

## Skin to skin transmission of leprosy

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The transmission of leprosy, unlike that of many other infections, continues to defy understanding despite the fact that we are already nearing elimination of the disease. Of the several gray areas, the onset or mode of infection stands out. There is almost a consensus that for the spread of leprosy, humans (leprosy patients) are the only reservoir of significance. This is despite the fact that leprosy-like infection has been reported in a few wild armadillos in the southern United States.

Of all leprosy patients, lepromatous ones (LL/BL), who have a large load of *M. leprae* (AFB), are considered more infectious. The continued presence and transmission of the disease in some parts of Africa, where a very high proportion of leprosy patients belong to the non-lepromatous group, does indicate some infectivity of other leprosy patients. The role of healthy individuals who are found to be positive for AFB, either in the nose or the skin, in the transmission of leprosy is not known.

For leprosy transmission to occur, *M. leprae* has to be discharged into the environment. Till the 1970's, the skin had been considered to be the major portal of exit of *M. leprae*, as large numbers of mycobacteria had been seen to be discharged from ulcerating lepromatous nodules. Further, it had long been held that in lepromatous patients the AFB from the dermis could move up towards the surface with epidermal cells and be shed into the environment along with keratin and sweat.<sup>[1]</sup> However, Weddell et al did not find AFB in the epidermis of lepromatous patients despite

examination of numerous biopsies.<sup>[2]</sup> Likewise, Pedley, using a method described as composite skin contact smear (CSCS) technique, did not observe many AFB on the skin of lepromatous patients, indicating that the bacilli do not pass through intact skin.<sup>[3]</sup> This view is widely accepted and intact skin is not considered as a major portal of exit of *M. leprae*. This is despite findings to the contrary by workers from Pondicherry, who found bacilli, albeit in small numbers, on the skin in 16 of 20 multibacillary (BL/LL) patients studied using the same CSCS method.<sup>[4]</sup>

However, two recent publications in this journal, one on the skin as a route of exit of *M. leprae*,<sup>[5]</sup> and the other on the occurrence of a solitary lesion of leprosy on the penile shaft in a contact of a lepromatous patient<sup>[6]</sup> have called for looking afresh at the evidence for the skin as a portal of transmission of leprosy.

Two groups of workers have shown that the bacilli are not infrequently found in the squamous layer of the epidermis.<sup>[7,8]</sup> In biopsy sections, clumps of AFB were demonstrated in one or more focal areas of the keratin layer. Bacilli have also been observed in cells of hair follicles and the hair shaft.<sup>[7,8]</sup> Electron microscopic findings have confirmed that the bacilli were indeed inside epidermal cells, both inside and outside the keratin.<sup>[9]</sup> Since bacilli have been found in dendritic cells,<sup>[10]</sup> some of which are known phagocytes and are known to migrate from the dermis to the epidermis, it is possible that they are carried to keratinocytes.

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Whether this transfer is similar to melanosome transfer is not clear.<sup>[10]</sup> With the progress of keratinization, the bacilli appear to go up to corneal layer and seem to eventually shed off with keratin. What is the state of bacilli live or dead, at the time of being shed on the surface, is not clear. AFB have also been seen in the lumina of sweat glands, sweat ducts, sebaceous glands as also their orifices at the surface.<sup>[11]</sup>

It has been suggested that the CSCS technique used by Pedley<sup>[3]</sup> may not have been successful in picking up bacilli as no adhesive was used on slides when these were pressed against the skin of patients. In one study, a fair number of bacilli were seen in 6 of the eight sites examined by pressing slides coated with water soluble glue against the skin of an untreated lepromatous patient.<sup>[8]</sup> Further, it has been emphasized that the skin is seldom unbroken; minor scratches or wounds are usually present,<sup>[12]</sup> which may bring AFB to the surface of the skin. These findings indicate that the skin is possibly an important portal of bacillary exit. Admittedly, the quantum of bacillary discharge from the skin surface may not be as much as from the nose or mouth of untreated lepromatous patients, but it may still be sufficient to transmit the infection as has been shown by positive takes in the mouse model following inoculation with a very small number of *M. leprae*.<sup>13</sup>

The mode of entry of organisms into the body continues to be debated. On the basis of anecdotal reports and on clinical grounds, it had been considered that the skin was the main route of infection by leprosy bacilli. Workers have long been looking at the site of the initial lesion to get a clue on the point of entry of infection. Overall, studies have shown that in children the initial lesion, which is generally a macule, is seen in less than 10% of cases on the trunk,<sup>[12]</sup> in the overwhelming majority it is seen on the extremities, the bare areas. Of the children with the initial lesion on the extremities, a significant proportion has it on the front of the knees and the back of the elbows, areas that are more prone to scratches and injuries. This correlates well with the clothing pattern in children in Asia and Africa, areas in which leprosy continues to be endemic.<sup>[14-16]</sup> As opposed to this, a few workers have not found the initial lesion to have any particular predilection for the exposed areas.<sup>[17,18]</sup> They point to

confounding factors and the fact that exposed parts are more easily examined than covered ones as explanations for the finding of the initial lesion on exposed areas. While this may be true in adults, their conclusion that the initial lesion has no predisposition for the exposed areas in children does not seem to be valid.

Occurrence of significantly more lesions on the exposed/bare parts of the body could well be due to closer contact as has been observed in the case of African children carried on the bare back of mothers,<sup>[19]</sup> and possibly on the shaft of the penis as reported by Kar et al.<sup>[6]</sup> Likewise, these areas are more exposed to dust and dirt and a contaminated environment. Being more prone to trauma and breaches, the skin at these sites can become the entry point for any infection, including leprosy. Apart from this, the lower temperature at these sites might help in establishment of infection locally. Similarly, published reports of initial leprosy lesion developing locally following accidental inoculation, tattooing, vaccination and dog bites in humans and thorn pricks in animals (armadillo and nude mice) suggest that the bacilli can enter through the skin.<sup>[20]</sup>

The role played by fomites and the soil in the spread of leprosy is also unclear. *M. leprae* can survive outside the human body for as long as 46 days.<sup>[21]</sup> Hence, any bacilli shed from the skin, nose or mouth into the environment, on articles of daily use or on the soil may come in contact with bare skin and result in infection.

Under natural conditions, how many organisms enter or can enter the host through the skin remains a big question. Work done in nude mice (athymic mice with no protective T lymphocytes) has shown that apart from other routes of inoculation (unbroken nasal mucosa, subcutaneous and intravenous routes), infection can develop following entry of organisms through abraded skin of cooler parts of the body and contaminated minor thorn pricks, suggesting that sufficient bacilli can enter to result in infection.<sup>[13,22]</sup>

In view of the above findings, it seems appropriate to consider that the skin is at least one of the important routes of transmission of the disease and that infection

can occur through skin to skin contact with patients of leprosy - in particular those at the lepromatous end.

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