STUDIES ON THE NEURO-HISTOLOGICAL
CHANGES IN THE MEISSNER CORPUSCLE
IN LEPROSY

By A. PAUL JAYARAJ, M.B.B.S.
Central Food Technological Research Institute, Mysore

and

D. S. CHAUDHURY, M.B.B.S.
Gandhi Memorial Leprosy Foundation, T. Narasipur, Mysore

The Meissner corpuscle is one of the most complex cutaneous sensory receptors. In spite of extensive work on the role and the
distribution of the nerve fibres in the Meissner corpuscle on normal
individuals for nearly a century, there is still substantial controversy
over the nature of the nerve termination and function of the cor­
puscle.

CAUNA (1956-8) conducted an interesting investigation on the
nerve supply and their endings in Meissner corpuscles on material
classified into various age and occupational groups (manual workers)
in both sexes. He observed in old age the nerve endings are restricted
to the distal end of the corpuscle, the rest of it consisting of twisted
bundles of nerve fibres. In manual workers he observed that the
nerve endings are reduced in number, but at the same time intra­
corporeal nerve fibres showed neurofibrillar expansions.

The present work is an investigation of nerve supply and their
changes in Meissner corpuscles in leprosy, since Meissner corpuscles
act as a selective touch receptor and are primarily designed for
tactile discrimination. An attempt has also been made to study the
location of the bacilli in these receptors in relation to the neurol­
ibrillar processes.

Material and method

Twenty-five pieces of skin were taken from the distal pad of the
fingers from 24 patients showing typical lesions of leprosy, 14 from
the lepromatous and 10 from tuberculous cases. There were no
visible lesions anywhere on the finger pads. Biopsies were also taken
from the lesions of each patient to confirm histologically the type of
lesion. Most of the specimens were taken from the back and a few
from the forearm. Tissues were fixed in 10% neutral formalin and
frozen sections were taken at 20 microns thickness and stained by
the method described by Bala SUBRAMANIAN, JAYARAJ and GARS
(1954) for nerve fibres. 20 sections were taken from each specimen.
for this study. Remaining tissues were processed for paraffin sections. Sections were stained with hematoxylin and eosin and for acid fast bacilli by the method described by JAYARA (1955). As a control 3 specimens were taken from the distal pad of the fingers of manual workers.

Results

Changes in the Meissner corpuscle in lepromatous leprosy. The stem fibres ending in Meissner corpuscle show certain complexity and fragmentation. Most of the corpuscles receive single medullated nerve fibres which end with branching. Occasionally two medullated nerve fibres are seen ascending and ramifying in a most fragmentated condition. The neural fragments are seen scattered all over the dermal papillae and they seem to line up with the neurofibrillar process of the corpuscle. In few cases Meissner corpuscles show the free fading filaments in the connective tissue. Bunches fragments of the neurofibrillar structure are also found in the papillae, deep in the epithelium. In early lepromatous leprosy, the nerve endings in Meissner corpuscles undergo less damage compared to advanced lepromatous leprosy. Most of the corpuscles in this stage of leprosy show normal neurofibrillar structure.

Paraffin sections stained for acid fast bacilli show that the bacilli are situated alongside the visible neurofibrillar ramification in the Meissner corpuscles. They are found abundant in early lepromatous leprosy. In advanced lepromatous leprosy the bacilli are found less in number.

Changes in tuberculoid leprosy. The degenerated nerve fibres ascend in a most difficult course towards the papillary region where they usually end as naked fading filaments. Most of the fibres break up into several segments which disintegrate in the dermal corpuscle. In a few specimens complete destruction of Meissner corpuscles are noticed. Several neural fragments are found in corpuscles and they are highly macerated and are not connected to the stem fibre. The epidermis is much flattened and the papillary regions are collapsed.

Paraffin sections stained for acid fast bacilli have not shown the presence of bacilli.

Changes in Manual Workers. The ascending stem fibres reach the papillary region without any changes compared to normal individuals. The ramification of the fine nerve filaments show expansion in the end bulbs. The papillary regions are slightly compressed.

Discussion

Meissner corpuscles contain a series of nerve fibres. The stem fibres ascend within the capsule and branch in layers in between the cells parallel to the surface of the capsule and to their stem fibres.
Fig. 1. A Meissner corpuscle in the dermal papillae showing central inter­
medial core with little of terminal thickening in the corpicole. Dental pad of middle finger, male, 30 years, manual worker. x400.

Fig. 2. A Meissner corpuscle in the dermal papillae showing a single myeli­
nated stem fibre ascending from the subcutaneous tissue to the corpuscle where it branches as fine filaments. On the top of the corpuscle thickened fibril lar structures are seen. Dental pad of the ring finger, male, 28 years, advanced lepromatous leprosy. x400.
Fig. 3. A Meissner corpuscle in the dermal papillae showing a single axon fiber ascending into the corpuscle where it splits into partially fading nerve filaments without much structural alteration. Male, 30 years, advanced hypoplastic leprosy, X400.

Fig. 4. Meissner corpuscle in the dermal papillae shows clumps of bacilli situated alongside the nerve fibrillary processes in the corpuscle. Male, 25 years, Early hypoplastic leprosy, X900.
Fig. 5. Meissner corpuscle in the dermal papilla showing a single ascending nerve fibre ramifying in the corpuscle and partially dividing into filaments. Several neural segments are seen. Distal pad of the ring finger. Male, 36 years. Early lepromatous leprosy. x400.

Fig. 6. Meissner corpuscle showing a myelinated single fibre ascending right up to the dermal papilla with limited coiling. The whole process looks myelinated. Distal pad of the ring finger. Male, 28 years. Lepromatous leprosy. x400.
Fig. 7. Meissner corpuscles showing two myelinated nerve fibres ascending into the flattened dermal papillae and ramifying with feathery nerve filaments. A thickened neural element is seen in the middle of the corpuscle and connected to the nerve fibres. Distal pad of the middle finger. Male, 37 years. Lepromatous leprosy. X400.

Fig. 8. Meissner corpuscles showing a single nerve fibre ascending into the dermal papillae and ramifying with myelinated neural segments and feeding filaments. Distal pad of the middle finger. Male, 28 years. Tuberculoid leprosy. X400.
Fig. 9. Meissner corpuscles in the dermal papilla showing the corpuscles embedded in the connective tissue elements and the neural fragments situated in the periphery of the corpuscle. Distal pad of the ring finger. Male, 22 years. Tuberculoid leprosy.

Fig. 10. Meissner corpuscles in the dermal papilla showing the neural mass in the center of the corpuscle with structural collapse. The two main fibers which reach the corpuscles show degenerated changes and are not connected to the fine neural elements situated in the center of the corpuscle. Distal pad of the middle finger. Male, 22 years. Tuberculoid leprosy.
Fig. 11. Two nerve fibres are seen ascending in the dermal papilla. The ramifying neural fibres are destroyed and a few nerve fibres are seen deep in the dermal papilla surrounded by the same fibres. Distal pad of the ring finger. Male, 30 years. Tuberculoid. x400.

Fig. 12. A single nerve fibre is seen ascending into dermal papilla with irregular branching and embedded into the connective tissue elements. Distal pad of the ring finger. Male, 40 years. Tuberculoid. x400.
Direct pressure will produce stimulation to all these fibres. Woolf (1944a) showed the pattern of cutaneous innervation in relation to cutaneous sensitivity and brought out the clinical significance of the pattern of cutaneous innervation. He demonstrated that the density of innervation of skin varies from place to place and that tactile acuity is dependent upon both the number of compact encapsulated nerve endings and the number of pre-terminal nerve fibres per unit field serving them. He further observed that in hairy skin, there are normally no receptor bodies like Meissner corpuscles other than the nerve endings related to hairs. In non-hairy areas, Meissner corpuscles and their functional status determine the tactile acuity of the concerned area.

In leprosy the changes in Meissner corpuscles are of considerable interest. Alteration of the Meissner corpuscles in manual workers has been reported by Cauna (1938). However, there are no reports in detail in the literature on the changes of Meissner corpuscles in leprosy. In recent years a considerable amount of work has been done on nerve changes in leprosy. Gour and Balasubramanian (1954) studied the damage of nerves in different kinds of leprosy lesions. Balasubramanian, Jayaraj and Gour (1954) demonstrated the acid fast bacilli in the myelinated nerve fibres. Gaul, Jayaraj and Gour (1955) demonstrated the basophilic containing capillaries and axons by treatment for alkaline and acid phosphatases. They observed that the bulbous swelling of axons are filled up with bacilli. Kishore (1951) brought out the theory that the bacilli invade the fine nerve and travel into the axons. Mokuno et al in a study by the acid phosphatase method described by Gaul, Jayaraj and Gour (1955), observed parenchymatous degeneration of fibres in lepromatous leprosy and thought it to be possibly of toxic origin. They further observed that the changes in tuberculoid leprosy start with perineural infiltration in the fine nerves near the epidermis. The compact perineural infiltration, they found, penetrated into the thicker nerve and brought about fragmentation of fibres which lead to Wallerian degeneration. In the lepromatous lesions, they found no fragmentation of fibres. They observed that location of bacilli in the cutaneous nerves was mainly in the inter-fibre spaces, but in the lepromatous lesions they were occasionally encountered in the different parts of a nerve fibre, such as myelin sheath, Schwann sheath, Schwann cell and faintly stained axons. Jayaraj and Choudhary (1955) reported the existence of nerve fibres even in advanced lepromatous leprosy in the most superficial layers of the epithelial and sub-epithelial regions. The present observation shows that in Meissner corpuscles in early lepromatous leprosy the bacilli invade the whole processes of the corpuscles when the corpuscle maintains its normal ramifications of fine axons. In the later stages the bacilli are not found in these corpuscles and are found more in stem fibres. However the
structurally ramification of the fine nerve fibres in Meissner corpuscles is always maintained in lepromatous leprosy without much alteration and damage. In tuberculoïd leprosy the stem fibres that enter into the corpuscles show more segmentation and they do not branch and ramify into the capsule. The continuity of the fine fibres is not seen. It looks as if the corpuscle is completely damaged in this type of leprosy.

Summary

1. Biopsies from distal pad of the fingers from 24 leprosy patients comprising 14 lepromatous and 10 tuberculoïd were studied by cytological and nerve staining methods.

2. It was found that the terminal fibres in Meissner corpuscles undergo characteristic changes in leprosy. In early lepromatous leprosy abundant bacilli were found alongside of the neuro-fibrillary ramification and the corpuscles look almost normal. Whereas in advanced lepromatous leprosy, bacilli were not found in Meissner's corpuscles and the corpuscles was found slightly damaged.

3. In tuberculoïd leprosy the fading filaments are commonly found in the corpuscle. The papilla that occupies the corpuscle is compressed causing severe damage to the corpuscle. The ascending stem fibres which reach the papillae undergo severe damage by way of fragmentation leaving several neural filaments far away in the papillary region not connected to the stem fibres.

4. It is generally assumed that the receptor mechanism does play a part in alteration of sensory modalities more in tuberculoïd type of leprosy and less in lepromatous leprosy. There is a tendency for regaining the structural and functional status of Meissner corpuscles in lepromatous leprosy when the disease process is arrested. The possibilities in regaining the functional and structural status in tuberculoïd leprosy are far less.

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References


