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Temperature Variations in Plantar Angiosomes are Quantitatively Estimated: A Review

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Abstract

Thermography is a useful tool because it provides information that can help diagnose certain diseases quickly and non-invasively. In particular, the thermometer has been applied in the study of diabetic feet. However, most of these studies reported only qualitative information, making it difficult to measure meaningful parameters such as temperature change. These variations are important in the analysis of diabetic foot because they can yield knowledge, for example, of ulcer risk. Early detection of ulcer risk is considered an important research topic in the medical field, as its goal is to avoid serious complications that can lead to amputation. The absence of symptoms in the early stages of ulceration is a major obstacle in making a timely diagnosis in neuropathic subjects. The relationship between temperature and ulcer risk is well established in the literature, a method to obtain quantitative temperature differences in the soles of the feet of diabetics to detect ulcer risk is well established, proposed in this work. This method is based on the concept of angiosome and image processing.

Keywords: Thermography; Neuropathic; Diabetic foot

Introduction

Infrared technology allows capturing the natural thermal radiation of the human body and representing it in a thermal image. Since this thermal radiation is generated by heat exchange between skin tissues, internal tissues, local blood vessels and metabolic activity, the outcomeing temperature distribution can provide information about some sick. People with diabetes are known to have a higher risk of foot complications; Furthermore, several studies have focused on the analysis and characterization of its temperature. Some studies suggest continuously checking the temperature of the foot to know its behavior in diabetics [1, 2]. In addition, several reports have identified a significant difference in temperature in the soles of the feet between healthy and diabetic subjects with and without neuropathy-associated disease. According to some investigations, the presence of hot areas on the soles of the feet can indicate tissue damage, inflammation and blockage of the arteries, which can affect nutrient capillary flow and increase the likelihood of skin ulcers. For example, Brånemark found that diabetics exhibited abnormal temperature in the feet and hands associated with common ulcerative areas in a study using IR. Recently, an analysis based on the thermal profile of leg wound was proposed to provide a healing index for diabetic subjects. In fact, the application of IR technology has even been used to determine the degree of amputation required. In 2014, it was reported that nearly 50% of diabetes cases had foot complications due to decreased blood supply and loss of sensation. Worldwide, the rate of foot ulcers is 2% in people with diabetes, of which about 15% will have amputations. This represents an amputation every 30 seconds with more than 2500 limbs lost per day [3-5]. The early detection of ulcers is complicated because diabetes causes a loss of connection between muscles and nerves, and affects the heat and mechanical receptors so that the patient does not feel any symptoms. Such as pain or swelling when an injury occurs. Diabetics require ongoing medical care and require the development of tools that provide reliable information to facilitate early diagnosis. Since early detection of at-risk areas on the diabetic foot is a topic of interest and temperature monitoring can reduce the risk of foot ulcers and amputation, the development of makes timely diagnosis a relevant task. Therefore, it can be said that temperature measurement is an opportunity for early detection of ulcer risk as well as a reliable and non-invasive method for foot care in diabetic patients. In this study, a method to identify and analyze temperature differences is proposed to detect abnormal temperature rise in the feet of diabetic patients [6]. The soles of the feet were analyzed taking into account the concept of angiosome because blood flow in these regions faithfully reflected changes in temperature. In the angiosome, the temperature estimate is calculated by determining the existing color regions, which are simultaneously characterized and related to the temperature value. Thus, a temperature difference between the respective angiosome can be achieved. In addition, this method allows determining the coverage of each temperature; therefore, it also enables the detection of anomalous hotspots inside angiosome.

Patients with Diabetes mellitus type 2

This study was conducted to review a group of patients diagnosed with type 2 diabetes at General Hospital, in collaboration with a group of diabetes specialists in 2012. The target group included patients. Men and women, ages 35 to 80, with and without neurological disease, Patients attending a scheduled meeting were invited to participate in the study and they gave their consent. Exclusion occurred when the patient had toe amputation, lower extremity fracture or surgery, peripheral artery disease, ulceration, or history of ulceration. Temperature graphs were obtained in an air-conditioned, temperature-controlled °C room, where the patient was allowed to rest in the supine position, as suggested in previous work [7-9]. The recommendations of the International Academy of Clinical Thermodynamics were also followed. As emphasized in previous studies, this preparation allows detecting changes in skin temperature in the range of 0.05 to 0.1°C. The

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preparation goes as follows:

Patients are asked to take off their shoes and socks and wipe their feet with a damp cloth. The patient is then placed in the supine position on the examination bed, while the medical professional collects certain data such as name, age, gender, height, and weight and body temperature. After the first 15 to 20 minutes of stabilization, an infrared blocker is placed on the patient's leg to prevent external thermal radiation from appearing on the heat chart. The temperature of the insulated foot with the corresponding color chart and temperature scale is obtained using a heat chart. The sensor of a thermal camera is an infrared detector that absorbs infrared energy emitted by an object and converts it into an electrical signal. IR is a technology that uses the law of black body radiation proposed by Max Plank, which states that any object with a temperature above absolute zero emits electromagnetic radiation, also known as infrared radiation or thermal radiation. Later, Hardy proposed that human skin could be thought of as a blackbody radiator, opening the way for the use of IR in medicine. Therefore, when the skin surface changes, the emitted thermal radiation will be captured by the infrared sensor and converted into a temperature graph. Each pixel in the heatmap has a specific temperature value, and the contrast of the image is derived from the difference in skin surface temperature [10]. In this study, heat histograms were able to represent color and were captured with a FLIR A300 IR camera with a thermal sensitivity of 0.05 at 30°C.

Temperature

The importance of this process is that, in the original image, it is difficult to determine the beginning or end of a color due to the large number of colors. The proposed classification process provides an estimate of the number of pixels for each temperature class. Each time a pixel is classified as belonging to a class, the counter associated with this class is incremented. Since only the area of the foot is suitable for analysis, the remaining temperatures are considered as background and they are not taken into account in the measurement. So the layers must cover the total surface area of the foot. In this way, the foot is outside the bottom, as can be observed, where the bottom is uniform and the regions are well defined in their respective layers. In this case, the whole foot was taken as an example and to give a better view of the classification process. For convenience, in this method, the pixel classification is as follows. After the feet were separated into their respective images, they were further divided into four subsections, one on each angiosome. Looking at the original image of the MPA angiosome of the left foot, it can be assumed that the color corresponds to the layer with the largest area. However, it is difficult to clearly establish the boundaries between color regions due to the similarity between some colors. A visual comparison between the MPA angiosomes of the two feet could be even more complicated; therefore, it is important to go beyond visual perception and to make quantitative comparisons of temperature distributions. After pixel classification is done, it is possible to clearly observe the area covering a certain temperature associated with a layer.

Discussion

Although there are a considerable number of scientific reports on temperature analysis in diabetic feet, most of them are based on qualitative analysis. However, it is not always easy to estimate anomalous temperature deviations by visual inspection of the heat chart. The goal of the proposed approach is to provide accurate information about these differences by facilitating the detection of regions at risk and their evolution for the medical professional. While not all areas with abnormal temperatures develop sores, monitoring them is important because they are high-risk areas. It is important to note that this method is not a diagnostic tool but rather a tool that provides additional information for evaluation by the medical professional to facilitate early detection of ulcer risk.

Conclusion

Thermal imaging and image analysis are useful tools in the field of medicine applied to the study of diseases such as diabetes. The temperature distribution in the soles contains relevant information about the condition of the diabetic foot and the risk of ulcers. In this work, a method was presented that provides quantitative information on anomalous temperature differences in symmetric regions between the foot and within the same foot. This method took into account the difference in temperature, their distribution and area. In the first analysis, the difference between the symmetrical regions of the two feet was investigated because it was known that the symmetrical regions of the body had similar temperatures. For this, the vegetative zone is divided into four main zones, and the temperatures within these zones are grouped into classes according to the criterion of color similarity. An index based on the relationship between the largest surface layer and its adjacent layers has been proposed to estimate representative temperatures for each angiosome. Therefore, it is possible to obtain an estimated difference between the symmetry regions to obtain an accurate measurement to determine whether there is an outlier difference. A second analysis was performed to study the temperature inside the angiosomes to detect the presence of unusually small areas. For this reason, he proposed a representative temperature-related hotspot estimator of the angiosome with the highest temperature. This estimator can detect the presence of anomalous regions in the initial phase which, for their small surface, are not detected by the estimator. In this way, it is possible to analyze the entire soleus area providing quantitative information to determine the presence of areas at risk of ulceration. The temperature measurement outcomes are consistent with previous reports on the characterization of foot temperature of diabetic patients. As such, this study provides a reliable, informative approach for the early detection of heat-related diabetes-related foot ulcers.

References

1. Jeffcoate WJ, Harding KG (2003) Diabetic foot ulcers. Lancet 361(9368): 1545-1551.
2. https://europepmc.org/article/nbk/nbk537328.
3. Wagner FW (1981) The dysvascular foot: a system for diagnosis and treatment. Foot Ankle 64-122.
4. Armstrong DG, Boulton AJM, Bus SA (2017) Diabetic Foot Ulcers and Their Recurrence. N Engl J Med 376(24): 2367-2375.
5. Mutluoglu M, Uzun G, Turhan V, Gorenek L, Ay H, et al. (2012) How reliable are cultures of specimens from superficial swabs compared with those of deep tissue in patients with diabetic foot ulcers? J Diabetes Complications 26(3): 225-229.
6. Porrini E, Ruggenenti P, Mogensen CE, Barlovic DP, Praga M, et al. (2015) Non-proteinuric pathways in loss of renal function in patients with type 2 diabetes. Lancet Diabetes Endocrinol 3: 382-391.
7. Harjutsalo V, Groop PH (2014) Epidemiology and risk factors for diabetic kidney disease. Adv Chronic Kidney Dis 21: 260-266.
8. Haffner SM, Valdez RA, Hazuda HP, Mitchell BD, Morales PA (1992) Prospective analysis of the insulin-resistance syndrome (syndrome x). Diabetes 41: 715-722.
9. Bae JH, Han KD, Ko SH, Yang YS, Choi JH, et al. (2022) Diabetes fact sheet in Korea. Diabetes Metab J 46: 417-426.
10. https://pubmed.ncbi.nlm.nih.gov/35321676/