INTERNATIONAL JOURNAL OF LEPROSY Volume 54, Number 4
Printed in the U.S.A.

Objective Grading of the Loss of Pain and Touch Sensations in Leprosy Patients[1]

Ganpat Lal Jain, Jagjit Singh Pasricha,
and Sujoy Kumar Guha[2]

Current methods of evaluating the sensations of pain and touch in leprosy patients, using a pin and cotton wool, respectively, are crude. For evaluating pain sensation, it is difficult to keep a constant pressure on the pin. Moreover, the angle of the pin and the quality of its tip also affect the intensity of the stimulus. Evaluation by different individuals can add further errors. Similarly, the touch stimulus can also vary from one individual to another and from one test to another. Hardy, *et al.* ([2]) devised a system of exposure to thermal radiation to evoke a pain sensation and to measure the pain threshold. Although the system was accurate, it was too complicated for routine use. Antia, *et al.* ([1]) used a straight and sharp cutting needle loaded with a 4 g weight as a standardized pain stimulus. This system, however, did not have any provision for grading sensory loss. For grading the loss of touch sensation, nylon threads of different thicknesses have been used by different workers ([1, 4, 5, 6, 9]). One of us ([7]) designed three devices for applying standardized stimuli and for grading the loss of the temperature, pain, and touch sensations. The method of grading the loss of temperature sensation ([3]) and preliminary studies on grading the loss of touch and pain sensations ([8]) have already been reported.

The present report describes the further use of these devices for testing and grading the loss of pain and touch sensations.

[1] Received for publication on 25 November 1985; accepted for publication on 14 May 1986.

[2] G. L. Jain, M.Sc., Senior Scientific Officer-I; S. K. Guha, B.Tech.(Hons), M.Tech., M.S., Ph.D., M.B.B.S., Professor and Head, Centre for Biomedical Engineering; J. S. Pasricha, M.D., Ph.D., F.C.A.I., Associate Professor, Department of Dermatology and Venereology, All India Institute of Medical Sciences, New Delhi 110029, India.

Reprint requests to Dr. Pasricha.

MATERIALS AND METHODS

Pain Sensation Testing and Grading device. This measuring device (Fig. 1) consists of a spring-loaded needle which protrudes from a metallic housing. The tip of the needle is especially designed and is used to provide the pain stimulus. At the other end of the housing is a piston divided into four equal parts along its length. By pressing the piston to varying lengths, the pressure on the needle can be increased to obtain stimuli of graded intensities.

Touch Sensation Testing and Grading device. This measuring device (Fig. 2) consists of a bead mounted on the tip of a stainless-steel wire. The wire is connected to a spring-loaded piston which can move the wire in and out of a metallic housing. The diameter and the length of the wire when fully protruded are 0.4 mm and 40 mm, respectively. When the bead is pressed against the skin to produce a gentle bend in the wire, it provides a measured touch stimulus. By step-wise decreasing the length of the wire protruding from the housing, the intensity of the touch stimulus can be correspondingly increased.

Subjects. This study was undertaken on leprosy patients, mostly TT, BT, or BL. None of the patients was in reaction. In the initial 97 patients, grading of the loss of pain and touch sensations was carried out only at the center of the lesion. This grading was repeated at every subsequent visit of the patient, and the grades so obtained were compared with the grades recorded previously. Later on in this study, the whole lesion was charted on a centimeter-graph paper and the sensory loss at some of the 1 cm square areas of the lesion was graded. This charting was repeated at every subsequent visit of the patient. All patients were given specific treatment for leprosy with two or even three drugs.

Testing methods. The sensory loss at the

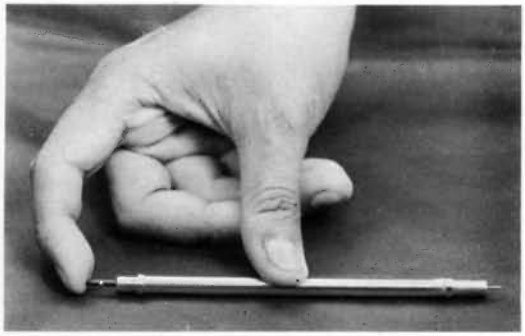

FIG. 1. Pain Sensation Testing and Grading device.

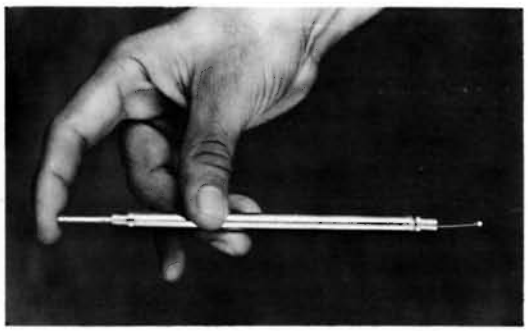

FIG. 2. Touch Sensation Testing and Grading device.

lesion was graded by comparison with the sensation perceived at the corresponding unaffected area on the opposite side of the patient's body, or on the unaffected area adjoining the lesion in case the contralateral side of the body was also involved.

The pain sensation was tested by pressing the needle of the Pain Sensation Testing and Grading device against the skin area with a pressure which pushes the needle completely inside the metallic housing. The stimulus was applied first at the unaffected normal skin and then at the affected skin area. If the patient perceived pain on the lesion equal to the pain sensation on the normal skin, the sensory loss was graded as 0 (no sensory loss). In case he perceived it as less, the intensity of the stimulus was increased stepwise until the patient perceived it to be equal to the sensation on the normal skin. The sensory loss was graded accordingly. If the patient did not perceive the stimulus of even the maximum intensity, the sensory loss was considered to be grade 5 (complete loss).

The touch sensation was tested in a similar manner by comparing the sensation on the lesion with that on the contralateral normal skin.

TABLE 1. *Grades of sensory loss at the center of the lesion of leprosy patients.*

Sensation	No. of lesions having sensory loss of grade						Total
	0	1	2	3	4	5	
Pain	8	6	14	26	19	37	110
Touch	12	3	5	9	15	22	66

RESULTS

The first part of this study included 97 patients, 63 males and 34 females between 12–80 years of age, having had the disease for 3 months to 17 years. In 13 patients, two lesions were evaluated, making the total number of lesions 110. Forty-four lesions were evaluated for pain sensation only, while the remaining 66 were evaluated for both pain and touch sensations. The grades of sensory loss at the center of these lesions during the patient's first visit are given in Table 1.

Forty-six of these lesions were evaluated again at a later date for both pain and touch sensations. For the pain sensation, 17 lesions showed a decrease in the grade of sensory loss, indicating an improvement in the perception of pain. Four lesions showed an increase in grade (Table 2), while the remaining 25 did not show any change in grade. Of the 17 lesions showing a decrease in grade, three had complete loss of pain sensation at their first visit. Similarly, for the touch sensation 10 lesions showed a decrease, 1 lesion showed an increase (Table 3), while the remaining 35 did not show any change in grade of sensory loss. Of the ten lesions which showed a decrease in grade, five lesions had complete loss of the touch sensation at their first visit. These changes in the grades of sensory loss for both pain and touch sensations occurred at intervals ranging between 2 and 40 weeks.

Twenty-eight lesions in 21 patients were studied by charting the whole lesion. Three of these lesions had complete loss throughout the lesion, while four lesions had no loss

TABLE 2. *Change in grades of pain sensation following specific treatment for leprosy.*

Patient no.	Grades of sensory loss for pain		Interval between visits (weeks)
	First visit	Subsequent visit	
1	3	2	4
2	2	1	4
3	2	1	4
4	3	0	24
5	5	4	8
6	2	1	4
7	3	2	12
8	2	1	4
9	5	3	16
10	4	2	8
11	3	2	2
12	4	3	9
13	3	4	40
14	2	3	4
15	3	1	14
16	4	1	32
17	4	5	16
18	3	2	12
19	2	3	4
20	2	1	2
21	5	2	24

TABLE 3. *Changes in grades of touch sensation following specific treatment for leprosy.*

Patient no.	Grades of sensory loss for touch		Interval between visits (weeks)
	First visit	Subsequent visit	
1	5	3	24
2	5	4	8
3	2	1	4
4	5	0	40
5	5	4	32
6	3	1	12
7	2	1	12
8	4	5	4
9	3	1	12
10	2	1	2
11	5	3	24

of sensation for either touch or pain. In the remaining 21 lesions, the sensory loss for pain ranged between grades 1 and 4. For the touch sensation, 2 lesions had complete loss, 1 lesion had no loss, and in 18 lesions the sensory loss ranged between grades 1 and 4. Eleven of these lesions were evaluated again on a subsequent visit after 2–18 weeks. Seven of these lesions showed a decrease for touch sensation only, while two lesions did not show any change for either sensation. The size of four lesions decreased and one lesion increased in size.

Sensory loss in these lesions was neither uniform nor always maximum at the center of the lesion. At the margin of the lesions, however, it was generally less in comparison to the central area. The grades of sensory loss in one of the lesions charted on the first visit and two subsequent visits, at 4 weeks of 4 and 18 weeks, respectively, are shown in Figure 3.

DISCUSSION

The perception of touch and pain stimuli is likely to vary depending upon the alertness of the patient, emotional status, condition of the skin, and the immediate environment of the individual ([10]). In addition, the perceptibility can also vary from individual to individual and from one area of the body to another in the same individual. It has been reported to be less in adults than in children and less in females than in males ([10]). However, when the grading of sensory loss is based on comparison of the perception at the affected skin area with that at the contralateral unaffected area of the same individual at the same time, the effect of these factors would tend to be eliminated.

The reproducibility of our method was checked by grading the sensory loss in each of the 1-cm-square areas of the entire lesion in three patients by two independent investigators. The grades of sensory loss obtained by the two investigators were identical in most of the areas although in some areas the values differed by one grade. This confirms that our method of testing is by and large reproducible and that these devices are useful in objectively grading the loss of these sensory modalities.

The grading of sensory loss and the charting of lesions is especially useful in objectively evaluating the progress of the lesion. Changes in size as well as in sensory loss can easily be compared with previous records. It is also interesting to note that sensory loss is neither uniform all over the lesion nor always maximum at the center of the lesion.

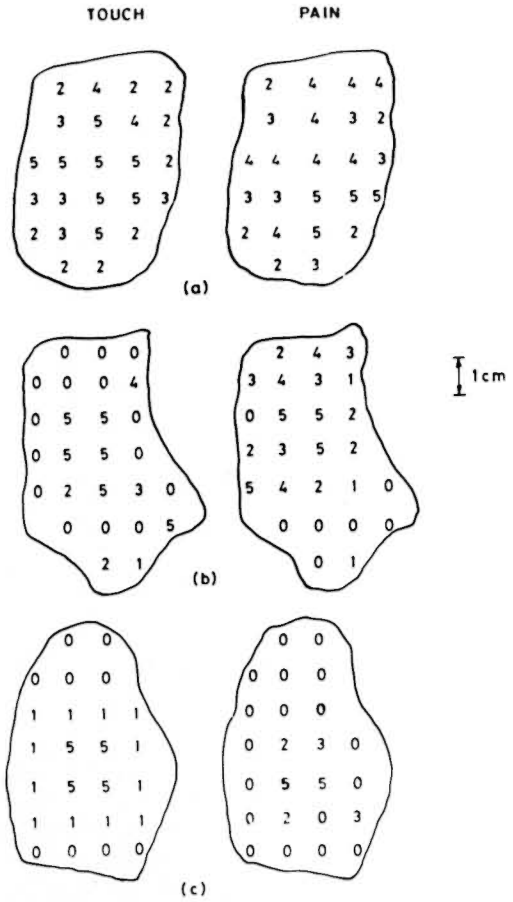

FIG. 3. Outline of a lesion with grades of sensory loss at each centimeter square area at first visit (a), second visit after 4 weeks (b), and third visit after 18 weeks (c).

SUMMARY

Two new instruments named Pain/Touch Sensation Testing and Grading devices, which provide standardized and graded stimuli of pain and touch, respectively, were employed to grade the sensory loss at the center of 110 lesions in 97 patients. The grades of sensory loss for pain were 0 (no sensory loss) in 8 lesions, 1 in 6 lesions, 2 in 14 lesions, 3 in 26 lesions, 4 in 19 lesions, and 5 (complete loss) in 37 lesions (total 110 lesions). Grades of sensory loss for touch were 0 in 12 lesions, 1 in 3 lesions, 2 in 5 lesions, 3 in 9 lesions, 4 in 15 lesions, and 5 in 22 lesions (total 66 lesions). Reevaluation done after 2–40 weeks in 46 of these lesions revealed that the grade for pain had decreased in 17 lesions, increased in 4, and remained the same in 25. The grade for loss of touch sensation had decreased in 10, increased in 1, and remained the same in 35.

Grading of the sensory loss in most of the 1-cm-square areas of the entire lesion, done in 19 patients (26 lesions), revealed that the sensory loss was not uniform all over the lesion and it was also not maximum at the center of the lesion, though generally it was less at the margin in comparison with the central area. Follow up of 11 of these lesions revealed a decrease in the grades in 7 lesions for both pain and touch sensations, while 2 lesions showed a decrease in the grades for touch sensation only. A concomitant decrease in the size of the lesion was also observed in four lesions, while in one lesion there was an increase in size.

It is concluded that objective grading of the sensory loss in a lesion can be a useful additional parameter in assessing the progress of leprosy patients.

RESUMEN

Se emplearon 2 nuevos instrumentos para probar y cuantificar la sensación de dolor y toque en el centro de 110 lesiones en 97 pacientes. Los grados de pérdida sensorial al dolor fueron 0 (no pérdida sensorial en 8 lesiones, 1 en 6 lesiones, 2 en 14 lesiones, 3 en 26 lesiones, 4 en 19 lesiones, y 5 (pérdida completa) en 37 lesiones (110 lesiones en total). Los grados de pérdida sensorial al toque fueron 0 en 12 lesiones, 1 en 3 lesiones, 2 en 5 lesiones, 3 en 9 lesiones, 4 en 15 lesiones, y 5 en 22 lesiones (total 66 lesiones). La reevaluación hecha después de 2 a 40 semanas en 46 de estas lesiones reveló que la sensación al tacto disminuyó en 17 lesiones, aumentó en 4, y permaneció igual en 25. La sensación al dolor disminuyó en 10, aumentó en 1, y permaneció sin cambio en 35 lesiones.

La graduación de la pérdida sensorial en la mayoría de las áreas de 1 cm^2 de la lesión entera, hecha en 19 pacientes (26 lesiones), reveló que la pérdida sensorial no fue uniforme sobre toda la lesión y que tampoco fue máxima en el centro de la lesión, aunque en general fue menor en los márgenes que en el área central. El seguimiento de 11 de estas lesiones reveló una disminución en los grados en 7 lesiones tanto para dolor y para toque, mientras que 2 lesiones sólo mostraron una disminución de la sensación al toque. En 4 lesiones también se observó una disminución concomitante en el tamaño de la lesión mientras que en una lesión hubo un incremento en tamaño.

Se concluye que la graduación objetiva de la pérdida sensorial al dolor en una lesión puede ser un parametro adicional, útil en el establecimiento del progreso de un paciente con lepra.

RÉSUMÉ

Pour mesurer la perte de la sensibilité au centre de 110 lésions chez 97 malades on a utilisé deux nouveaux instruments, le "Pain/Touch Sensation Testing" et des instruments de gradation (Grading devices). Ces deux nouvelles méthodes permettent de stimuler la douleur et le toucher d'une manière standardisée et graduée. Dans huit lésions, on n'a enregistré aucune perte de sensation à la douleur. Une perte de degré 1 a été notée dans 6 lésions, de degré 2 dans 14 lésions, de degré 3 dans 26 lésions, de degré 4 dans 19 lésions, et de degré 5 (perte complète) dans 37 lésions. On a noté une perte de la douleur dans 110 lésions au total. En ce qui concerne la perte du sens du toucher, aucune perte n'a été notée dans 12 lésions; des pertes de degré 1 ont été observées dans 3 lésions, de degré 2 dans 5 lésions, de degré 3 dans 9 lésions, de degré 4 dans 15 lésions et de degré 5 dans 22 lésions, soit au total dans 66 lésions. Après 2 à 40 semaines, on a procédé à une réévaluation au niveau de 46 de ces lésions, avec les résultats suivants: la perte de la sensation à la douleur après avoir rétrogradé dans 17 lésions, s'était aggravée dans 4, mais était demeurée sans changement dans 25; en ce qui concerne la perte du toucher, elle avait rétrogradé dans 10 lésions, s'était aggravée dans une, et ne présentait aucun changement dans 35 lésions.

Au niveau de 26 lésions, présentes chez 19 malades, on a procédé à la mesure de la perte sensitive dans la quasi entièreté d'une zone de 1 cm^2, correspondant à l'entièreté de la lésion. Ceci a révélé que la perte de la sensation n'était pas uniforme partout dans la lésion, qu'elle n'était pas davantage plus prononcée au centre de la lésion, mais que le plus souvent elle était moins nette à la périphérie par comparaison au centre.

Un suivi de 11 de ces lésions a révélé une rétrogradation dans 7 lésions à la fois pour le sens du toucher et celui de la douleur; 2 lésions ont présenté une rétrogradation limitée au sens du toucher uniquement. Une diminution correspondante de la dimension des lésions a été observée dans 4 lésions, alors que dans une lésion on a relevé une augmentation de cette dimension. On en conclutque la mesure objective de la perte de la sensibilité au niveau des lésions de lèpre peut constituer paramètre supplémentaire utile pour suivre l'évolution de la maladie.

Acknowledgment. This study was supported in part by a grant from the Ministry of Social Welfare, Government of India.

REFERENCES

1. Antia, N. H., Mehta, L., Shetty, V. and Irani, P. F. Clinical, electrophysiological, quantitative, histological and ultrastructural studies of the index branch of the radial cutaneous nerve in leprosy. I. Preliminary report. Int. J. Lepr. **43** (1975) 106–113.
2. Hardy, J. D., Wolff, H. G. and Goodell, H. Studies on pain: a new method of measuring pain threshold, observations on spatial summation of pain. J. Clin. Invest. **19** (1940) 649–657.
3. Jain, G. L., Pasricha, J. S. and Guha, S. K. Minimum temperature felt as hot (MTH)—a new concept for grading the loss of temperature sensation in leprosy patients. Int. J. Lepr. **53** (1985) 206–210.
4. Jamison, D. G. Sensitivity testing as a means of differentiating the various forms of leprosy found in Nigeria. Lepr. Rev. **40** (1969) 17–20.
5. Lewis, S. Reproducibility of sensory testing and voluntary muscle testing in evaluating the treatment of acute neuritis in leprosy patients. Lepr. Rev. **54** (1983) 23–30.
6. Naafs, B. and Dagne, T. Sensory testing—a sensitive method in the follow-up of nerve involvement. Int. J. Lepr. **45** (1977) 364–368.
7. Pasricha, J. S. Standardisation of testing procedures in dermatology. Indian J. Dermatol. Venereol. Leprol. **48** (1982) 78–83.
8. Pasricha, J. S. and Dhillon, I. S. Monitoring the recovery of touch and pain sensations in leprosy with grading devices. Indian J. Dermatol. Venereol. Leprol. **51** (1985) 63–65.
9. Pearson, J. M. H. and Weddell, G. Changes in sensory acuity following radial nerve biopsy in patients with leprosy. Brain **94** (1971) 43–50.
10. Weddell, G., Jamison, D. and Palmer, E. Recent investigations into the sensory and neurohistological changes in leprosy. In: Leprosy in Theory and Practice. Cochrane, R. G., ed. Bristol: John Wright & Sons Ltd., 1959, pp. 96–113.