C) |
| AT overall | 32.9 | 32.1 | 0.8 |
| Q1 Upper-outer | 32.7 | 31.7 | 1.0 |
| Q2 Upper-inner | 32.3 | 31.8 | 0.5 |
| Q3 Lower-inner | 33.1 | 32.0 | 1.1 |
| Q4 Lower-outer | 33.2 | 32.0 | 1.2 |
| Armpit | 34.4 | 34.0 | 0.4 |
| AT nipple+aureole | 32.8 | 31.6 | 1.2 |

The results, from the second thermogram, are displayed in table 2. The fourth column shows ATD, between the right and left ROI. The ATD from all-over breast was still of about 0.8°C. At this time, the ATD from the quadrants Q1, Q2, and the N+A were equal-greater than 1.0°C, which is considered abnormal.2

**Table 2.** Results from second breast thermogram, which was took seven weeks after from the first one.

|  |  |  |  |
| --- | --- | --- | --- |
| Skin tissue | AT Right (°C) | AT Left (°C) | AT Difference ATD(°C) |
| AT overall | 35.3 | 34.5 | 0.8 |
| Q1 Upper-outer | 35.3 | 34.3 | 1.0 |
| Q2 Upper-inner | 34.8 | 33.5 | 1.3 |
| Q3 Lower-inner | 35.7 | 34.8 | 0.9 |
| Q4 Lower-outer | 35.7 | 35.1 | 0.5 |
| Armpit | 35.9 | 36.6 | -0.7 |
| AT nipple+aureole | 35.6 | 34.4 | 1.2 |

The volunteer got an ultrasound of her breast. The results showed a simple cyst of 2.4-millimeter diameter predominant on the upper-outer quadrant of the left breast (Q1). The lymph nodes. on both axillae, were abnormal, with diffuse cortical enlargement of 8 and 3 millimetre for the right and the left, respectively. Furthermore, rim blood vessel was observed on both lymph nodes. At the time this report was submitted, the woman was attending by the health professional team, where she is receiving all the necessary attentions.

The volunteer, who participated in the campaign for breast thermography, received information that improved the quality of her life, as she said, thanks to the thermography, I now know that I have health issues with my breast to attend with the medical team.

A more detailed data, and its analysis, is required to study why the hotter breast does not correspond to breast where the cyst is present. Furthermore, to study the axillary average temperature, over some period, requires more cases.

The thermography of the breast may be incorporated as a complement study into standard protocols.

The volunteer informed that; she was aware that her both lymph nodes were enlarged; she did not put much attention to that. It was the thermography that provides information about the breast’s health and took pertinent actions.

**Discussion**

In terms of heat conservation/dissipation, which is autonomous physiological process, the thermography technique is useful to compare, objectively, the average temperature at the different equivalent, physiologically, ROIs. In the breast thermography, it is not appropriate to suppose that the average temperature difference must always be associated to some kind of cancer; it could be aroused from inflammation, infection, trauma, physical issues, or some other.

From the case presented here, location of the cyst does not correspond to the hotter ROI, that is, according to the ultrasound study the cyst is predominantly in the quadrant Q1 of the left breast, while, from the thermograms the hotter regions are present in the quadrants Q1, Q2, Q3 and Q4 of the right breast. Another aspect of heat dissipation/conservation is observed in the axillae, where, according to the ultrasound study, both lymph nodes were abnormal. However, from the isolated thermograms, the ATD from the axillae are considered normal.2 To search for evolution of the axillary’s average temperature, arithmetic operations were conducting, between both thermograms, then it can be demonstrated that ATD of the left armpits tends to be hotter than the right.

It is well accepted that the axillary lymph node may be considered the sentinel lymph node for the breast cancer. Once, the lymph node is detected, it is biopsied to identify the cancer type.3,4,5,6 However, it seems that, no techniques, nor protocols are reported for its early detection in young women. Thus, that seems that the thermography can be a way to have information of its presence. A series of thermogram protocol must be developed to look for this lymph node.

Most young women are unaware of their breast health, that is, that some signs or symptoms may pass unnoticed even for the health professional team. Thus, the thermography of the breast may be an alternative to have objective information of the breast. Furthermore, the thermography may be incorporated to the available protocols. For example, the Papanikolaou study may be accompanied by a breast thermography. That is not because the cervix cancer has a correlation with breast sickness, it is to provide an “integral” study for the women health.

The thermography of the breast may provide information to differentiate between benign sickness to some breast cancer.7

**Authors contributions**

Francisco-J Renero-C: Conceptualization – data curation – formal analysis – investigation – methodology – project administration – writing original draft – writing review and editing.

Tania-Cristell Martínez-Azmitia: Conceptualization – supervision – validation

**References**

1. Arnold M, Morgan E, Rumgay H, AlMafra A, Singh D, Laversanne M, Vignat J, Gralow JR, Cardoso F, Siesling S, Soerjomataram I. Current and future burden of breast cancer: Global statistics for 2020 and 2040. The Breast. 2022;66:15. [accessed June 17, 2024]. Available from https://doi.org/10.1016/j.breast.2022.08.010.
2. American Academy of Thermology, A Guidelines for Breast Thermology: Greenville, SC; 2021; [Accessed May 1, 2024]. Available from https://aathermology.org/wp-content/uploads/2018/04/AAT-Breast-Guidelines-2021v2.pdf
3. Chen MY, Gillanders WE. Staging of the Axilla in Breast Cancer and the Evolving Role of Axillary Ultrasound. Breast Cancer (Dove Med Press). 2021;13:311. [Accessed June 10, 2024] Available from <https://doi.org/10.2147/BCTT.S273039>
4. Yadav S.K., Bharath S., Sharma D, Srivastava A, Jha CK, Agarwal G, Khadka S, Singh M, Shekhar S, Goyal A. A systematic review and meta-analysis of diagnostic performance of fluorescein-guided sentinel lymph node biopsy in early breast cancer. Breast Cancer Res Treat. 2024;66:15. [Accessed June 5, 2024]. Available from <https://doi.org/10.1007/s10549-024-07310-0>
5. Yang L, Zhao X, Yang L, Chang L, Cao C, Xiaolong L, Wang Q, Song Z. A new prediction nomogram of non-sentinel lymph node metastasis in cT1-2 breast cancer patients with positive sentinel lymph nodes. Sci Rep. 2024;14:9596. [Accessed June 5, 2024]. Available from <https://doi.org/10.1038/s41598-024-60198-0>
6. Abel F, Landsmann A, Hejduk P, Ruppert C, Borkowski K, Ciritsis A, Rossi C, Boss A. Detecting Abnormal Axillary Lymph Nodes on Mammograms Using a Deep Convolutional Neural Network. Diagnostics. 2022;12(6):1347. [Accessed June 12, 2024]. Available from <https://doi.org/10.3390/diagnostics12061347>
7. Stachs A, Stubert J, Reimer T, Hartmann S. Benign Breast Disease in Women. Dtsch Arztebl Int. 2019;116:565. [Accessed June 17, 2024]. Available from https://doi.org/10.3238/arztebl.2019.056

**Appendix A**

The thermography is a technique for recording thermal radiation from the study region. This technology does not emit any type of signals, it is based on meshes of thermal radiation sensors, the electronics of the device convert the thermal radiation, coming from each pixel, into temperature values which are stored in a digital file. The temperature values are displayed as a thermal map in false color which is called the thermogram.

.

.