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EDITORIAL

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Corneal Sensation in Leprosy

The hallmark of leprosy is sensory loss. This clinical feature of leprosy has been extensively researched and applied to various aspects of leprosy diagnosis and therapeutics. Although sensory evaluation of the skin has undergone changes, from the use of feathers and pins to graded nylon monofilaments, it is a relatively simple procedure and has been widely used despite its limitations. This is not true of corneal sensation. Estimating corneal sensation has been largely restricted. There are many reasons for this, chief among them being the lack of understanding of what should be considered the most significant aspect of ocular leprosy.

More than 10.7 million cases of leprosy are reported to be cured of leprosy by multidrug therapy (MDT) in 1998.[1] It is not known how many of them have decreased corneal sensation in their eyes. Many who are multibacillary (MB) patients and who have a relatively long duration of disease are likely to have impaired corneal sensation. Decreased corneal sensation is the underlying factor that leads to corneal ulceration and scarring, and it has been reported that other than cataract, they constitute the leading cause of blindness in leprosy.[2] In order to decrease or prevent ocular morbidity and blindness in leprosy, sound knowledge of the various aspects of corneal sensation in leprosy is useful.

The cornea is supplied by the ophthalmic division of the trigeminal nerve via the anterior ciliary nerves and those of the surrounding conjunctiva. The anterior ciliary nerves enter the sclera from the perichoroidal space a short distance behind the limbus. They connect with each other and with the conjunctival nerves, forming pericorneal plexuses at various levels. The nerves from these plexuses pass into the cornea as 60–80 flattened, mainly myelinated branches about 8-μm wide and surrounded by perineurium. After about 1–2 mm they usually lose their myelin sheaths and divide into two groups—anterior and posterior. The anterior nerves (40–50) pass through the substance of the corneal stroma and form a plexus just below the Bowman's

[1] WHO Action Programme for the Elimination of Leprosy. Status report. Geneva: World Health Organization, 1998.

[2] ffytche, T. J. The prevalence of disabling ocular complications of leprosy: a global study. Lepr. Rev. **70** (1998) 49–59.

membrane. The nerves then penetrate the membrane and form a subepithelial plexus which gives rise to fine, free nerve terminals which branch dichotomously in the superficial epithelial layers. The posterior group of nerves (40–50) pass to the posterior part of the cornea to innervate the posterior stroma excluding the Descemet's membrane.[3]

There are several ways in which decreased corneal sensation can produce damage to the corneal surface of a leprosy patient:

a) The sensory supply of the cornea gives warning of injury and is regarded as the sentinel of the eye. A foreign body falling on a cornea that has decreased sensation is hardly noticed and the subsequent abrasion, if left unattended, can be difficult to heal[4] and can also become secondarily infected. Many of the corneal ulcers that have occurred in leprosy patients have been shown to occur in eyes that had reduced sensation. These patients also reported late for treatment since pain was not an early symptom. Sometimes this delay was calamitous and the only treatment was evisceration.[5] A misdirected eyelash which rubs against the cornea or conjunctiva can produce the sensation of itching in a patient with impaired corneal sensation. If such a patient should have calloused, deformed or ulcerated hands with anesthesia, then the efforts taken by the patient to deal with the itching eye by rubbing can produce severe injury to the corneal surface. Sensory loss in the hands and itching eyes with partially impaired sensation are a lethal combination. In a recent study of infectious corneal ulcers occurring among leprosy patients, it was found that a significant number had both grade 2 deformity of the hands and impaired corneal sensation. If a patient has a hand ulcer and rubs the eyes with it there is a high probability of creating an infected corneal ulcer by producing a corneal abrasion which is impregnated with organisms from the hand ulcer.

b) Intact corneal sensation drives tear secretion and a decrease in corneal sensation produces decreased tear secretion.[6] Studies have shown that eyes with neurotropic keratitis show abnormal rose bengal staining, decreased conjunctival goblet cell density, decreased corneal epithelial glycogen and conjunctival epithelial cell abnormalities. Essentially a dry eye is produced that could give rise to epithelial damage and intense itching which could induce excessive rubbing and aggravate the existing damage.

c) Decreased sensory loss in the cornea is also associated with decreased corneal mitosis. This is thought to be due to decreased acetylcholine uptake by the cells in neurotropic keratitis.[7, 8] The decreased corneal mitosis could be an important reason for the poor healing encountered in eyes with impaired corneal sensation that have sustained damage.

There exists the notion that the corneal sensory loss encountered in leprosy is secondary to the exposure that occurs in patients with lagophthalmos. Although this is possible in some cases, predominantly decreased corneal sensation occurs in MB patients with a fairly long duration of disease. Although the corneal nerves are uniquely placed for direct observation very few investigations have been done on them in leprosy.[9] We do not know whether factors such as avascular keratitis and beaded corneal nerves are significantly associated with decreased corneal sensation.

The Seventh Report of the WHO Expert Committee on Leprosy has the following statement: Although loss of sensitivity to touch is an important criterion for grading

[3] Bron, A. J., Tripathi, R. C. and Tripathi, B. J. The cornea and sclera. In: *Wolff's Anatomy of the eye and the Orbit.* 8th edn. London: Chapman & Hall, 1997, pp. 266–267.

[4] Daniel, E. and Brand, M. An unusual presentation of recurrent corneal abrasion in a lepromatous patient with impaired corneal sensation. (Clinical Note) Int. J. Lepr. **63** (1995) 450–452.

[5] John, D. and Daniel, E. Infectious keratitis in leprosy. Br. J. Ophthalmol. **83** (1999) 173–176.

[6] Jordan, A. and Baum, J. Basic tear flow. Does it exist? Ophthalmology **87** (1980) 920.

[7] Cavanagh, H. D. and Colley, A. M. The molecular basis of neurotrophic keratitis. Acta Ophthalmol. **76** Suppl. (1989) 115.

[8] Siegelman, S. and Friedenwald, J. S. Mitotic and wound healing activities of the corneal epithelium. Arch. Ophthalmol. **52** (1954) 46.

[9] Daniel, E., David, A. and Sundar Rao, P. S. S. Quantitative assessment of the visibility of unmyelinated corneal nerves in leprosy. Int. J. Lepr. **62** (1994) 374–379.

disabilities of the eyes, the Committee did not recommend testing the sensitivity of the cornea to touch under field conditions, for safety reasons.[10] There is no doubt that in the hands of inexperienced health workers testing corneal sensation can turn out to be a hazardous procedure for the patient. The corneal epithelium can be damaged due to over-enthusiastic application of the cotton wisp over the corneal surface in order to elicit a response from the patient, and there is always the risk of introducing infection into the abrasions produced because of this faulty technique in sensory impaired eyes. However, the importance of evaluating corneal sensation cannot be underestimated in light of the large quantum of pathology that can occur in the leprosy patient's eye if this feature of ocular leprosy is neglected. It is worth considering if field workers can be taught the correct procedure to evaluate corneal sensation without causing any damage to the corneal epithelium or introducing infection into the eyes.

The involuntary blink rate can be estimated while conversing with the patient and can indicate whether the patient has reduced corneal sensation. It has been proved that eyes that have been anesthetized with topical anesthetics have reduced blink rates. If there is no discernable weakness of the orbicularis oculi muscle or lagophthalmos and the blink occurs at a rate of less than once every 15 seconds, then decreased corneal sensation should be suspected. Normally, a person would blink at least more than six times in a minute. It must be remembered that a large number of patients with lagophthalmos or orbicularis oculi muscle weakness also have concurrent corneal sensory deficit.

In most instances, the cotton wisp has been used to estimate corneal sensation in hospitals and in the field. It is a pity that most health personnel involved in leprosy work do not know how to estimate corneal sensation properly. This is underscored in many of the training courses that we have conducted for people working in the field of leprosy. It is, therefore, important that the exact mode of evaluating corneal sensation in leprosy patients is spelled out and the dangers of improper use of this procedure are made clear. In evaluating sensation over the limbs and body, the patient keeps the eyes closed which obviously cannot be done while testing sensation of the cornea. This makes corneal sensory testing a rather difficult procedure. A cotton wisp has been used for corneal sensory testing because it is cheap and easy to use. Importance should be given as to how one actually does the test.

The hands of the examiner must be clean. This cannot be over-emphasized. The patient should be made comfortable and told that a small test is to be performed. The test need not be described in detail since this tends to make the patient apprehensive and gives false results. The cotton wisp is made out of sterile cotton in such a manner that after the cotton is gripped between the thumb and the index finger a thin wisp of about 1 cm is available to be applied to the corneal surface. The patient should be asked to gaze upward, the cotton wisp should be brought from the lateral side, and the tip should be applied gently over the cornea. The standard practice at the Ophthalmology Department of the Schieffelin Leprosy Research and Training Center, Karigiri, India, is to apply the cotton tip over the area of the cornea which is approximately 2 mm from the limbus at the 6 o'clock position. When the cotton wisp is applied to the cornea it should be seen to bend, and it is this pressure which estimates the crude sensory threshold of the cornea. The reaction of the patient, whether by a voluntary blink or by a reflex withdrawal of the face, should be noted. If there is absolutely no reaction from the patient, then impairment of corneal sensation should be recorded. Sometimes the test needs to be repeated, but at no time should undue pressure be applied or the cotton wisp rubbed against the corneal surface to elicit a reaction.

There are certain difficulties with the cotton wisp procedure. The examiner must make sure that the same wisp of cotton is not used for testing both eyes in order to prevent iatrogenic spread of infection from one eye to the other, if one of the eyes has an infection. Care must be taken to bring the wisp of cotton from the side while applying it to the surface of the cornea, otherwise the menace reflex would yield false-

[10] WHO Expert Committee on Leprosy. Seventh report. Geneva: World Health Organization, 1998, p. 25. Tech. Rep. Ser. 847.

negative results. If the cornea is poked with the cotton wisp, instead of the wisp being gently placed on its surface, damage to the cornea is liable to occur. The value or the sensitivity of the corneal sensory testing by placing it on the cornea is not clear, but it certainly does not cause damage to the epithelium, if done faultlessly. The test is also highly subjective. In one project undertaken in our Department we evaluated the corneal sensation of MB patients using the cotton wisp every 6 months. When the test was done during the initial visit, due to the patient's apprehension, the result was almost always a positive reaction when the cotton wisp was applied to the cornea, resulting in few patients with reduced corneal sensation. At the next and subsequent visits, the patients being less apprehensive and assuming that the examiner would prefer more cooperation, do not blink and remain stoic when the cotton wisp is applied, resulting in a large number of false-positives. It is difficult to overcome this unless the patient is asked whether the cotton wisp was felt when it was applied on the eye. Then the responses were even more subjective! It is also difficult for cotton wisps to be standardized. Some wisps may be thick, some may be thin. Some may be longer and some shorter. Perhaps cotton threads, available in different sizes, may be the answer to standardizing the testing material. They can be cut into standard lengths and can be sterilized easily. The Cochet and Bonnet esthesiometer quantifies measurement of corneal sensation. Although a better procedure in evaluating sensation of the cornea, this instrument cannot be used in routine sensory testing since the instrument is expensive and it takes an inordinately long time to measure corneal sensation with it.

Once a patient is found to have decreased corneal sensation, it is important to give health education regarding protection of the eyes. This education must be given repeatedly and a constant watch must be kept on patients with increased risk. This would include patients with lid abnormalities such as trichiasis, entropion, ectropion, orbicularis oculi weakness, lagophthalmos and patients with useful vision in only one eye. Conscious blinking (think and blink) at frequent intervals should become a habit. Rubbing of the eyes must be prohibited.[11] Adequate instillation of tear lubricants should be carried out. Eyes must be protected using dark glasses. Patients must be taught to examine their own eyes every day for redness or opacities or foreign bodies on the cornea. Patients must also be taught to estimate their vision every day. Any abnormality should be reported immediately, without any delay. These measures, along with inculcating a knowledge of the vulnerability of a sensory-impaired eye in the patient, the patient's relatives and friends, the community in which the patient lives, and the health care worker would go a long way toward decreasing the ocular morbidity and blindness in leprosy.

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