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CASE REPORT

Multibacillary leprosy in an adolescent with a family history of leprosy at Kedurus health center, Surabaya

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ABSTRACT

Background: Leprosy is a chronic human infection caused by *Mycobacterium leprae* which primarily affects peripheral nerves and can cause various disabilities. One of the main risk factors for leprosy transmission is direct contact with leprosy patients, which significantly increases the likelihood of contracting this disease compared to the general population. **Objective:** This case report aims to describe the clinical presentation and risk factors of leprosy in an adolescent with a family history of leprosy. **Case:** An 18-year-old male was diagnosed with multibacillary leprosy based on clinical findings, despite having a negative laboratory test result. The patient had a family history of leprosy. **Discussion:** The diagnosis was primarily made from clinical evidence, with direct transmission identified as the main risk factor. **Conclusion:** The patient was diagnosed with multibacillary leprosy accompanied by a type I reaction and no signs of disability. The main risk factor for transmission was interfamilial contact. The patient's prognosis was good, given the absence of disability and the positive response to treatment.

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Highlights

1. Recent evidence found that leprosy transmission occurs through airborne droplets and the respiratory tract.

2. Risk factors for leprosy include close contact with individuals who have lepromatous or multibacillary leprosy, animal vectors, immunosuppression or immunodeficiency, and genetic predisposition.

BACKGROUND

Morbus Hansen (MH), or leprosy, is an infectious disease that poses a significant global health burden (Menaldi et al., 2022), as it affecs the social life of the patients due to neurological disfunction and disability (Franco-Paredes et al., 2022). The disease is caused by acid-fast bacilli (AFB) from the *Mycobacterium leprae* complex (*M. leprae* and *M. lepromatosis*) (Hansen, 1875), which affect Schwann cells, leading to their destruction (Martoreli Júnior et al., 2021). Leprosy affects the skin, peripheral nervous system, upper respiratory tract mucosa, and eyes (Kinanti et al., 2024). Initially, the diseases manifests on the skin and can progress to a secondary stage with peripheral neuropathy as the long-term cause of disability (Chen et al., 2022). The disease remains a significant health burden in the 21st century with more than four million new cases identified between 2000 and 2020, despite advancements aimed at reducing its incidence and long-term complications (White and Franco-Paredes, 2015). Leprosy is predominantly found in tropical regions, especially in underdeveloped and developing countries (Chen et al., 2022).

Leprosy can affect individuals of any age, from children to adults, and both males or females. However, children are more susceptible than adults (Gofur et al., 2023). This infectious disease is transmitted through airborne droplets or aerosols from coughing and sneezing, as well as through direct contact with infected individuals (Ploemacher et al., 2020). The incubation period ranges from three to seven years before symptoms appear, with males being more frequently affected than females. Leprosy typically manifests in the second or third decade of life (Oliveira et al., 2019). However, it can also be classified as a zoonotic disease, with several animals, such as the nine-banded armadillo (*Dasypus novemcinctus*), Eurasian red squirrel (*Sciurus vulgaris*) and amoebae, identified as the hosts of *M. leprae* (Urban et al., 2021).

Environmental factors contributing to the transmission of *M. leprae* include socioeconomic status, population density, nutrition, immune response, public health facilities, and BCG immunization coverage (Gofur et al., 2023). Additionally, a family history of leprosy accounted for 18.7% of new cases (Hambridge et al., 2021). Among the 2,919 new cases reported in 2019, 1,861 or 10% involved children under 15 years old, indicating high transmission rates and low infection control (Hambridge et al., 2021). Early diagnosis is crucial to reduce the risk of deformities. Indonesia ranked among the top three countries with the highest leprosy burden in 2019 (Wulan Dewanti Martamevia, 2024). In East Java, leprosy remains endemic, with a prevalence of one per 10,000 population across 14 districts (Rahmawati and Bimanto, 2021). East Java was reported as having the highest leprosy prevalence. The Outpatient Clinic of Dr. Soetomo Regional General Hospital recorded 364 leprosy cases from 2017 to 2019 (Rosdiana et al., 2021).

OBJECTIVE

This report presents a case of multibacillary leprosy, aiming to describe the clinical features and risk factors in a patient from a family with a previous history of leprosy.

CASE

An 18-year-old male presented to the Outpatient Clinic of Kedurus Health Center accompanied by his mother on November 5, 2023. The primary complaint was the presence of reddish elevated patches on the face. The patient initially reported a burning sensation and itchy spots, which exacerbated upon exposure to sunlight, resulting in increased redness. According to the patient's statement, the spots first appeared approximately six months prior, in August. He finally decided to seek treatment following the emergence of the burning sensation and his mother’s insistence on treatment. Additionally, the patient

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noted the appearance of several other reddish-white elevated spots on his lower right back. Numerous white spots were also observed on the back of the patient where he experienced numbness in the affected areas. The white spots were distributed around the right back, although the patient admitted that he was unaware of their presence prior to his visit, focusing instead on the complaints regarding his facial spots. The patient also reported numbness on the back of the right hand, specifically affecting the fourth and fifth fingers and extending to two-thirds of the right lower arm. Similar numbness was also noted on the back of the left foot, affecting the fourth and fifth toes and extending to the left ankle. The patient had a history of close contact with individuals with leprosy over the past 10 years, with three family members having been diagnosed and treated.

The patient's nutritional intake and nutrition status were adequate. The patient consumed three meals daily. However, he did not regularly include vegetables in his diet, although he did consume fruits regularly. The patient reported bathing twice daily using soap and running water, typically immediately after returning home from school and work. Despite this, the patient often wore clothes multiple times before washing them, although he did use a personal towel and did not share towels with other family members.

Physical examination revealed less than 1-10 BTA in 100 visual fields in the left and right earlobes. In addition, more than five leprosy lesions were identified, alongside thickening of peripheral nerves in multiple branches. These findings suggested a diagnosis of multibacillary leprosy (Morbus Hansen).

Treatment was initiated in accordance with the national guidelines for leprosy management, specifically using multidrug therapy (MDT) as recommended by the Ministry of Health of the Republic of Indonesia. The patient was provided with a blister pack. For multibacillary leprosy, the blister pack for one month is marked red. The total duration of treatment for multibacillary Morbus Hansen is 12-18 months, requiring 12 blisters, which are administered over the course of 12-18 months (Menaldi, 2020). The MDT regimen includes the following medications.

a. Monthly treatment (administered in the presence of a health worker on day 1):
    a) 2 capsules of Rifampicin 300 mg (600 mg)
    b) 3 tablets Clofazimine 100 mg (300 mg)
    c) 1 tablet Dapsone/ drug delivery system 100 mg
b. Daily treatment (for days 2 to 28):
    a) 1 tablet Clofazimine 50 mg
    b) 1 tablet Dapsone/ drug delivery system 100 mg

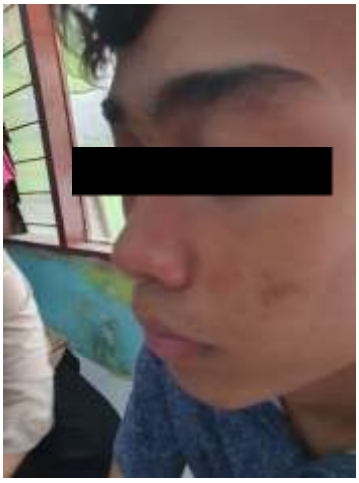

Figure 1. Leprosy lesion on the patient's face during physical examination

For type I leprosy reactions, the following therapy was prescribed.

a. Initial dose: Prednisone at 40 mg for the first two weeks (weeks 1 and 2)
b. Tapering off: gradual reduction of the dose to 10 mg every two weeks:

a) 30 mg/day (weeks 3 and 4)
b) 20 mg/day (weeks 5 and 6)
c) 15 mg/day (weeks 7 and 8)
d) 10 mg/day (weeks 9 and 10)
e) 5 mg/day (weeks 11 and 12)

Follow-up home-visit assessments conducted three months post-treatment indicated a notable change in the patient's the dermatological status. The facial examination revealed erythematous macules with clear boundaries and irregular shape, exhibiting a confluence of varying diameters (2-6 cm), with more than three lesions identified.

Examination of the posterior thoracic region displayed multiple hypopigmented macules with clear boundaries and irregular shapes, some of which were confluent with diameters varying from 1-6 cm, with more than five lesions identified.

Figure 2. Leprosy lesions on the patient's back during physical examination

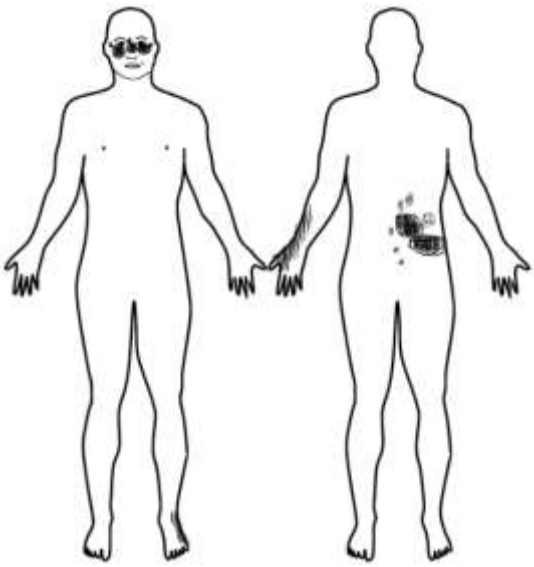

Figure 3. Schematic representation of the lesions on the patient's body

Neurological examination yielded the following results.

a. Touch sensation: hypoesthesia (+) (on the back of the right hand, fourth and fifth fingers to 2/3 of the upper arm), hypoesthesia (+) (on the lateral side of the back of the left foot from the left fourth and fifth toes to the ankle)

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b. Pain sensation: hypoalgesia (+) (on the back of the right hand, fourth and fifth fingers to 2/3 of the upper arm)
c. Temperature sensation: not assessed
d. Achromia: hypopigmentation (+)
e. Alopecia: (-)
f. Anhidrosis: Not assessed
g. N. Auricularis magnus: Enlargement (-/-), pain (-/-)
h. Ulnar nerve: Enlargement (-/-), pain (-/-)
i. Lateral popliteal nerve: Enlargement (-/-), pain (-/-)
j. Posterior tibial nerve: Enlargement (-/-), pain (-/-)
k. Claw hand (-/-), wrist drop (-/-), foot drop (-/-), lagophthalmus (-/-),
l. Claw toes (-/-), pursing of lips (-)

Meanwhile, muscle strength examination yielded the following results.

1. Facial muscles: within normal limits
2. Ulnar nerve: 5/5 (ring finger and little finger)
3. Median nerve: 5/5 (thumb, index finger, and middle finger)
4. Radial nerve: 5/5 (wrist)
5. Peroneus communis: 5/5 (ankle)
6. Tibialis posterior: 5/5 (toes)

The patient had lived in a rental house measuring 6 m x12 m with ceramic flooring and walls made of brick and plywood for the past 12 years. Although the house had a ceiling, parts of it had collapsed. The house consisted of one floor with a terrace, a living room, three bedrooms, a kitchen, and a bathroom. It was inhabited by eight individuals, namely the patient, his father, older brother, twin brother, younger brother, grandmother, and cousin. Given the area of 72 m^2, the house is considered overcrowded, as the recommended minimum is 10 m^2 per occupant.

The house had eight windows with a total window area exceeding 10% of the floor area. There were one large window in the living room, three windows in the living room, one window in each room, and one window in the kitchen. The windows in the living room, two windows in the front rooms, and two windows in the middle room were always opened each morning and closed at around 4 PM daily. The kitchen window was opened only during cooking, while the bathroom lacked ventilation. Lighting was adequate throughout the house, except for the kitchen and bathroom, where artificial lighting from lamps was necessary. The bathroom was equipped with a permanent toilet and septic tank. The bathwater was drained approximately once every three days. The overall cleanliness of the house was suboptimal, with clutter and poor organization, leading to insufficient air circulation. The tight spacing between the house and neighboring structures further limited airflow. The house was cleaned only once daily.

Based on the patient's anamnesis, physical examination, and supporting examinations, the diagnosis was multibacillary Morbus Hansen with a type I reaction with no signs of abnormalities. The patient was in the third month of treatment and had shown a positive response. Home visits and contract tracing identified the main risk factors for contacting leprosy as close contact with infected family members and living in densely populated conditions with inadequate ventilation and lighting.

DISCUSSION

Diagnosis

The clinical presentation of leprosy is determined by the host's immune response. Early diagnosis, followed by multidrug therapy (MDT), is needed to minimize deformity and disability. Physicians must be familiar with the clinical manifestations of leprosy to diagnose the disease (Nascimento, 2013). Patients may report of lack of sensation on the skin, hypopigmentation on the skin, hyperpigmented patches, and hypoesthetic skin lesions (Ebenezer and Scollard, 2021). However, the diagnosis of leprosy is made when one or more of the following clinical signs are observed.

- Lesions and/or areas of skin with changes in thermal, pain, and/or tactile sensitivity;
- Thickening of peripheral nerves associated with sensory, motor, autonomic changes; and
- The presence of *M. leprae* bacilli, confirmed by microscopic examination of an intradermal smear or skin biopsy (Noer and Kurniawan, 2023).

M. leprae infection damages nerve fibers, leading to fibrosis, where functional tissue is replaced with conjunctive tissue. Nerve damage due to the bacterial infection begins with invasion of the nerves, specifically infecting Schwan cells, followed by self-immune response, demyelination, and axonal atrophy. This process is accompanied by edema and inflammation (Nascimento, 2013). The disease manifests in two forms, multibacillary (MB) and paucibacillary (PB) depending on the host's immune response and the number of skin lesions (Froes et al., 2022). More than five skin lesions indicate MB, while fewer indicate PB (Fonseca et al., 2017). Leprosy is classified into five types based on clinical, bacteriological, histological, and immunological features: tuberculoid (TT), borderline tuberculoid (BT), mid-borderline (BB), borderline lepromatous (BL), and lepromatous leprosy (LL) (Alrehaili, 2023). However, the WHO classified leprosy into two types based on the number of lesions: PB and MB (Ebenezer and Scollard, 2021). In TT, the immune response (Th1 and Th17) limits bacterial multiplication, whereas in LL, the immune response (Th2 and T regulator) is insufficient to control the replication, allowing bacterial dissemination. The BT form presents with less extreme immune imbalances (Fonseca et al., 2017). Leprosy can evolve into tuberculoid (T) or (L) if left untreated (Franco-Paredes et al., 2022).

Leprosy causes peripheral neuropathy, presenting with various symptoms and manifestations, including cutaneous nerve involvement due to skin patches or lesions, symmetrical pansensory neuropathy, and sensory ataxia resulting from leprous ganglionitis (Khadilkar et al., 2021). Leprosy refers to the acute inflammatory episodes caused by *M. Leprae* infection, which can occur before, during, or after treatment and often involves neuropathy (Fonseca et al., 2017). Leprosy-associated neuropathy does not affect the brain and spinal cord; instead, it primarily affects other organs such as the skin, nasal mucous membranes, testicles, and eyes. This neuropathy progresses slowly, ranging from six months to 40 years (Noer and Kurniawan, 2023). Leprosy-associated neuropathy is a significant medical concern due to its potential to cause permanent disability (Ebenezer and Scollard, 2021), such as grade 2 disability due to visible impairments and deformities (Swift and Sabin, 1998).

The degree of neuropathy in leprosy varies depending on the involvement of intradermal nerves in skin patches or peripheral nerve trunk. Commonly affected superficial nerves include the great auricular, median, ulnar, sural, posterior tibial, and superficial peroneal nerves. In this case, peripheral neuropathy was confirmed through a neurological examination, which revealed numbness in the extremities, namely in the fourth and fifth fingers on the back of the right hand and the fourth and fifth toes on the back of the left foot. This is consistent with other reports describing sensory impairment in leprosy, including the loss of sensation, touch, pain, and temperature over the skin lesions (Ebenezer and Scollard, 2021). The diagnosis of multibacillary type leprosy in this case was based on clinical examination which identified characteristic lesions and symptoms. This is consistent with the WHO classification of leprosy, where the diagnosis of multibacillary leprosy is established if at least one cardinal sign is present, namely more than five skin lesions and/or the involvement of more than one nerve branch with impaired neurological function. The clinical presentation of leprosy in the nerves and skin depends on the host's immunological status, making advanced diagnostic techniques necessary, including ultrasonography, magnetic resonance neurography, serological markers, molecular tests, skin

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biopsy, and nerve biopsy (Khadilkar et al., 2021). The accuracy of a skin biopsy depends on selecting the appropriate biopsy site, obtaining a representative sample, and the pathologist's expertise in diagnosing leprosy (Chen et al., 2022). This diagnostic approach remains valid even when the BTA bacterial index from earlobe samples is negative.

Risk factors for disease transmission

Direct contact with leprosy patients increases the risk of disease transmission compared to the general population. Additional risk factors include demographic variables, healthcare conditions, and socioeconomic (Li et al., 2021). These include inadequate housing, proximity to the patients, overcrowding, malnutrition, immunocompromised states, rural residence, advanced age, ethnicity, and male gender (Chen et al., 2021). Inadequate bedding and contaminated water sources (Bhat and Prakash, 2012) also contribute to reduced cell immunity, creating conditions ideal for the spread of the disease through droplets or skin-to-skin contact. *M. leprae* is present in large numbers in the dermis of leprosy patients. The organism has been detected in the desquamating epithelium, epidermis, and superficial keratin layer of the skin (Bhat and Prakash, 2012). In this case, three of the patient's family members who lived under the same roof had a history of leprosy and had completed therapy. The cramped living conditions with minimal ventilation and lighting increased the risk of transmission of the bacteria among family members. While both skin and upper respiratory tract are known routes of infection, recent research has identified the respiratory route as the primary path of transmission, based on the predominant presence of *M. leprae* in the nasal mucosa (Bhat and Prakash, 2012; Rees and McDougall, 1977).

A study identified individuals aged 15-34 years as being at higher risk for type I leprosy type at Dr. Soetomo Regional General Hospital (Rosdiana et al., 2021), and the patient in this case falls within this age range. Socioeconomic factors, such as low education levels, bathing weekly in open water bodies, and infrequent changing of bed linens (Kerr-Pontes et al., 2006) were also noted as risk factors. Male were found to be 2.2 times more likely to contract leprosy than females, while households with more than seven members had 3.1 times the risk compared to households with 1-4 members. Additionally, those with a history of household contact with leprosy had an adjusted hazard ratio (aHR) of 0.36 (Bakker et al., 2006). All these risk factors were found in the patient. Another study reported that contact with leprosy patients increased the risk of infection by 5.6 times, while high occupancy density increased it by 13.0 times (Rahmawati and Bimanto, 2021). Humidity, occupancy density, and personal hygiene were identified as the most significant factors influencing leprosy transmission in Indonesia (Edi and Azizah, 2023). Household exposure was also noted as a risk factor (OR = 1.96) (Sales et al., 2011). In Indonesia, leprosy is more commonly observed in adult males, with the MB type and ENL reaction being the most frequent manifestations (Prakoeswa et al., 2022).

Medical treatments

The primary treatment for leprosy is multidrug therapy (MDT) for six to 24 months (Martahi and Tasman, 2021). Leprosy reaction therapy is available at community health centers for adult patients with MB leprosy based on the Indonesian Ministry of Health's national guidelines for leprosy management. MDT has been recommended to treat PB and MB with a combination of dapsone, rifampin, and clofazimine. These drugs are administered to reduce the prevalence and transmission of the disease (Franco-Paredes et al., 2022). The complete cure is observed after six months of therapy. The WHO recommends MDT for six months for PB type and 12 months or until the smear is negative for MB type to reduce financial burdens (Lazo-Porras et al., 2020).

Dapsone acts as bacteriostatic agent by competitively inhibiting two important enzymes in *M. Leprae* biosynthesis: dihydrofolate synthetase and dihydrofolate reductase. The effectiveness of this drug is observed after 3-6 months, with complete clearance typically seen after 2-3 years, especially in mucosal lesions. Rifampicin selectively inhibits bacterial DNA-dependent RNA polymerase and blocks RNA synthesis. This drug is effective at killing intracellular organisms, with results seen within 4-6 weeks, although the bacteriological index takes longer to decline. A single dose of 1500 mg (administered as

600 mg doses three to four times a day) has been shown to kill 99.99% of *M. leprae*. The WHO recommends a monthly dose of 600 mg for adults. Clofazimine serves both bacteriostatic and anti-inflammatory functions by increasing lysosomal enzyme synthesis and enhancing macrophage phagocytic capacity. Clofazimine binds to guanine-cytosine (GC)-rich regions of mycobacterial DNA, while its anti-inflammatory effects are mediated through the stimulation of prostaglandin E_2 (PGE_2) synthesis, inhibition of neutrophil motility, and selective suppression of Th1 response (Lazo-Porras et al., 2020).

Although MDT is effective in reducing the prevalence of leprosy, several studies reported adverse effects, including hemolytic anemia (Goncalves et al., 2012). The occurrence rate of adverse effects is 0.82% over four years of medication, with MB patients experiencing the highest rate (94.44%). Reported adverse effects include jaundice (77.77%), exfoliative dermatitis (44.44%), hemolytic anemia (27.77%), and fever and headache (22.22%) (Guragain et al., 2017). A study also noted an increased risk of adverse effects: dapsone was associated with a 7% increased risk involving the hematopoietic system (HR = 1.07), while rifampicin was associated with a 31% increased risk (HR = 1.31) (Celestino et al., 2024). In this patient, no adverse reactions were reported during three months of medication. A study conducted at a tertiary hospital in Surabaya using the bacterial index (BI) and morphological index (MI) as efficacy parameters found that 71.4% of MB leprosy patients had a BI of zero, and 100% had an MI of zero following MDT (Rahmi et al., 2024). Another study described the side effects of MDT: dapsone affected 88 patients, rifampicin 24, and clofazimine 18 (Deps et al., 2007). Dapsone hypersensitivity syndrome (DHS) characterized by exfoliative dermatitis, lymphadenopathy, hepatosplenomegaly, fever, and hepatitis typically appears six weeks after the administration of dapsone and has been associated with five reported fatalities (Lockwood et al., 2022).

Outcomes

Leprosy can result in organ deformities and disabilities, necessitating comprehensive prevention, management and intervention strategies. The WHO classified the outcomes of this disease into mild (warning of possible disability), moderate (requiring therapeutic intervention to prevent severe disability), and severe disability. These classifications have been revised into grades 1, 2, and 3, as describe below.

Table 1. The severity of leprosy based on the WHO criteria

No.	Organ	Severity
1.	Hands	1 = insensitive hand
		2 = ulcers and injuries and/or mobile claw hand and/or slight absorption
		3 = wrist drop or fingers clawed and joints stiff and/or severe absorption 1 of fingers
2.	Foot	1 = insensitive foot
		2 = with trophic ulcer and/or clawed toes or foot drop and/or slight absorption
		3 = contracture and/or severe absorption.
3.	Eyes	1 = redness of conjunctiva
		2 = lagophthalmos and/or blurring of vision and/or inflammation of globe
		3 = severe loss of vision or blindness.

Source: World Health Organization (WHO), 1969

A study noted that most leprosy patients presented with hand and foot deformities classified as grade 1 (Prakoeswa et al., 2022), similar to the patient in this case. Another study involving 2,129 leprosy patients highlighted a high prevalence of the MB type, accounting for 89.1% of cases, with a mean age of 38.7 $\pm$ 16.2 years, and a higher prevalence among males (Lubis et al., 2022).

Although MDT has improved outcomes for leprosy patients, cases of disease relapse have been reported after completing therapy. Relapse is defined as an increase in the BI and the appearance of new skin lesions. Relapse occurs after an average of 10.8 years (range 3-11 years), depending on the type of leprosy (Cellona et al., 2003). Therefore, yearly BI monitoring and physical examination are recommended to prevent relapse in these patients.

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Limitations

This study has several limitations. The number of patients was limited to a patient. The short duration of this study compared to the duration of the patient's therapy prevents a complete assessment of the patient's response to treatment. Additionally, the absence of family members during the contact tracing examination limited the researchers' ability to fully address the chain of transmission in this case.

CONCLUSION

The diagnosis of multibacillary leprosy with a Morbus Hansen type I reaction and no abnormalities was based on the results of the patient's physical examination. The main risk factor for transmission in this case was familial, beginning with the patient's twin brother, father, and mother who were previously affected. The prognosis for this patient was good, as no disabilities had occurred and the patient showed a positive response to treatment, as well as compliance with medication.

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Conflict of Interest

The author declares that there is no conflict of interest in the preparation of this article.

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Patient concern for Publication

Informed consent was voluntarily obtained from the patient regarding the dissemination of their case information, upholding their autonomy and privacy rights.

Author Contribution

IDPGBKP: supervising, conceptual, funding; HRM: data curation, drafting, translating; HT: data curation, drafting, translating; IGARFM: data curation, drafting, EP: supervising, editing; EP: supervising, editing; RIW: Editing; CAF: data curation, editing; WD: editing.

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