Telethermography of the back

by R. E. WOODROUGH

Department of Medical Electronics, Saint Bartholomew's Hospital, London (England).

SUMMARY. The possible causes of abnormal thermograms are briefly considered and it is pointed out that from the point of the thermologist, the various clinical conditions give rise to abnormal blood flow, either in the superficial vessels or in tbe cutaneous vessels.
Thermograms of the asymptomatic back are then presented, followed by examples of abnormal thermograms.
Particular attention being given to an on-going study into the effect of scoliosis.

Key words: thermography, back, scoliosis.

INTRODUCTION

Abnormal thermograms of the back can arise from numerous conditions that are normally dealt with by specialists in particular clinical disciplines. Thermologists, however, have to be concerned with the back, not with a particular clinical condition. A good thermologist needs to be able to recommend a reliable examination technique and to advise about the interpretation of the resulting thermogram. Interpretation of thermographic findings must always be considered against the clinical background and this demands a cooperative effort between the thermologist and the clinical specialist. In this lecture I am going to review what constitutes normal thermograms of the back and some of the conditions known to cause abnormal thermograms.

Let us begin by considering the possible causes of abnormal thermograms of the back. These can be injury or disease directly related to the skin of the back or the underlying tissues, but alternatively, certain conditions not directly related to the back can cause abnormal thermograms by influencing blood flow. I am thinking particularly of co-arctation of the aorta [1] and reflex responses of the cutaneous circulation.

Direct causes of abnormal thermograms of the back include spinal injury or disease, herniated discs, scoliosis, spinal metastasis, muscular injury or disease, and skin disorders. Thus, abnormal thermograms can, from the point of view of the thermologist, be divided into those caused by abnormal blood flow in the superficial vessels, those caused by abnormal cutaneous blood flow, and those resulting from a metabolic energy source, although this really results in abnormal blood flow since the venous blood becomes abnormally hot. Such a categorisation exists no matter what part of the body is being examined, and the correct examination technique depends upon which category is being examined.

THERMOGRAMS OF THE ASYMPTOMATIC RACK

There is general agreement that thermograms of the asymptomatic back are characterised by a high degree of symmetry. The most common patterns being the so-called Y or V patterns (Figs 1 and 2), in the lumbar region the centrally localised area of raised skin temperature fans out symmetrically towards the sacroiliac joints. The region located

Fig. 1. Typical colour isothermogram (scale length 9 °C, temperature reference 32 °C) of the Y pattern associated with normals.

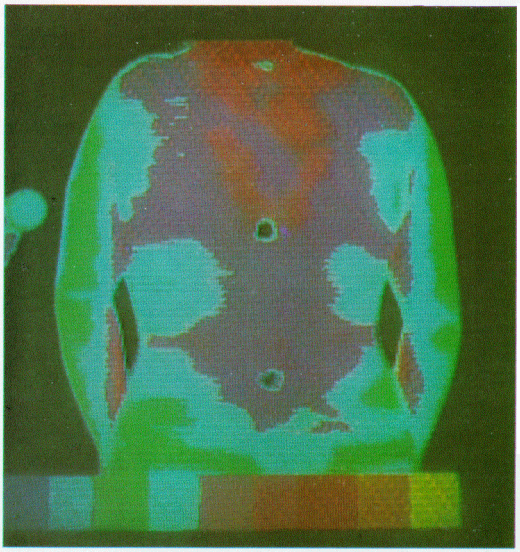

Fig. 3. Colour isothermogram (scale length 9 °C, temperature refercnce 32 °C) illustrating the effect of obesity on the normal thermographic pattern.

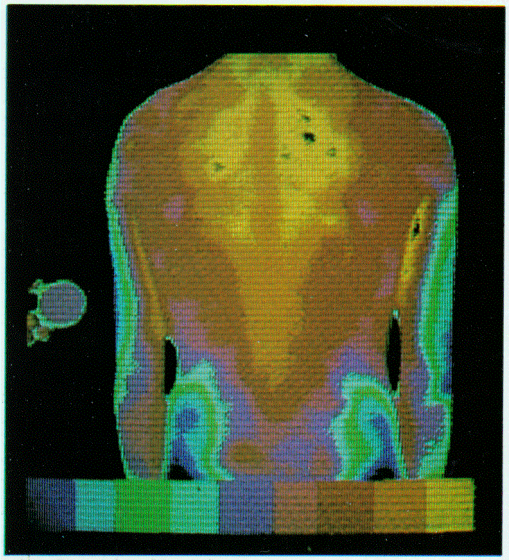

Fig. 2. Colour isothermogram (scale length 4.5 °C, temperature reference 32 °C) of the V pattern assumed to be a normal variation on the Y pattern.

between the lower lumbar spine, intergluteal cleft and sacroiliac joints appearing as a relatively cool area. There is great variation observed in these patterns, undoubtedly due to variation in the distribution and thickness of subcutaneous fat. The Fig. 3 illustrates an extreme example of the effect that obesity has on thermograms of the back. Notice, however. that there remains a high degree of symmetry (Fig. 3).

ABNORMAL THERMOGRAMS OF THE BACK

Abnormal thermograms have been shown to correlate with spinal metastasis, herniated discs, ankylosing spondylitis, scoliosis, musculoligamentous injuries and various dermatological conditions. This list is by no means exhaustive and illustrates the wide variety of causes that may give rise, to a thermographic abnormality of the back. It is therefore imperative that the thermograms are interpreted against the patient's clinical background. Thermography must be regarded as providing the clinician with extra information about the patient's health, not a specific diagnosis. Providing that this is accepted, thermography has a valuable role to play. Most of us can point to examples where thermography has been invaluable in confirming a diagnosis or in drawing attention to an unsuspected pathology. The danger is that not all abnormal thermograms are 50 obvious, or so easily correlated with a specific cause. There is still a great

deal of work to be done, particularly in complicated interdisciplinary fields such as thermography of the back. In the remainder of this lecture I am going to discuss a little of this work. I will begin by drawing your attention to some work being carried out by other groups.

ANKYLQSING SPONDYLITIS

Cosh and Ring (1967, 70)[4,5] at the royal National Hospital for Rheumatic Diseases in Bath, England, Agarwal et al. (1970)[2] and Sadowska-Wroblewska et al. (1976)[7] have all reported abnormal thermograms associated with inflammatory changes in the sacroiliac joints. An outstanding example is illustrated in the Fig. 4. The asymmetry is obvious, but equally obvious is the difficulty of quantification. Last year, during the symposium on thermography of bone and joint diseases held at Bath, England, Sadowska-Wroblcwska described the work which she and her co-workers have been conducting at the Institute of Rheumatology in Warsaw, Poland (Sadowska-Wroblewska et al. 1976) aimed at quantifying the lumbar thermograms. Francis Ring informs me that he and his colleagues at Bath have embarked on a comprehensive program to study the aetiology and pathological history or ankylosing spondylitis, and that the study is to include a project aimed at assessing the role of thermography in the detection and management of the disease, which will of course necessitate the development of quantifiable criteria.

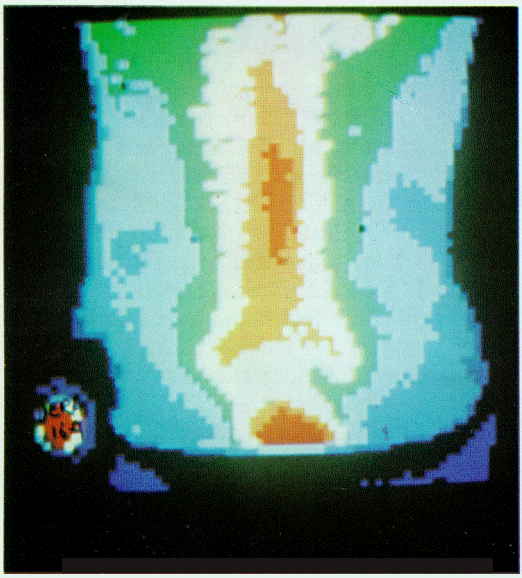

fig. 4. Colour i5otlmniogram (scale length 3.5 °C. temperature reference 34.5 "C) of a patient with ankylosing spondylitis. (Courtesy of Francis Ring, Bath, England).

HERNIATED LUMBAR DISCS AND MUSCULOLIGAMENTOUS INJURIES

Raskin (1976)[6] has recently reviewed the role of thermography in the diagnosis of low back disease, including an evaluation of the use of thermographic examinations for patients presenting with clinical disc symptoms. He discussed the types of thermographic abnormality produced by herniated discs and concludes that lumbar thermography might be a useful procedure, but points out that although a positive thermogram indicates a high probability of an abnormal myelogram, the converse is not true, and the myelographic findings cannot be accurately predicted by a negative thermogram.

Raskin (1976) indicated that he felt that thermography had a particularly important role to play in the diagnosis and management of musculoligamentous injuries. We are presently engaged in our own assessment of the value of thermography in the diagnosis of the causes of lower back pain but our project is still in its infancy.

SCOLIOSIS

To date, most of our work on the back has revolved around a project aimed at assessing the effect of scoliosis on back thermograms. This work stemmed from an observation by Cooke and Pilcher (well known for their pioneering work on the use of thermography to diagnose deep venous thrombosis; Cooke (1976)[3]. They had the insight to thermograph the backs of some of the children attending their Scoliosis Clinic in London at the Great Ormond Street Hospital for Sick Children and found a considerable asymmetry in the resulting thermograms. When our thermography unit was set up at Saint Bartholomew's Hospital in London, Ernest Cooke suggested to me

that scoliosis was a worthwhile topic for further investigation by thermography and we agreed to cooperate in a combined study. I must stress that this study is still at a very preliminary stage and it is too early to formulate conclusions.

The Fig. 5 is an example of the pattern originally associated with scoliosis. The thermogram is of a child with a 15" curve in the lumbar spine, concave on the left hand side. Fig. 5 is the most clear cut example of the pattern that we have, and typically, during the course of our study we have found children with mild scoliosis whose thermograms appear normal, and conversely, some of the children considered to have abnormal thermograms, have been shown to have radiologically straight spines. The Figures 6 and 7 are examples of' such cases, the first (Fig. 6) shows the thermogram of a child who was classified as having a normal thermogram but was referred for further investigation because visual inspection indicated a postural abnormality. Subsequent radiological examination revealed a 10 curve, concave on the left hand side. The second example (Fig. 7) is the thermogram of a child, classified as thermographically abnormal but found to have a radiologically straight spine. These false positives and negatives

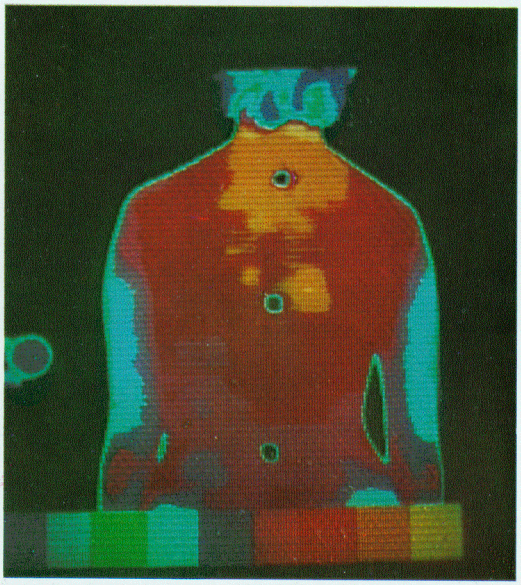

Fig. 5. Colour isothermogram (scale length 4.5 °C, temperature reference 32°C) of the type of pattern originally associated with scoliosis.

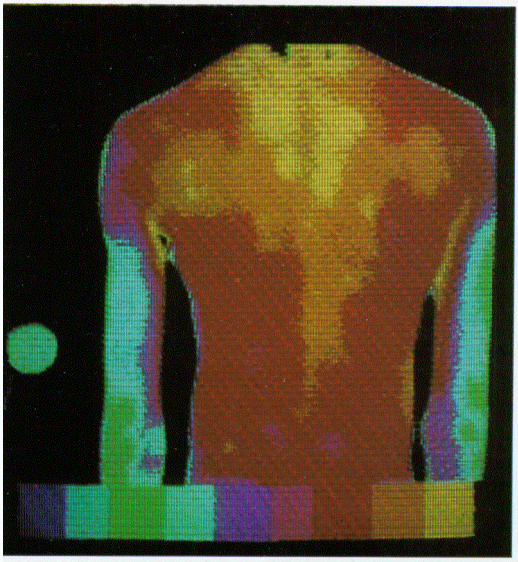

Fig. 6. Example of a colour isothermogram (scale length 4.3 °C, temperature reference 32 "C) originally classified as normal from a child found to have a 10" curve to the left.

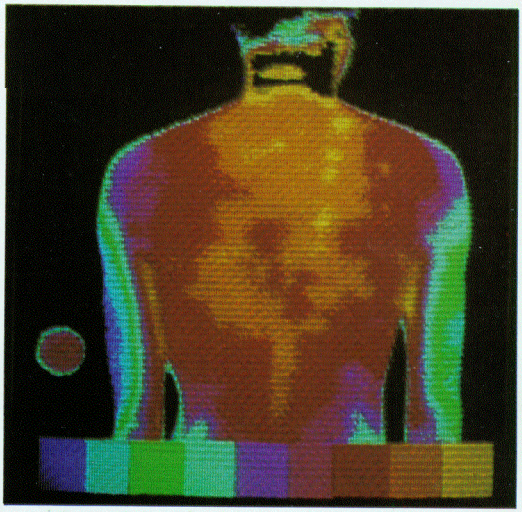

Fig. 7. Example of a colour isothermogram (scale length 4.5 °C, temperature reference 32 "C) originslly classified as abnormal from a child with a radiologically straight spine.

might turn out to be the result of inadequacies in the criteria used to classify the thermograms, but it might also turn out that while the radiograph is an image of the growth that has

occurred in the past, the thermogram reflects the growth that will occur in the future. I other words, these thermograms, rather Ntlmn being false negatives and positives, might be indicating That the spine is destined to spon taneously straighten or bend. To be of real clinical use, thermography must be able to identify those children that are destined to develop curves of 20" or more. Clearly, whe. ther this is possible will only be revealed after many years of follow-up.

At the seminar held in Bath last year, I reported three principal types of thermogram which I considered abnormal. The criteria for this categorisation was purely personal and subjective and related only to the thermographic pattern, s0 that any rarely seen thermographic pattern was classed as abnormal. Thosc patterns which could be explained as variants of the common patterns were, of course, classed as normal. The pattern seen in the very obese or the easily recogniscd << leopard. spot » pattern are particular examples that come to mind.

In addition to the abnormal pattern just discussed, I considered the arrow head pattern in Fig. 8 to be abnormal. This is somewhat similar to the pattern observed by Abernathy et al. (1971) to be associated with coarctation of the aorta. Finally in 5 cases out of a school screening survey consisting of 113 children. a very marked, well-defined, asymmetry was observed. The figures 9, 10, 11, 12 and 13 are the thermograms in question and i think that you will agree with me that they are thermographically, very abnormal indeed. So unusual are these thermograms that I must insist that they were not produced by a machine fault! Each of these children were radiographed, 2 (Figs. 9, 10), had radiographically straight spines, 2 (Figs. 11, 12) had the slight suspicion of a curve but these were not measurable, and one (Fig. 13) had an 1 I-15" curve

Clearly, only long term follow-up will reveal the nature and significance of this thermographic abnormality. In particular, the fate of the four children round to have radiologically straight spines. The organisation or the screening survey necessitated considerable delay between the initial thermographic examination> and the radiographic examinations, but future follow-up of these children is planned with

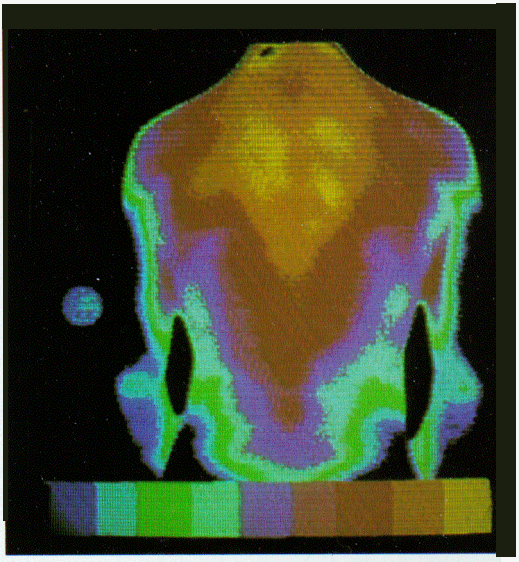

Fig. 8. A colour isothermogram (scale length 4.5 "Ç. temperature refreence 32 "C) showing the « arrow-head » pattern.

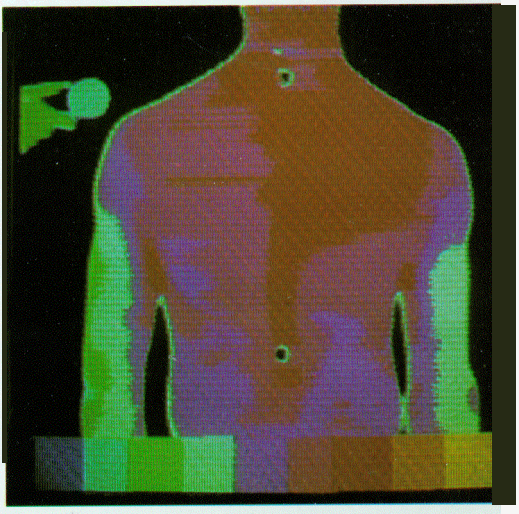

Fig. 9. Colour isothcrmogram (scale length 9 "C, temperature reference 32 "C) refer to text.

both thermographic and radiological examination within the same week.

Of the 113 children examined in the school screening survey, 58 were sent for clinical and radiographic examination on the grounds that they had an abnormal thermogram or that they appeared (to my eyes) to have some form of postural abnormality which gave me the im-

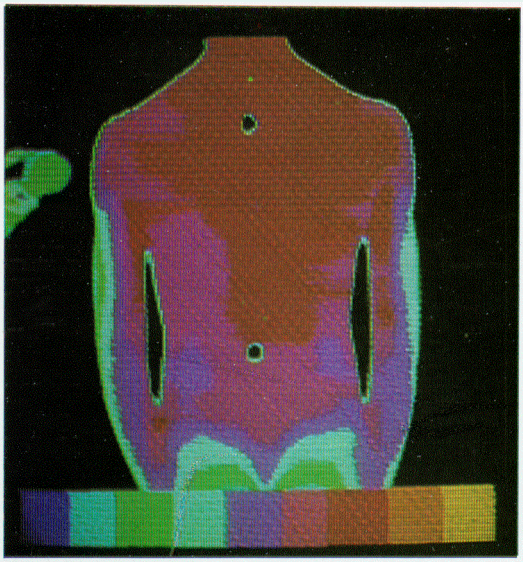

Fig. 10. Colour isothermogram (scale length 9 °C, temperature reference 32 °C) refer to text.

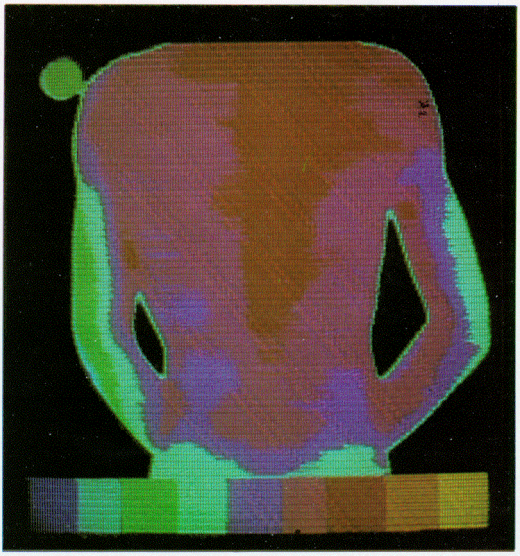

Fig. 12. Colour isothermogram (scale length 9 °C, temperature reference 32 °C) refer to text.

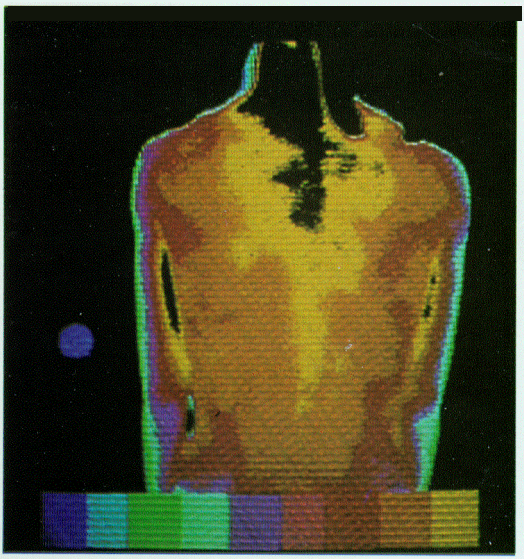

Fig. 11. Colour isothermogram (scale length 4.5 °C, temperature reference 32 °C) refer to text.

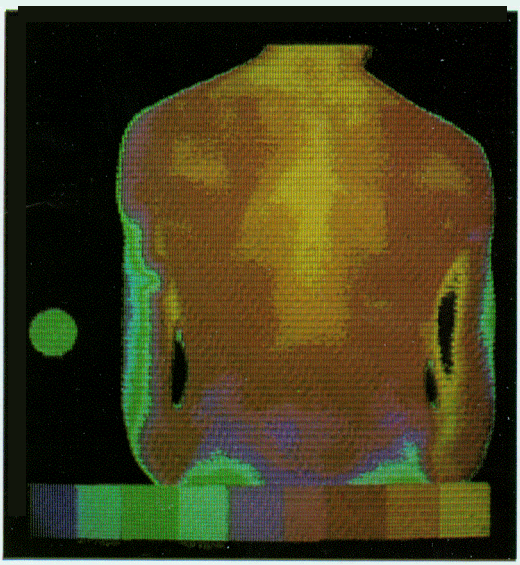

Fig. 13. Colour isothermogram (scale length 4.5 °C, temperature reference 32 °C) refer to text.

pression that their spines were not straight. Subsequent analysis indicates that while thermography has picked up about 30% more scoiiotic curves than visual examination, the number of apparently false positives is increased by about the same proportion. This proportionality exists despite the fact that there is agreement between the visual and thermographic findings of abnormality in only 22% of the cases. 31 cases of scoliosis were diagno-

sed from the group of 58 children referred for radiological examination. Of these, only 5 had curves greater than 11" and 4 of these were picked out by visual examination as well as thermographic examination. One curve greater than 11" was picked out by thermographic examination alone, but the greatest curve seen (between 16° and 20°) was picked out both thermographically and visually. Allow me to stress again the fact that this is an on-going study, and that of particular importance is the degree of correlation between the thermogram and the subsequent growth of the spine. We still have the difficult task of following up children considered thermographically normal in order to determine the percentage of false negatives. This information will take a long time to acquire, but is being pursued by my colleagues, Ernest Cooke and Linda Carter.

CONCLUDING REMARKS

Our work at Saint Bartholomew's Hospital is particularly aimed at the assessment and development of thermographic techniques and applications, and although in this lecture I have been speaking primarily about the back, this is but one aspect of our work. Thermology, perhaps more than any other discipline, has to consider the physiology and health of the whole body rather than a localised area of interest. I believe that thermography of the back can be a useful adjunct to existing diagnostic techniques, but there remains a great amount of work to be done.

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