

Quantitation of thermography in arthritis using multi-isothermal analysis

II. Effect of nonsteroidal anti-inflammatory therapy on the thermographic index

E. F. J. RING, A. J. COLLINS, P. A. BACON, AND J. A. COSH

From the Arthritis and Rheumatism Council Research Group, Royal National Hospital for Rheumatic Diseases, and the Pharmacology Group, University of Bath

Thermography has been used to quantify the inflammation of active joints in rheumatoid arthritis (Collins, Ring, Cosh, and Bacon, 1974). The numerical measure used was the thermographic index (TI), calculated from the areas of the isotherms shown on the thermogram. The effectiveness of the method was shown using the accepted anti-inflammatory

properties of an intra-articular injection of a steroid.

We report here that oral nonsteroidal anti-inflammatory agents used in rheumatoid arthritis and gout also reduce the TI, which can thus be used as a measure of drug action.

Methods

The thermographic apparatus, and the conditions for thermography, were as described by Collins and others (1974). The effects of three oral nonsteroidal anti-inflammatory compounds were investigated and compared with the effect of a steroid given by intra-articular injection.

Three different anatomical areas were studied, choosing clinically inflamed target joints. The thermograms of knee, hand, and foot areas were defined for analysis as follows.

Knee (anterior aspect) An area of 100 cm², including the whole of the patella.

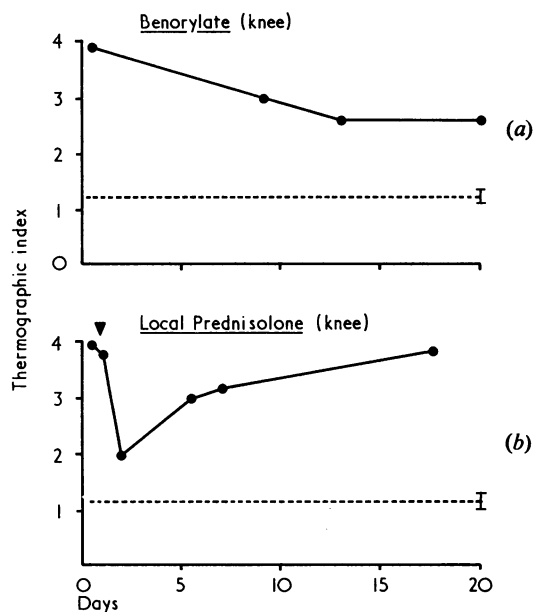


FIG. 1a Thermographic indices of acute rheumatoid arthritis knee. Benorylate (8 g/day) was given after the first recorded index. The broken line represents the normal range of thermographic index, with its standard error of the mean shown as a vertical bar. (b) Indices of acute rheumatoid arthritis knee. Single intra-articular injection of prednisolone (Ultracortenol, Ciba) given after first thermogram. Broken line indicates normal index ranges; SEM is shown as a vertical bar

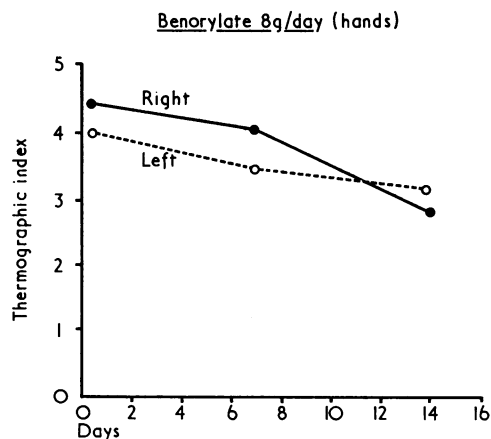


FIG. 2 Thermographic index measured over 14 days from the dorsal surface of the left and right hands of a patient with rheumatoid arthritis. Before the first thermogram, the patient was maintained on paracetamol 3 g/day, then on benorylate 8 g/day

Hand (dorsal aspect) An area of 50 cm², including the metacarpo-phalangeal joints and wrist.

Foot (medial aspect) An area of 75 cm², including the first metatarso-phalangeal joints and forefoot.

Results

The effect of oral benorylate (Winthrop) in a dose of 8 g/day is shown in Fig. 1a. The thermograms were taken from the knee in a patient with rheumatoid arthritis (RA). Therapy was started immediately

after the first thermographic measurement. For comparison, Fig. 1b shows the effect of a single injection of 100 mg prednisolone trimethyl acetate (Ciba) into the knee of a different patient with RA. Both knees were acutely inflamed and had similar TIs initially. In both cases there was a marked fall in TI, though the rate of change was very different. The effect of benorylate 8 g/day was assessed in another patient with RA, using thermograms of hands (Fig. 2). Serial measurements were made over 14 days; a marked fall in TI

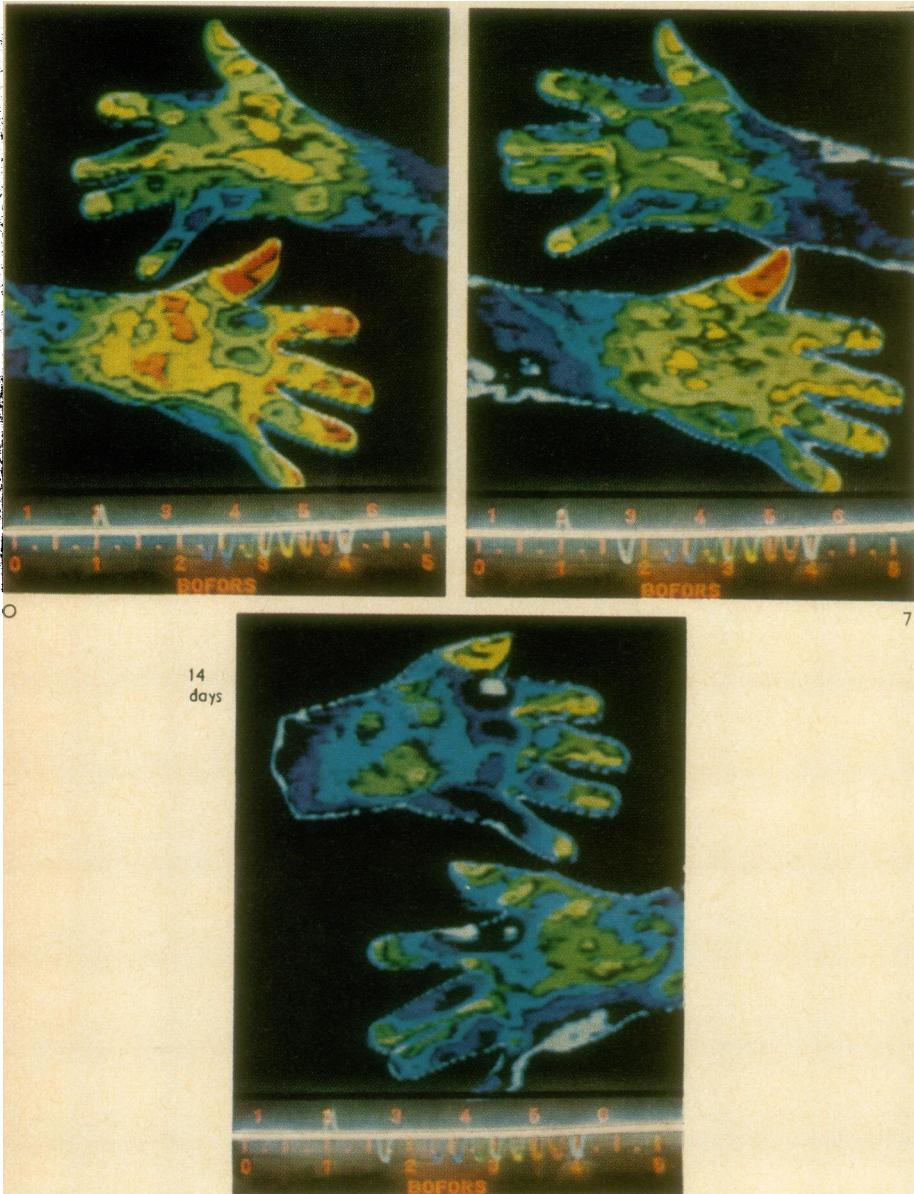


FIG. 3 Colour thermograms of the hands illustrated in Fig. 2, taken at 0, 7, and 14 days of benorylate therapy

was shown in both hands. The original colour thermograms are shown in Fig. 3. The effect of aspirin 4.8 g/day (9 days) is shown in Fig. 4. A fall in the index was seen after 2 days and this was more marked at 16 days. During a prior paracetamol period of 7 days, the TI had increased.

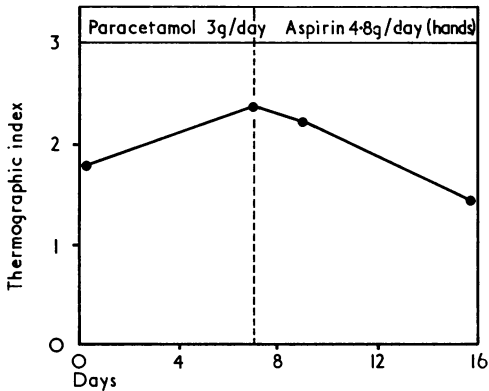


FIG. 4 Measurement of the thermographic index from the dorsal surface of the right hand of a patient with rheumatoid arthritis. Paracetamol 3 g/day and aspirin 4.8 g/day were given orally during the two periods shown

The effect of oral indomethacin (M.S.D.) in acute gout involving the great toe is shown in Fig. 5. Two doses of 50 mg indomethacin were given with an interval of 6 hours. Serial measurements were made over a period of 24 hours. A rapid fall in TI was observed, reaching its lowest point after 18 hours, in parallel with dramatic clinical improvement. In the absence of further anti-inflammatory therapy, a minor increase in the index was then measured up to 24 hours.

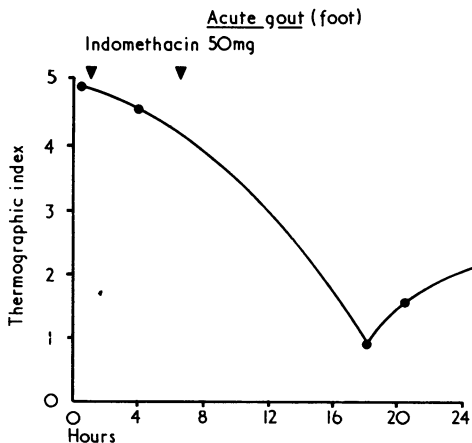


FIG. 5 The effect of indomethacin on the thermographic index of an inflamed foot. Indomethacin 50 mg was given orally on two occasions (arrowed)

Discussion

The thermographic technique described measures changes in temperature of an inflamed area, and is thus able to quantify inflammation. It has been shown that local anti-inflammatory steroid injections bring about a sharp fall in the TI of an inflamed joint (Collins and others, 1974). The index can be used as a measure of anti-inflammatory therapy. The examples shown here have been selected to show the effect of three anti-inflammatory, oral regimens on three different joints.

The fall produced in the TI after injection of local anti-inflammatory steroid is rapid. This contrasts with the slower change in TI produced by oral anti-inflammatory treatment. However, sustained oral therapy caused the index to fall almost to the level achieved by local steroid injection in the cases shown. It has recently been suggested that nonsteroidal anti-inflammatory agents are not only less powerful, but act in a different manner to corticosteroids (McConkey, Crockson, Crockson, and Wilkinson, 1973). This may be true for the acute phase proteins measured by these authors. We have shown here that aspirin, benorylate, and indomethacin have a powerful effect on the vascular aspects of synovial inflammation, almost equivalent to that of steroids, though with a different time course.

The method is able to distinguish between analgesic and anti-inflammatory activity. This was shown by the continuing rise of the TI in a patient during paracetamol therapy, followed by an immediate fall when a recognized anti-inflammatory drug— aspirin—was introduced. The case illustrated is typical of our findings when paracetamol has been used in cross-over studies with anti-inflammatory drug therapy.

Any superficial joint can be examined thermographically and we have shown three examples here. Where a number of small joints in close proximity are inflamed, as in the hand, a compound TI is obtained. This corresponds to clinical assessment where such joints as the metacarpo-phalangeals are often examined as a unit, as in the articular index of Ritchie (Ritchie, Boyle, McInnes, Jasani, Dalakos, Grieveason, and Buchanan, 1960).

The technique is harmless, non-invasive, and reproducible (Haberman, Sisk, Tourtellotte, Birtwell, and Martin, 1971). Repeated measurements can be made to follow drug action over a few hours or a number of weeks. This is an advantage over isotope methods of studying inflammation. The TI provides an objective tool in assessing and comparing the effects of anti-inflammatory drugs in arthritis.

Summary

The thermographic index (TI) has been used to measure the effect of nonsteroidal anti-inflammatory agents in rheumatoid arthritis and gout. The effect

of three compounds— aspirin, indomethacin, and benorylate—has been studied in three anatomical areas—knees, hands, and the foot. The effect of these drugs has been compared with an analgesic and an intra-articular anti-inflammatory steroid. The method is suitable for measuring short or long-term response

to anti-inflammatory therapy. It is objective and harmless.

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