Patterns of Sensory Loss in Lepromatous Leprosy

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Sensory loss plays a key role in the development of the digital absorption and trophic ulceration which characterize leprosy. When host resistance is high as in tuberculoid and some dimorphous cases, the sensory loss tends to be roughly extensive with skin lesions, whereas all types of leprosy may develop typical nerve trunk sensory deficits. In lepromatous leprosy the pattern of sensory loss has been less precisely defined as "stocking-glove" in distribution. This pattern, strictly interpreted, is seen only in hysteria, but the expression is often used to describe the familiar pattern of symmetric distal sensory loss with gradual increase in acuity to normal as one moves proximally. This pattern, seen in a variety of toxic, metabolic, nutritional, and hereditary neuropathies, is likely related to an increasing vulnerability of the nerve fibers as the distance from their cell bodies increases. Absent deep tendon reflexes are commonly associated with these neuropathies. Patients with lepromatous leprosy do not show this type of purely distal symmetric sensory loss and absent reflexes are exceptional. Nor do the patterns of sensory deficits conform perfectly to the distribution of subcutaneous nerves, nerve trunks or nerve roots. This paper attempts to correlate the configuration of sensory loss in lepromatous leprosy with the relatively cool surface areas of the body.

MATERIALS AND METHODS

The Barnes Medical Thermograph (Model M-1A) was used to make photographs of the infrared radiation emitted from various areas of the skin of normal subjects and of lepromatous patients. Leprosy patients may show alterations in skin temperature due to destruction of autonomic nerve fibers. Figure 1 shows the thermal gray scale; each square, moving from dark to light, representing a carefully calibrated fixed temperature source with increments of one degree over the range of 29.0°–38.0°C. The number of shades of gray between total saturation (white areas) and no saturation (black areas) is the temperature delta (AT) and is indicated with each thermograph. Though the ambient temperature was maintained at 72–74°F, no effort was made to control emotional state, level of prior physical activity, time of most recent meal, etc., because our goal was not to establish normal values for skin temperature, but to observe any constant features in the temperature patterns. Sensory examinations were carried out for pinprick by the usual clinical methods. Patients were cautioned to make the distinction between pressure and a painful pricking sensation. Twenty-five cases with histologically established lepromatous leprosy were examined.

RESULTS

The results are best appreciated by comparing the sensory and thermal patterns in the accompanying representative illustrations. A few general points might be emphasized on a regional basis.

The extremities. The earliest deficits of sensation occur in both upper and lower extremities. In the lower extremities, the dorsum of the feet and lateral aspects of the legs are first involved while in the upper extremities sensory loss occurs earliest over the dorsal aspects of the hands and forearms (Figs. 2, 13). Skin surface temper...
INTERPRETATION OF THE THERMAL GRAY SCALE

**Fig. 1.** Interpretation of the Thermal Gray Scale.

**Fig. 2.** Early sensory loss in lepromatous leprosy.
Areas of sensory sparing in more advanced lepromatous leprosy.

**DISCUSSION**

The observations on the significance of temperature as a determinant of the distribution of the lesions in lepromatous leprosy are longstanding. In 1916, Dyer and
Hopkins (8) in testimony before the United States Senate concerning the establishment of a national leprosarium speculated that the location of leprosy lesions and the death of bacilli with fevers indicated that elevated temperature impedes the growth of M. leprae. In 1956, Binford (4) suggested that the apparent propensity of M. leprae to grow at relatively cool temperatures should be considered in attempts to grow the bacilli in animals. Brand (6) in 1959, re-emphasized the fact that the skin, anterior third of eyes, nerves, testes, and upper respiratory mucous membranes were the major sites of destruction in lepromatous leprosy and these sites were likely some degrees below core body temperature. The clearly segmental involvement of nerves at sites where they are most superficial was lucidly underscored.

Recently, Hastings et al. (9) demonstrated that the stripe down the center of the back averaged 1.3°C warmer than areas 10 cm. lateral to it, and that biopsies from these areas showed statistically significant fewer bacilli in the midline warm area. Shepard (12, 13) found that the most active proliferation of M. leprae occurred when the temperature in the mouse foot pad was lowered to a range of 27-30°C.

![Figure 4](image-url)

**Fig. 4.** A. The medial aspect of the leg (left) is slightly warmer than the lateral aspect (right) (ΔT=3.5). B. The dorsal surfaces of the feet are cooler than C. plantar surfaces (ΔT=7°C).
FIG. 5. The palm and antecubital fossa (upper) are warmer than surrounding and dorsal (lower) skin surfaces (Δ T = 0°C).

FIG. 6. A thermograph of the lumbar back showing the stripe of relatively warm skin down the center (Δ T = 0°C).
FIG. 7. Thermograph of anterior trunk with arms abducted to show warmth of axillae (Δ T=5°C).

FIG. 8. Thermograph of the buttocks and legs demonstrating the relative warmth of the low mid back, intergluteal fold and popliteal fossae (Δ T=5°C).
Such evidence indicates that the growth rate of *M. leprae* is exquisitely sensitive to the temperature of its milieu in a situation of low host resistance. The sensory patterns depicted here suggest that the basic pattern of sensory loss in lepromatous leprosy is determined by relative skin temperature and apparently follows the bacterial density in the skin. This pattern of sensory loss tends to involve the cooler skin surfaces earliest and then progresses on the basis of relative skin temperature. The scalp (when covered by hair), the axillae, the intergluteal fold and the inguinal areas are all warm areas that tend to show normal sensation even in far advanced cases. This basic pattern may be modified by areas of anesthesia due to pre-existing dimorphous leprosy, or the superimposition of a typical nerve trunk deficit.

**SUMMARY**

Thermographs depicting skin temperature patterns of normal subjects are compared with the configuration of sensory loss to pinprick in a series of patients with...
lepromatous leprosy. Sensory loss appears to begin in the cooler skin surfaces and progresses on the basis of relative skin temperature. This pattern is modified by the presence of a pre-existing patch of sensory loss due to dimorphous leprosy or the superimposition of sensory loss typical of a nerve trunk lesion. Evidence that the proliferation of *M. leprae* is favored by an environmental temperature several degrees below core body temperature is briefly reviewed.

![Fig. 10. Sensory loss on the face.](image)

![Fig. 11. Thermograph of face (△ T=7°C).](image)
Fig. 12. Extensive sensory loss on face with sparing under scalp hair and in the deep nasolabial folds.

Fig. 13. The patch of sensory loss on the left thigh antedated the symptoms of lepromatous leprosy by 22 years.
RESUMEN

Termógrafos dibujando modelos de la temperatura de la piel en personas normales se comparan con la configuración de la pérdida al alfilerazo en una serie de pacientes leprosos lepromatosos. Pérdida sensoria aparece comenzar en las superficies mas frescas de la piel, y progresa en la base de la temperatura relativa de la piel. Este modelo se modifica por la presencia de una mancha pre-existente de pérdida sensoria debida a lepra dimorfa o la superimposición de pérdida sensoria típica de una lesión del tronco nervioso. Evidencia indicando que la proliferación de M. leprae se favorece por una temperatura ambiente unos grados bajo la temperatura básica del cuerpo se revisa brevemente.

RESUME

On a comparé des thermographes fournis­sant les profils de la température cutanée chez des sujets normaux, avec la configuration de la perte de la sensibilité à la piqure dans une série de malades atteints de lèpre lépromateuse. Il apparaît que la perte de la sensibilité débute dans les surfaces cutanées les plus froides, et progresse selon la température relative de la peau. Ce profil est modifié par la présence de zones pré-existantes de perte de la sensibilité, dû à la lèpre dimorphe, ou à la sur-impression d’une perte de sensibilité typique d’une lésion des troncs nerveux. On passe brièvement en revue les données qui révèlent que la prolifération de M. leprae est favorisée par une température du milieu de plusieurs degrés inférieure à la température interne du corps.

Acknowledgment. The authors wish to express their appreciation to Paul W. Brand, FRCS, CBE, for his advice and encouragement in this study.

REFERENCES