

**Histopathological spectrum of Leprosy – A prospective study**Sandeep Kodali<sup>1</sup>, T. Satya Sri<sup>2</sup>, Vodapalli Akshay Kumar<sup>3</sup>, D S S Srinivas<sup>4</sup>, Meghana Narayan<sup>5</sup><sup>1</sup>Professor and Head, department of Dermatology, Venereology and Leprosy (DVL), Mamata Academy of Medical Sciences, Bachupally, Hyderabad, Telangana<sup>2</sup>Associate Professor, department of Dermatology, Venereology, Leprosy (DVL), Government Medical College and General Hospital, Survey No. 237, Uyyalawada Village, Nagarkurnool, Telangana<sup>3</sup>Associate Professor, department of Dermatology, Venereology and Leprosy (DVL), Mamata Academy of Medical Sciences, Bachupally, Hyderabad, Telangana<sup>4</sup>Associate Professor, department of Dermatology, Venereology and Leprosy (DVL), Guntur Medical College and Government General Hospital, Kanna Vari Thota, Guntur, Andhra Pradesh<sup>5</sup>Senior Resident, Department of Dermatology, Venereology and Leprosy (DVL), Mamata Academy of Medical Sciences, Bachupally, Hyderabad, Telangana

Received: 26-10-2024 / Revised: 27-11-2024 / Accepted: 28-12-2024

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Conflict of interest: Nil

**Abstract****Introduction:** Leprosy, caused by *Mycobacterium leprae*, remains a major public health issue in developing countries, affecting various organs. Multi-drug therapy (MDT) has significantly reduced cases, including Dapsone-resistant strains. Leprosy lesions are classified based on immune response into five types. This study aims to explore the histological types of leprosy.**Methods:** This prospective study, conducted at Mamata Academy of Medical Sciences, Hyderabad, from January 2023 to August 2024, included clinically diagnosed or suspected leprosy cases aged >18 years. Demographic data, clinical findings, and skin biopsies were recorded. Histopathological analysis, using H&E and Fite-Faraco staining, followed Ridley-Jopling classification and bacillary index.**Results:** Out of 52 leprosy cases, the majority (53.8%) were aged 21–40 years, with a male-to-female ratio of 1.3. Hypopigmented patches were the most common clinical finding (61.5%), followed by erythematous lesions (28.8%) and nerve thickening (9.6%). Histologically, BT was the most frequent type (34.6%), followed by BL (23.1%).**Conclusion:** This study highlights the importance of histopathological classification in leprosy diagnosis. The most common histological types were BT and BL, with strong clinical and histopathological correlation, especially for TT. Early diagnosis and appropriate treatment, including MDT, remain crucial in managing leprosy and preventing further complications.**Keywords:** Leprosy, Histopathology, Tuberculoid, Borderline Lepromatous, Multi-Drug TherapyThis is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Leprosy is one of the oldest diseases of mankind, one of the major public health problems in the developing countries. It is a chronic granulomatous infection, *Mycobacterium leprae* (ML) is the causative agent. [1] Various systems as well as organs such as skin, nerves, muscles, testis and so on effected by the pathogen. Since so many years, there is a long battle by Indians against leprosy and there is significant reduction of leprosy after introducing multi drug treatment (MDT). More than >90% reduction of Dapsone resistance ML is another landmark of MDT.

Cell mediated immune response is the basis for the development of type of leprosy lesions. As per the

descending order of host immune status, there are 5 classes; tuberculoid (TT), borderline tuberculoid (BT), midborderline (BB), borderline lepromatous (BL) and lepromatous leprosy (LL). [3] In our previous report, it was mentioned that leprosy is common among the low socioeconomic class and male female ratio was 0.7. [4] With this background, the current study was aimed to find various histological types of leprosy.

**Methods**

It was prospective research conducted in the department of Dermatology, Mamata Academy of Medical Sciences, Bachupally, Hyderabad. Study protocol was approved by the Institutional Ethics

committee. Study was conducted between January 2023 to August 2024. Both gender aged  $\geq 18$  years, clinically diagnosed or suspected cases of leprosy were included in the study. Known cases, previously treated, non-co-operative, individuals were not considered in this research. Individuals those fit in the inclusion criteria during the study period were included in the research.

Demographic data such as age, gender, socioeconomic status, and duration of symptoms were recorded. Detailed clinical examination was conducted and findings such as hypopigmented lesions, nerve involvement were recorded. Skin biopsy was performed from the most representative lesion under sterile conditions using local anesthesia. A 4–6 mm punch biopsy is preferred. The tissue is fixed in 10% formalin and transported to the histopathology laboratory.

Formalin-fixed tissue is processed, embedded in paraffin, and sectioned. The sections were stained using Hematoxylin and Eosin (H&E) for routine evaluation and Fite-Faraco staining for identifying ML. Histopathological diagnosis is made based on the Ridley-Jopling classification. Simultaneously, epidermal atrophy, dermal granulomas, nerve involvement, and bacillary index (BI) are systematically documented. The bacillary load is determined using Ziehl-Neelsen staining for acid-fast bacilli (AFB) and graded on a scale of 0 to 6.

### Statistical Analysis

The data were analysed in SPSS version 21.0. Frequencies, percentages, and means are calculated for demographic and clinical variables. Clinical, histopathological, and bacteriological findings are statistically correlated.

### Results

Total 52 leprosy cases were included. Male female ratio was 1.3. Majority (53.8%; 28) were between 21 – 40 years followed by 41 – 60 (26.9%; 14), <20 (11.5%; 6) and >60 (7.7%; 4). Hypopigmented patches were seen in 32 (61.5%) members followed by erythematous lesions (28.8%; 15) and nerve thickening (9.6%; 5). As per the histopathological spectrum, BT was the most common (34.6%; 18), followed by BL (23.1%; 12). TT and LL accounted for 11.5% (6) and 15.4% (8), respectively, while BB constituted 15.4% (8). When clinical and histopathological diagnoses was correlated, TT achieved 100% concordance. BT and BB showed 88.9% and 87.5% agreement, respectively. BL had 91.7%, while LL had an 87.5% match.

### Discussion

In the present study, a total of 52 clinically diagnosed leprosy cases were analyzed. The male-to-female ratio was 1.3:1, indicating a slightly higher prevalence in male, consistent with global

patterns. This gender difference has been attributed to variations in healthcare-seeking behaviour, occupational exposure, and immunological factors. Similar trends have been reported in the literature [5], emphasizing the male preponderance in leprosy cases.

The age distribution revealed that the majority of cases (53.8%) occurred in the 21 – 40 years age group, followed by 26.9% in the 41–60 years range. This finding aligns with the general epidemiological trend where leprosy predominantly affects individuals in their productive years. [6, 7] Younger individuals (<20 years) and older adults (>60 years) contributed smaller proportions, 11.5% and 7.7%, respectively. This distribution suggests a potential link between disease manifestation and environmental, immunological, or occupational factors prevalent in the 21 – 40 years age group. The observed demographic patterns underscore the need for focused awareness and early detection programs targeting younger adults and vulnerable populations to minimize transmission and morbidity associated with leprosy. These findings corroborate existing literature and offer valuable insights for public health interventions.

In this study, hypopigmented patches were the most common clinical presentation, observed in 61.5% (32/52) of cases. Hypopigmented lesions are a hallmark of early leprosy, particularly in tuberculoid and borderline tuberculoid forms, due to localized immune responses leading to melanocyte suppression. These findings align with Ankad B et al. [8] who reported hypopigmented patches as a frequent initial presentation in endemic regions.

Erythematous lesions were noted in 28.8% (15/52) of cases, often associated with BL or LL, reflecting systemic immune compromise and higher bacillary loads. Nerve thickening, seen in 9.6% (5/52), is a critical diagnostic clue, often correlating with advanced or longstanding disease where neural involvement is significant. Alrehaili J et al. [9] emphasized the importance of clinical nerve examination for early diagnosis and disability prevention in such cases. These findings reinforce the importance of dermatological and neurological evaluation in diagnosing leprosy.

In the present study, the histopathological spectrum of leprosy showed that BT was the most prevalent type, accounting for 34.6% (18/52) of cases. This finding aligns with the immunological spectrum of leprosy, where BT is common in individuals with moderate immune responses, resulting in granuloma formation and localized lesions. A similar distribution was reported by Patel V et al. [10] highlighting the predominance of BT in endemic regions.

BL cases formed 23.1% (12/52), reflecting immune suppression and bacillary proliferation, often associated with higher rates of systemic manifestations. TT and LL accounted for 11.5% (6/52) and 15.4% (8/52), respectively. TT is linked to robust immunity and localized granulomas, whereas LL represents extreme immune anergy, as corroborated by studies by Froes LAR et al. [11] and de Carvalho Dornelas B et al. [12] BB leprosy constituted 15.4% (8/52) and represents a transient immunological phase. Sehgal VN and Sharma S [13] emphasized the variability in BB due to dynamic immune responses. The findings underscore the importance of histopathology in confirming the clinical diagnosis and understanding disease progression.

It was revealed that TT leprosy achieved 100% concordance, emphasizing the distinctive clinical and pathological features of this type. TT is characterized by well-formed granulomas with minimal bacillary presence, making it highly concordant with clinical findings, as observed in the study by Mukherjee et al. [14] BT and BB leprosy showed concordance rates of 88.9% and 87.5%, respectively. These subtypes lie on the immunological spectrum and often present overlapping clinical features, which may contribute to slight diagnostic discrepancies. Kumari K et al. [15] reported similar findings, highlighting the challenges in differentiating these subtypes clinically. BL cases had a high agreement of 91.7%, reflecting the characteristic histopathological features, such as the presence of numerous bacilli in macrophages. LL exhibited an 87.5% concordance, slightly lower due to variations in clinical presentations, including nodules and diffuse infiltration, as noted by Joshi R. [16] These results underline the critical role of histopathological evaluation in enhancing diagnostic accuracy and guiding treatment.

### Conclusion

This study highlights the importance of histopathological evaluation in leprosy diagnosis, offering critical insights into its diverse clinical and pathological spectrum. BT was the most prevalent histological type, followed by BL. A strong concordance was observed between clinical and histopathological diagnoses, particularly in TT cases with 100% agreement. Variations in concordance among other subtypes underscore the complexities of diagnosing borderline cases. These findings emphasize the necessity of combining clinical, histopathological, and immunological approaches to improve diagnostic accuracy and treatment strategies, ultimately aiding in the effective management and control of leprosy.

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