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CASE REPORTS ON LEPROSY – A SHARED PRACTICE

Borderline tuberculoid leprosy localized to a tattoo site: a case report and review of pathophysiological mechanisms

Hanseníase borderline tuberculoide localizada em área de tatuagem: relato de caso e revisão dos mecanismos fisiopatológicos

Lepra borderline tuberculoide localizada en un sitio de tatuaje: informe de un caso y revisión de los mecanismos fisiopatológicos

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ABSTRACT

Introduction: leprosy is a chronic infectious disease most commonly transmitted via respiratory droplets; however, alternative routes such as traumatic inoculation are increasingly recognized. **Objective:** to report a case of borderline tuberculoid leprosy localized to a tattoo site and explore possible pathogenetic mechanisms. **Justification:** tattoo-associated leprosy remains rare but clinically relevant, particularly in endemic settings, and may pose diagnostic challenges in paucibacillary disease. **Case description:** a 32-year-old male presented with an erythematous indurated plaque with superficial ulceration and sensory loss over a tattooed area on the right forearm, three

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years after tattooing. The lesion initially conformed to the tattoo margins and later extended beyond them. Slit-skin smear and Fite-Faraco stain were negative. Histopathology showed perivascular and periadnexal lymphoplasmacytic infiltrate with epithelioid histiocytes. RLEP-PCR for *Mycobacterium leprae* was positive, confirming borderline tuberculoid leprosy with type 1 reaction (lazarine leprosy). **Discussion:** this case supports the role of trauma as a potential portal of entry (inoculation), Koebner phenomenon, or localized immune dysregulation in leprosy pathogenesis, and highlights the diagnostic value of molecular techniques in smear-negative cases. **Final considerations:** early recognition and prompt multidrug therapy led to near-complete resolution, emphasizing the need for high clinical suspicion and appropriate diagnostic strategies in atypical presentations.

Keywords: *Tattoo. Skin. Paucibacillary leprosy. Polymerase Chain Reaction.*

RESUMO

Introdução: a hanseníase é uma doença infecciosa crônica cuja forma mais comum de transmissão é a via respiratória; no entanto, vias alternativas, como a inoculação traumática, têm sido cada vez mais reconhecidas. **Objetivo:** relatar um caso de hanseníase borderline tuberculoide localizada em área de tatuagem e explorar possíveis mecanismos patogenéticos. **Justificativa:** a hanseníase associada à tatuagem permanece rara, porém clinicamente relevante, especialmente em áreas endêmicas, podendo representar um desafio diagnóstico em casos paucibacilares. **Descrição do caso:** um homem de 32 anos apresentou placa eritematosa indurada, com ulceração superficial e perda de sensibilidade, localizada em área tatuada no antebraço direito, três anos após a realização da tatuagem. A lesão inicialmente correspondia aos limites da tatuagem e, posteriormente, estendeu-se para além deles. A baciloscopia e a coloração de Fite-Faraco foram negativas. O exame histopatológico demonstrou infiltrado linfoplasmocitário perivascular e perianexial com histiócitos epitelioides. A reação em cadeia da polimerase para elemento repetitivo (RLEP-PCR) para *Mycobacterium leprae* foi positiva, confirmando hanseníase borderline tuberculoide associada à reação tipo 1 (hanseníase lazarina). **Discussão:** este caso reforça o papel do trauma como possível porta de entrada (inoculação), fenômeno de Koebner ou desregulação imunológica localizada na patogênese da hanseníase, além de destacar o valor diagnóstico das técnicas moleculares em casos com baciloscopia negativa. **Considerações finais:** o reconhecimento precoce e o início oportuno da poliquimioterapia resultaram em resolução quase completa das lesões, ressaltando a importância de um alto grau de suspeição clínica e de estratégias diagnósticas adequadas em casos atípicos.

Palavras-chave: *Tatuagem. Pele. Hanseníase Paucibacilar. Reação em Cadeia da Polimerase.*

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RESUMEN

Introducción: la lepra es una enfermedad infecciosa crónica cuya vía de transmisión más común es la de las gotitas respiratorias; sin embargo, cada vez se reconocen más vías alternativas, como la inoculación traumática. **Objetivo:** reportar un caso de lepra borderline tuberculoide localizada en un sitio de tatuaje y explorar posibles mecanismos patogénicos. **Justificación:** la lepra asociada al tatuaje sigue siendo rara, pero clínicamente relevante, especialmente en áreas endémicas, y puede representar un desafío diagnóstico en casos paucibacilares. **Descripción del caso:** un hombre de 32 años presentó una placa eritematosa indurada, con ulceración superficial y pérdida de sensibilidad, localizada en un área tatuada del antebrazo derecho, tres años después del tatuaje. La lesión inicialmente se limitaba a los márgenes del tatuaje y posteriormente se extendió más allá de ellos. La baciloscopia y la tinción de Fite-Faraco fueron negativas. El examen histopatológico mostró un infiltrado linfoplasmocitario perivascular y perianexial con histiocitos epitelioides. La reacción en cadena de la polimerasa para el elemento repetitivo (RLEP-PCR) para *Mycobacterium leprae* resultó positiva, confirmando lepra borderline tuberculoide asociada a reacción tipo 1 (lepra lazarina). **Discusión:** este caso refuerza el papel del trauma como posible puerta de entrada (inoculación), del fenómeno de Koebner o de la desregulación inmunológica localizada en la patogénesis de la lepra, y destaca el valor diagnóstico de las técnicas moleculares en casos con baciloscopia negativa. **Consideraciones finales:** el reconocimiento precoz y el inicio oportuno de la poliquimioterapia dieron lugar a una resolución casi completa de las lesiones, lo que resalta la importancia de un alto índice de sospecha clínica y de estrategias diagnósticas adecuadas en presentaciones atípicas.

Palabras clave: *Tatuaje. Piel. Lepra Paucibacilar. Reacción en Cadena de la Polimerasa.*

INTRODUCTION

Leprosy remains a public health concern despite decades of global efforts to eliminate it. According to the World Health Organization (WHO) 2026 update, 167,356 new cases of leprosy were reported worldwide in 2025[1]. India alone accounted for 54.8% of the cases. The WHO Global Leprosy Strategy 2021-2030 emphasizes interrupting transmission, early diagnosis, preventing disability, and eliminating stigma[2]. Transmission of *Mycobacterium leprae* (*M. leprae*) has traditionally been attributed to prolonged close contact and to respiratory droplet spread[3]. However, the exact portal of entry remains incompletely understood. Several reports have documented the development of leprosy at sites of trauma, including thorn prick, abrasion, surgical wounds and tattooing, giving rise to the concept of 'inoculation leprosy'[4,5].

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Tattooing involves repeated needle punctures that deposit pigment into the dermis. In endemic regions, inadequate sterilization practices may theoretically facilitate *M. leprae* transmission. Alternatively, cutaneous trauma may act as a *locus minoris resistentiae*, predisposing to lesion localization through the Koebner phenomenon or localized immune dysregulation.

Most reported cases of tattoo-associated leprosy belong to the paucibacillary spectrum, particularly the borderline tuberculoid (BT) disease[5,6]. However, rare cases of lepromatous disease following trauma have also been documented, suggesting that the host immune response ultimately affects the clinical expression[7,8].

We hereby report a case of BT leprosy with type 1 reaction (T1R) localized predominantly to a tattoo site, confirmed by histopathology and polymerase chain reaction (PCR), with excellent response to multidrug therapy.

Case summary

A 32-year-old male with no known comorbidities presented to our outpatient department with redness, superficial ulceration, and numbness on his right forearm for the past year. He had undergone tattooing at the same site three years before presentation. The lesion had initially conformed to the tattoo margins but progressively extended beyond them over the next few months. The patient had no associated pain, fever, or constitutional symptoms. No history of contact with a known leprosy case.

Cutaneous examination revealed a well-defined, erythematous, indurated plaque on the right forearm, involving the tattoo and surrounding area (Figures 1 and 2).

Figure 1 – Tattoo on the volar aspect of the right forearm with surrounding erythema and a single superficial ulcer.



Source: Created by the author.
Note: The image was partially blurred to protect the patient's identity.

Figure 2 – Annular erythematous plaque on the dorsal forearm with superficial ulcers, crusting, and scarring.



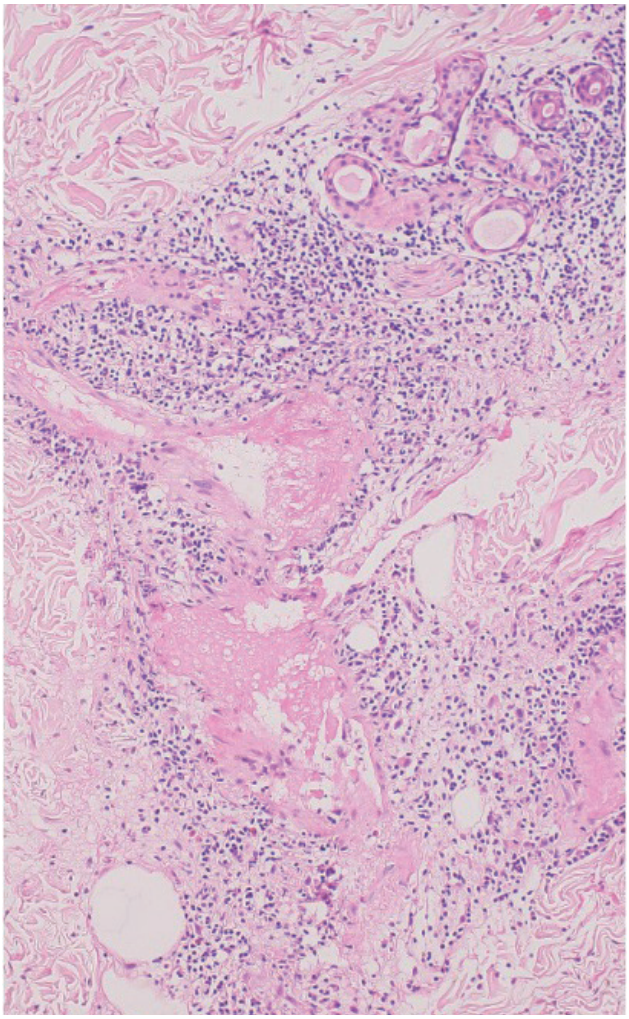
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Superficial ulceration with overlying brown semi-adherent crust was noted. Atrophic scarring was observed at the sites of previous ulcers. The rest of the cutaneous examination was normal. Sensory examination of the lesion with a Semmes-Weinstein (SW) filament showed no perception of the 10-gram filament. Sensory examination of the palms and soles was normal. On nerve palpation, the right ulnar nerve was thickened (2+) but non-tender. No other nerves were thickened, and motor examination was normal – no visible atrophy of the hand muscles or clawing.

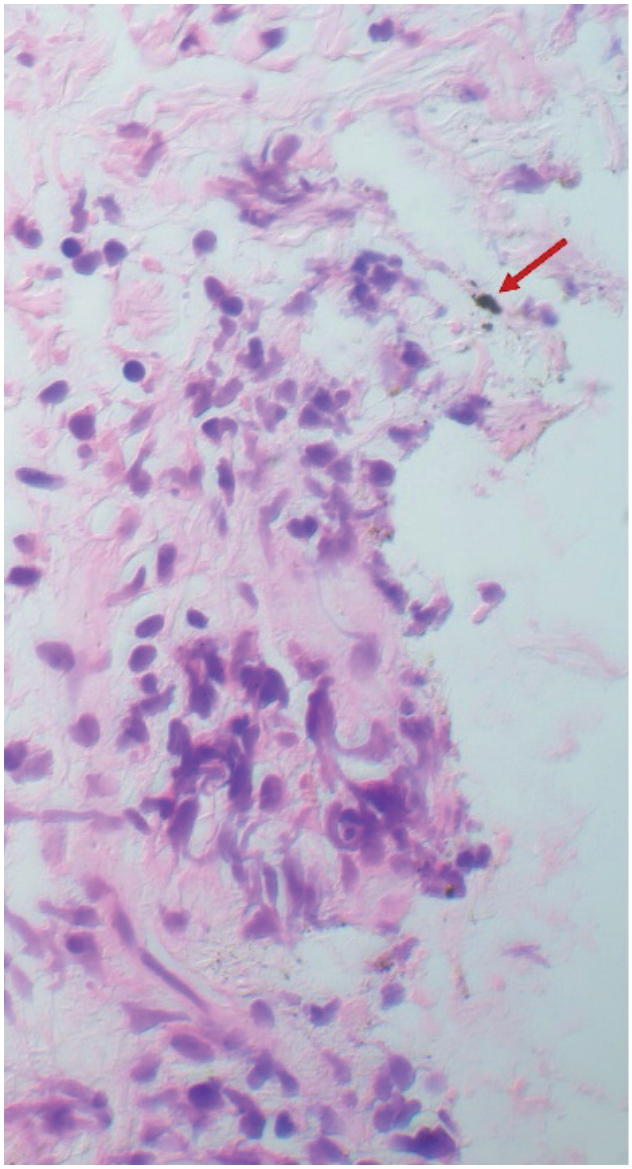
Slit-skin smear examination from the lesion, ears, and elbow was negative for acid-fast bacilli. Skin histopathology demonstrated hyperkeratosis and acanthosis, along with a moderately dense perivascular and periadnexal lymphoplasmacytic infiltrate and focal collections of epithelioid histiocytes involving the upper and mid-dermis (Figures 3 and 4). Fite-Faraco stain was negative.

Figure 3 – Skin biopsy showing histologically unremarkable epidermis with dermis showing presence of perivascular and peri-adnexal inflammatory infiltrates chiefly composed of lymphocytes and histiocytes without any defined granuloma formation, 40X, H&E.



Source: Created by the author.

Figure 4 – Very focal black tattoo pigment in the upper dermis (red arrow), 1000X, H&E.



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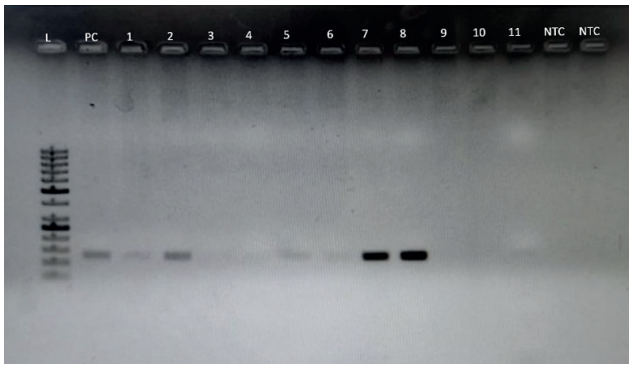
PCR for *Mycobacterium tuberculosis* complex and non-tuberculous mycobacteria were negative. However, given the high index of suspicion for leprosy and low bacillary load, we performed a Repetitive Element Polymerase Chain Reaction for *M. leprae* (RLEP-PCR) on the skin biopsy, which was positive (Figure 5).

Routine investigations were normal. Screening for hepatitis B, hepatitis C, and HIV was negative.

Based on the clinical features, histopathology, and PCR positivity, the patient was diagnosed with BT leprosy with T1R (lazarine leprosy). He was initiated on WHO-recommended multidrug therapy (MDT). Given the absence of local pain, systemic symptoms, or clinical evidence of neuritis, we managed the T1R conservatively with as-needed analgesics. After 6 months of therapy, the patient showed near-complete lesion resolution and improvement in nerve function (regained perception of a 2-gram SW filament). (Figure 6).

Written informed consent was obtained from the patient for publication of the clinical details and clinical images. All efforts were made to preserve patient anonymity, and no identifying personal information has been disclosed. The report was prepared in accordance with the ethical principles outlined in the Indian Council of Medical Research National Ethical Guidelines for Biomedical and Health Research Involving Human Participants[9], 2017, including respect for autonomy, privacy, confidentiality, and responsible reporting.

Figure 5 – Agarose gel electrophoresis of RLEP-PCR showing amplification at the expected size of 129 base pairs (bp).



Legend: Lane L: 50 bp DNA ladder; Lane PC: positive control; Lanes 1–11: test samples; Lane 7: patient sample demonstrating a distinct band at 129 bp, confirming the presence of *Mycobacterium leprae* DNA; Lane NTC: no-template control showing no amplification.
Source: Created by the author.

Figure 6 – Post-treatment images of the patient showing complete lesion resolution with some areas of atrophic scarring.



Source: Created by the author.

DISCUSSION

Leprosy is a chronic granulomatous infectious disease caused by *Mycobacterium leprae* and *Mycobacterium lepromatosis*. While respiratory droplets are considered the principal route of transmission, increasing evidence suggests that alternative modes, including traumatic inoculation, may contribute to a subset of cases[4,10].

Tattooing represents a unique form of cutaneous trauma involving repeated breaches of the skin barrier with potential exposure to contaminated instruments, inks, or unhygienic procedures[11]. Development of leprosy confined to tattoo sites has been documented in case reports and series, suggesting either direct inoculation or local immune dysregulation[5]. Granulomatous inflammation closely matching the distribution of tattoo pigment strengthens the inoculation hypothesis[6]. Recent observations of trans-epidermal extrusion of bacilli from histoid lesions have raised concerns regarding cutaneous dissemination as a potential transmission route[12]. In endemic settings, inadequate sterilization practices facilitate such transmission events[5].

Tattooed skin can also show a wide spectrum of reactions, both infectious and non-infectious, that must be differentiated from leprosy[13]. Sarcoidal granuloma presents either in isolation in the tattoo or as part of a systemic process[7]. Histopathological examination remains imperative in distinguishing these differential diagnoses.

Beyond tattooing, trauma itself is a precipitating and localizing factor for leprosy. Case reports have documented the development of leprosy at sites of prior injury, including road traffic accidents, surgical wounds, dog bites and vaccination scars[14]. Leprosy following minor trauma, such as a cut from a glass bangle, further supports the hypothesis that abraded skin may serve as a portal of entry for *M. leprae*[10]. These observations align with the concept of locus *minoris resistentiae*, suggesting that trauma creates an area of diminished resistance, making it susceptible to infection[15].

In some patients, however, the disease process has been observed to extend beyond the tattoo site and may even represent the initial manifestation of systemic disease[7]. This observation supports the hypothesis that tattooed skin may act as an immunologically altered microenvironment capable of harboring *M. leprae*. Persistent pigment deposition, chronic dermal injury, and macrophage activation can lead to localized immune dysregulation, thereby facilitating granuloma formation and disease expression[7]. In our patients, the lesion was initially confined to the tattoo site and then involved the surrounding region, suggesting its central role in disease activity. The host's immune status also shapes the disease spectrum, as seen in all patients with leprosy[8]. Previously reported tattoo-associated leprosy encompasses the full clinicopathological spectrum, ranging from tuberculoid to lepromatous disease, with variable latency

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periods following tattooing[5]. However, concomitant leprosy reaction has been seldom reported with tattoo-associated cases[16,17]. T1R represents an acute immunologically mediated episode occurring in the tuberculoid spectrum of leprosy[18]. Lazarine leprosy represents an exaggerated T1R and presents with ulceration of the tuberculoid leprosy lesions. Trauma has not been proposed as a precipitating factor for immunological reactions in borderline disease[16]. The inflammatory milieu may be altered locally, leading to heightened cell-mediated immunity and increased Th1 cytokine activity.

An additional sociocultural dimension is the traditional practice of tattooing around lesions with the belief that it can contain or prevent the spread of leprosy[19]. This misconception reflects the longstanding stigma and inadequate disease awareness. Such practices delay appropriate medical consultation and can contribute to disease progression.

A high index of suspicion and early diagnosis are essential to initiate appropriate therapy and curb leprosy transmission[11]. Histopathological examination should be undertaken in all patients. The emerging use of molecular diagnostics, including RLEP PCR, is an important adjunct in paucibacillary or smear-negative cases, significantly enhancing diagnostic sensitivity[20].

The shift from leprosy elimination to transmission interruption highlights the need to recognize atypical presentations[2]. Dermatologists in endemic regions should maintain a high index of suspicion for granulomatous lesions in tattooed skin.

CONCLUSION

In conclusion, this case illustrates BT leprosy with T1R localized to a tattoo site, confirmed by RLEP-PCR and responsive to standard MDT. It highlights the interplay among cutaneous trauma, localized immune modulation, and *M. leprae* infection, contributing to the evolving understanding of tattoo-associated leprosy in endemic settings.

Final comments or considerations

This case is presented to highlight an uncommon yet clinically significant presentation of BT leprosy localized to a tattoo site, supporting the hypothesis of inoculation leprosy in the setting of cutaneous trauma. The temporal association with tattooing, the initial confinement of lesions to the tattoo margins, and the subsequent centrifugal spread collectively strengthen the role of tattooed skin as a potential portal of entry and an immunologically susceptible niche for *M. leprae*.

The diagnostic challenge in this case was the absence of classical histopathological features and a negative slit-skin smear, necessitating a high index of clinical suspicion. RLEP-PCR-confirmed diagnosis underscores the importance of molecular diagnostics in paucibacillary cases where conventional methods may be inconclusive.

Therapeutically, initiating MDT based on clinicopathological correlation and molecular confirmation led to significant clinical and neurological improvement, thereby validating both the diagnostic approach and the disease classification.

Overall, this case emphasizes that leprosy should remain an important differential diagnosis for chronic inflammatory or granulomatous lesions arising in tattooed skin in endemic regions. It also highlights the need for early use of adjunctive diagnostic modalities and timely institution of standard therapy to prevent progression, disability, and ongoing transmission.

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