Directed dynamic cooling; a methodic contributiron in telethermograpby

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SUMMARY. Different methods and varying cooling down periods in thermographic diagnosis have been studied. Our investigations have shown that a directed cooling down method using a fan, at room temperature between 21-22" C, under monitoring, is a rapid and reliable method, enabling us to reach the same results as with the static cooling method which involves a waiting period of ten minutes.

Key words: telethermography; breast cancer; cooling period.

INTRODUCTION

Since telethermography has become a routine in clinical practice many methods have been described to obtain optimal conditions for this examination. An important point of the preliminaries is the cooling off period. In thermography of the breast one sees, immediately after the patient undresses, patchy hyperthermic areas secondary to heat storage by the clothing. Vessel structures are poorly or not at all visualized and a diagnosis is impossible to make. Therefore many authors **39 5,** 68, 10, have pointed out the importance and necessity of a cooling period. Investigations made by CARY et al. show that not only the already mentioned hyperthermic areas disappear, but also the blood vessels near a tumor open up 2. The diagnosis of a << hot spot >> or of atypical vessels is often only possible after cooling the patient.

Standardization of the examination procedure is at this time nonexistent in the thermographic literature. Most of investigators agree on the idea that telethermography has to be performed in an air-conditioned room. Data for the optimal temperature fluctuate between 18 "C and 23°C 1, 9. With regard to cooling time one finds a multiplicity of ideas, which differ significantly. Most investigators opt for a 10 minute cooling time. Others examine the patient only after a 20 minute period. The idea of a long cooling period resulted in the introduction of special cooling cabins into thermographic practice. Much has been reported concerning the physical and physiological base of thermography l, 4 9 l°, 'I. In this report we will discuss our investigations about controlled warmth parameters in telethermography.

MATERIAL AND METHODS

All examinations were performed with the Thermovision Model1 680 developed by AGA. We used a 25 degree optic, which has the advantage that the patient sits close to the camera and to the examiner. The mean distance between patient and camera was about 80 to 100 cm. The room temperature was kept constant at 21°C - 22°C. The patient sat in front of the camera immediately after undressing.

We examined the importance of the room temperature in a cooling series with room temperature up to 27°C. The next day we immediately removed the surface body heat of the same patients with a cold air fan as has been described in plate-thermography. During this cooling down the thermic behavior of the heat patterns as well as the blood vessels reaction were noted in the monitor.

Our results were documented with a Polaroid camera with gray-scan as well as colored pictures. In the gray-scan pictures we preferred the inverted ones because of the optically better picture of the blood vessels.

RESULTS

1. Room temperature

The best conditions for thcrmographic examination were realized with a room tcmperature of 21°C - 22°C.

In the lower temperature ranges one is limited by the subjective discomfort of the patient. Depending upon the seabon and the temperature outside, many women sense a temperature beneath 20°C as being cold. Some pa-

A

B

C

Fig. 1 A-B-C. *Case 1.* (A) Patient E. G. Thermogram immediately after undressing. (B) Same patient after 12 minutes static cooling in an air conditioned room of 21°C. (C) Same patient after 30 seconds of dynamic cooling down with a cold air fan. The « hot spot » is not influenced by our cooling procedure.

tients began shaking, which made an accurate examination more difficult. Also the cooling down of the patients was faster at this temperature, malting examination after IO minutes impossible since the patient was already too COOL

In the higher temperature range the upper limit was about 25°C. The diffusion of the surface body heat was incomplete if we didn't use other methods. Also cooling off with a fan was insufficient at room temperature above 25°C. Another negative effect of a temperature above 22°C is that many patients perspire cxcessively thus hampering especially the examination of the axilla.

2. Duration of the cooling period

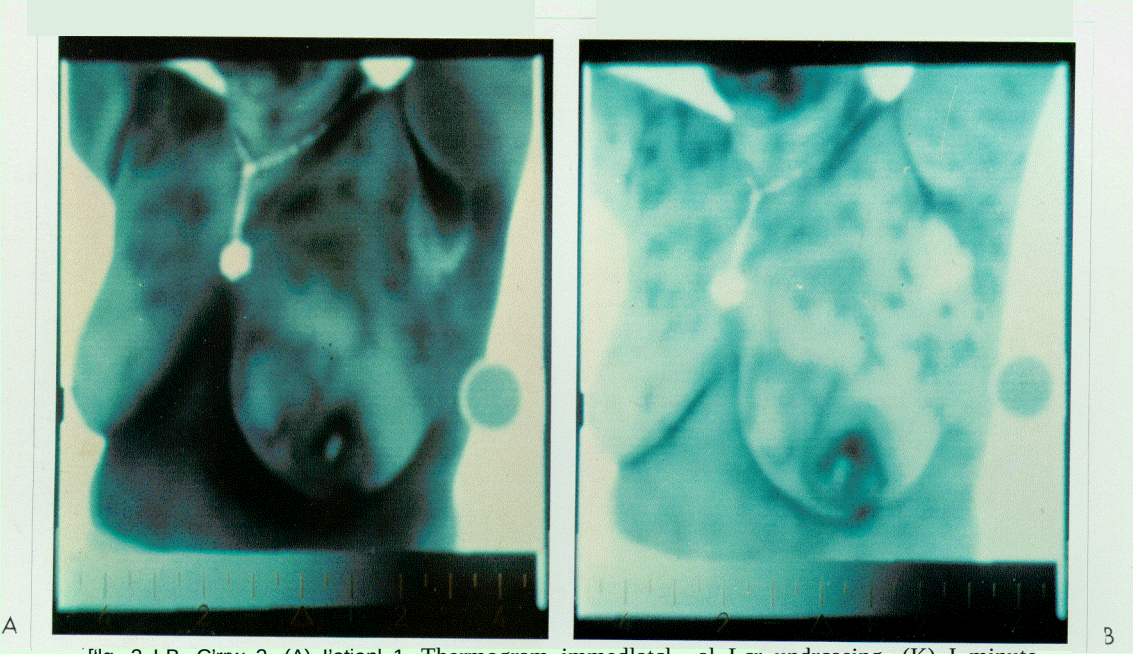
With an undressed patient at a constant temperature of about 21°C one notices after 2-4 minutes that most of the body surface heat has been removed. After this time the blood vessels are seen re!atively sharp. During the next minutes the picture stabilizes but after about 12 minutes the contrast diminishes, the outlines become blurry, small vessels disappear and the thermal profile is reduced. This observation only applies to women who were dressed sufficiently warm, and who did not smoke any cigarettes before the examination.

In other cases the patients come already overly cooled to the examination room. Such patients can only be examined after being rc-dressed for a waiting period.

3. Dynamic cooling

Without any waiting time our patients were put in front of the camera and cooled off by fan. Only a few women express negative feelings about this procedure. According to the intensity of the body surface heat, we symetritally cool down both breasts between five and l'iftecn seconds. In the gray-scan picture from the Thermovision equipment one can follow the whole cooling off process. In the first phase of dynamic cooling, the entire heat level, including the hyperthermia of blood vessels, is reduced. Only very prominent << hot spots >> with A T, more than 2°C do not change during the cooling procedure (Case 1, Fig. lA, B, C).

A few seconds after using the fan the reactive contraction of peripheral vessels diminished. The thermogram stabilizes one minute



['lg. 2 I-B. C'rrw 2. (A) I'atienl 1. Thermogram immedlatcl~ al Lcr undrcasing. (K) I minute alter dynamic coohng. Cleal contraat. cc Hot apot N with sharp outlines.

after using the fan and thus reaches the desired contrast.

Patients with and without carcinoma did not show any significant difference in findings after dynamic cooling or after ten minutes of normal cooling. In every patient criteria for malignancy such as differences between sides, general hyperthermia of one breast and delta T values were easily noted (Case 2, Figg. 2A, B, C, D, 0.

C

D

E

Fig. 2 C-D-t C*ase 2.* (C) Y minute5 alter cooling down. (U) Same patient after 17 minutes static cooling down. The << hot spot D and perimamillary ring structure are sharply outlined. Over-cooling of the lateral breast area. (E) After dynamic cooling down. Clearly outlined « hot spot ».

DISCUSSION

The cooling down procedure influence5 in a basic way the result5 of telethermography. Our experiences with room temperature correspond to those of other researchers [9]14 ‘6. Waiting time5 of ten to twenty minute5 before examination require large room space. For organizaticnal reasons one cannot take into account individual cooling rates caused by clothing or nikotin. A further problem of this IO-20 minute waiting period results from the fact that many women come to the examination with extreme canccrophobia and fear in general. Even under climatized conditions of 21°C - 22”C, excessive perspiration cannot bi: circumvented. On looking for a practical, optimal cooling down method, and by comparing advantages and disadvantages of several methods, we reached the opinion that cooling off the patient with a fan, a5 used in plate-thermography, has definite advantages. Immediately after using the fan the breast cools down. Then between 30 second5 and 1 minute one recognizes on the Thermovision monitor that the blood vessels again attain their original heat level. Comparing these pictures with pictures made after << sitting and waiting x one sees that the latter reach an equal level roughly after 8-12 minutes. We believe that normal as well as pathological structures are recognized better with this quick cooling down method. A diagnostic advantage depends on the fact that real G hot spots s are not affected by the fan. The crossover points of blood vessels which occasionally appear as << hot spots B and which can give differential diagnostic difficulties, can be made to disappear.

The selectively directed dynamic cooling down method seems to have special advantages in checking patients after mastectomy. These patients generally have been treated with ““Co irradiation postoperatively. Because radiotherapy the patients have a destruction or at least an insufficiency of the skin glands. A lung time after radiotherapy one also still recognizes a patchy hyperthermia in the axilla. A 20 minutes cooling time does not have any

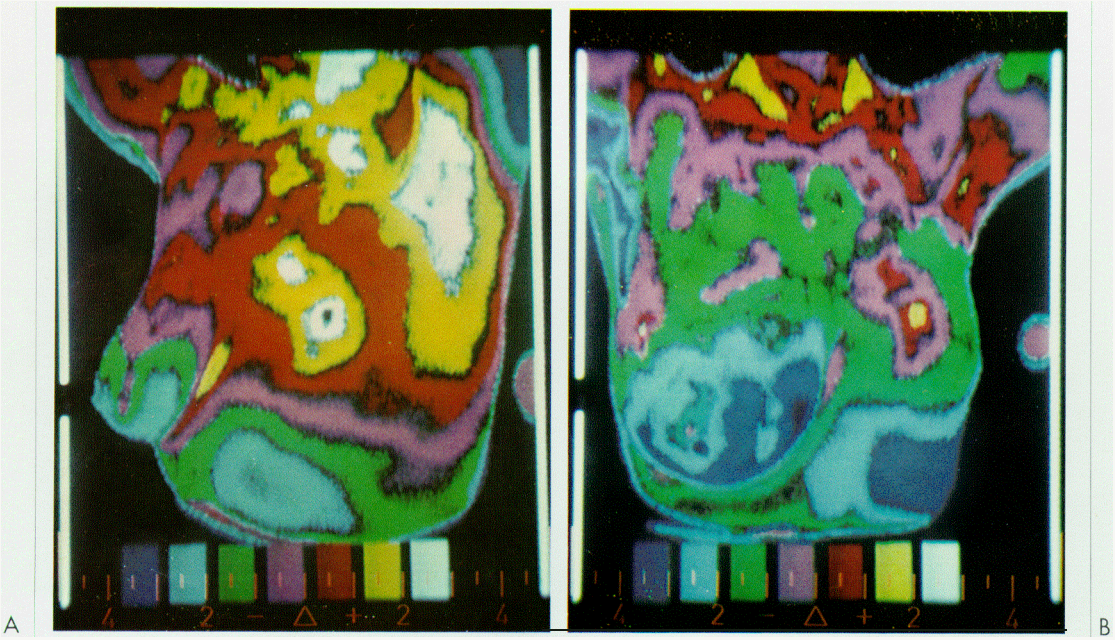


Fig. 3 A-B. Case 5. (A) After radical mastectomy (Halstedt operation) and radiation. (B) Thermogram al’ter selectively directed dynamic cooling. The x hot spot D does not correspond to any recurrence, but to the heart laying directly beneath the skin. A correct diagnosis is only possible by exact knowledge of anatomical and clinical situation.

essential influence upon the hyperthermia. This leads to false positive results. With the method of dynamic cooling the patchy areas of hyperthermia can be dissolved, the real << hot spot >) remains unchanged or diminishes for a short time only. With our method we had a false positive rate of only 3,2% with our last group of 130 post-mastectomy patients [7] (Case *3,* Fig. 3A, B).

One can acquire reproducible results and a correct diagnosis by this thermic procedure when the examination is done by a physician who has a thorough knowledge of the anatomy and pathology of the female breast. The accuracy of the results decreases when one just examines the pictures. To reach correct diagnosis, one should observe the dynamic thermic behavior directly in the monitor.

All researchers would like to standardize the method of examination, but one should be aware of the fact that our examination object can only be standardized incompletely.

CONCLUSION

A comparison between the effects of different methods and varying cooling down periods in thermographic diagnosis have been studied. All through the literature one finds cooling down intervals of 10 to 20 minutes in air-conditioned rooms with temperatures between 1%23°C. This long cooling period needs extensive organizational measures. Our investigations have shown that a directed cooling down method using a fan, at room temperature between 21-22”C, under monitoring, is a rapid and reilable method, enabling us to reach the same results as with the static cooling method.

Real << hot spots >> cannot be cooled away. This is a reliable feature to differentiate between pathological and normal results.

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