



DECODING LEPROSY: A HISTOPATHOLOGICAL INSIGHT INTO SPECTRUM AND DIAGNOSIS

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ABSTRACT

Background: Leprosy also known as Hansen's disease, is a chronic granulomatous disease caused by *Mycobacterium leprae*. It is one of the oldest disease known to mankind that can cause permanent disabilities. Leprosy continues to be a significant public health challenge in India, accounting for approximately 60% of the global cases. Aim of the study is to analyze the role of histopathological examination in the accurate diagnosis and Ridley-Jopling classification of various forms of leprosy. **Material And Methods:** This is a Retrospective observational study. A total of 35 cases were studied. All the cases of leprosy were studied with respect to its age of presentation, clinical symptoms and morphological classification. Data thus collected were analyzed and compared with other study findings. **Results:** A total of 35 leprosy cases were studied. Lepromatous leprosy (45.71%) were the most common among leprosy cases followed by Borderline Tuberculoid leprosy (20%) cases. Males were affected more commonly than females with M:F ratio of 1.7:1. Among lepromatous leprosy cases, 69% cases were recorded in males while only 31% cases were seen in females. **Conclusion:** Leprosy exhibits a broad range of overlapping clinical presentations, thus histopathological examination continues to be the definitive method for early detection and its classification. Precise diagnosis is crucial for initiating effective therapy and for minimizing the risk of physical disabilities.

KEYWORDS : Hansen's disease, Fite Faraco, Lepromatous, Histopathology

INTRODUCTION

Mycobacterium leprae is the causative organism of Hansen's disease (Leprosy), which was first discovered in 1873 by Sir Gerhard Armauer Hansen. Leprosy had already been described in *Susruth Samhita* (600 BC). Leprosy is the chronic granulomatous bacterial infection which mainly affects the skin and the peripheral nerves. Leprosy may additionally affect muscles, eyes, bones, testes, and internal organs to varying degrees.

classification scheme, which includes indeterminate leprosy (IL), Tuberculoid leprosy (TL), Borderline tuberculoid leprosy (BT), mid-borderline leprosy (BB), Borderline Lepromatous leprosy (BL) and Lepromatous leprosy (LL). WHO in early 1980s, used the bacillary index (BI) for the classification of leprosy for treatment purposes, as multibacillary (MB) and paucibacillary (PB). In Paucibacillary leprosy, the BI index was <2 and in Multibacillary leprosy, the BI index is >2.^[2] (Table1)

Table 1: Bacillary Index (BI) Grading^[2]

Grade	Bacilli	Examination OIF (oil immersion field)
1+	1-10 bacilli/100 OIF	100 OIF
2+	1-10 bacilli/10 OIF	100 OIF
3+	1-10 bacilli/ OIF	25 OIF
4+	10-100 bacilli/ OIF	25 OIF
5+	100-1000 bacilli/ OIF	25 OIF
6+	>= 1000 bacilli/ OIF	25 OIF

Mycobacterium leprae replicates at a slow rate, with an average incubation period of approximately five years. The bacterium primarily targets histiocytes, Schwann cells, and melanocytes. Although India reduced the prevalence rate to 0.66/10,000 population in 2016, it still contributes about 60% of the newly reported leprosy cases worldwide each year.^[1] Leprosy is a leading cause of permanent physical disability among all communicable diseases. However, early diagnosis and treatment is curative and prevents permanent disability. It is predominantly found in tropical and subtropical regions, with India and Brazil bearing the highest burden of the disease.^[2] Clinical manifestations typically involve hypopigmented skin patches accompanied by sensory impairment, as well as peripheral nerve involvement, which may present as discernible nerve thickening with or without associated sensory deficits.^[3]

Based on immunological, clinical and histopathological findings, Ridley & Jopling proposed a histological

At one end of the spectrum, TT has a highly cellular immune response to *M. leprae* with few lesions and a paucity of organisms. On the other end, LL has defective cellular immune response with numerous lesions with multiple bacilli. A special stain has been developed for detecting the leprae bacilli in the lesions, which is fite-faraco (FF) stain.^[4] Histopathological study of leprosy cases along with the clinical presentation helps in early diagnosis and thus prevents the permanent disability.

MATERIALS AND METHODS

This is a Retrospective Observational Study which was conducted in the department of Pathology, GMERS Medical College and Hospital, Gotri, Vadodara. The study was done after getting approval from Ethics Committee. This study included all the leprosy cases received from February 2023 to January 2024.

A total of 35 leprosy cases were studied during this period.

All the skin biopsies were received and fixed in 10% formalin on the same day and were kept for fixation. The skin biopsies were then bisected, wherever it was required and all the tissue were processed in the tissue processor and paraffin blocks were made using Leukharts mold. Sections were taken with semi-automated rotary microtome having 3-5 microns thickness and slides were stained with Hematoxylin & Eosin routine stain. The relevant clinical data of leprosy cases were collected from the Department of Dermatology.

Also, all the skin biopsies were stained with special stain, Fite Faracco for the better classification of leprosy cases.

These slides were then examined under a light microscope for a histopathological diagnosis. The histopathological diagnosis was based on morphologic features and the tumors were classified according to Ridley & Jopling classification. All the collected data was charted in the Microsoft excel and descriptive analysis like percentage, mean and median were used in the present study.

ETHICS

This is a Retrospective, observational study, and any intervention was not done. The study was undertaken after the Institutional Ethics Committee gave its approval.

RESULTS

A total of 35 cases of leprosy were taken for one year period from February 2023 – January 2024 and were included in the present study. Lepromatous leprosy were the most common cases with 45.71% cases followed by Borderline Tuberculoid leprosy with 20 % cases and indeterminate leprosy with 14.28% cases.(Table2) Only 5.71% cases of Histoid Leprosy were found in the present study.

Out of these 35 cases recorded, 57% of leprosy cases were reported in the age group of 21-40 years and 17% of cases were under the age group of 41 – 50 years and 5% of cases were reported within the 51-60 years of age. Only 5% of cases were reported above 60 years of age. The maximum disease burden (74%) was seen in the age group of 21 – 50 years. Not a single case of leprosy was recorded in the childhood category. All the subtype of leprosy cases were common in males. The study population consists of 22 (63%) males and 13 (37%) females with Male: female ratio 1.7:1.

Among the 35 leprosy cases, 16 cases of Lepromatous Leprosy were recorded. Out of these lepromatous leprosy cases, 69% cases were recorded in males while only 31% cases were seen in females.

Most common clinical feature was hypopigmented plaque (51.4%) followed by erythematous skin lesions (25.7%), nodules (14.28%) and macules (8.65%).

Table 2: Distribution Of Leprosy Cases According To Gender

Leprosy Spectrum	Number Of Cases	Male	Female	Percentage (%)
Lepromatous leprosy (LL)	16	11	5	45.71
Histoid leprosy (HL)	2	0	2	5.71
Borderline leprosy (BB)	2	2	0	5.71
Borderline Tuberculoid (BT)	7	4	3	20
Tuberculoid leprosy (TT)	3	2	1	8.57
Indeterminate	5	4	1	14.28

In the present study, Fite-Faraco (FF) staining—a modified acid-fast stain used specifically to detect *Mycobacterium leprae*—was employed to evaluate the bacillary load in skin biopsies from suspected leprosy patients. The FF stain is particularly valuable in the histopathological diagnosis of leprosy, as it allows for visualization of the acid-fast bacilli (AFB) within tissue sections.

Table 3: Age-wise Distribution Of Leprosy Cases

Age (in years)	Total number of cases	Percentage (%)
0-10	00	0
11-20	02	5.71

21-30	10	28.5
31-40	10	28.5
41-50	06	17.14
51-60	05	14.2
61-70	01	2.85
71-80	01	2.85

The intensity of FF staining and bacillary positivity correlates with the immunological spectrum of leprosy. In our findings, FF staining was positive in 51% of total cases, demonstrating a significant utility in diagnosing multibacillary forms. Notably, FF positivity was observed in 100% of Lepromatous Leprosy cases, underlining its diagnostic reliability in high bacillary load settings. Conversely, all cases of Borderline Tuberculoid (BT) leprosy showed 100% negativity with FF staining, consistent with the expected low bacillary index in these patients.

DISCUSSION

Leprosy is a chronic granulomatous disease resulting from *Mycobacterium leprae*. Its clinical and pathological manifestations vary based on the host's immune response. Accurate diagnosis and classification are essential for appropriate treatment, effective management, and the prevention of physical disabilities associated with it. The leprosy subtypes are classified based on patient's immunity status combined with clinical, histopathological and bacteriological findings. Histoid leprosy and indeterminate leprosy cases were also included in the present study.

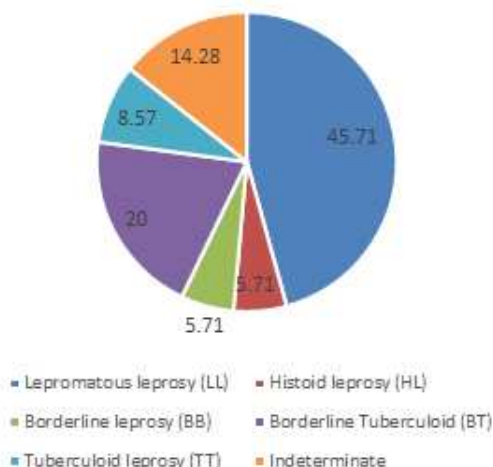


Chart 1: Incidence Of Various Leprosy Subtypes

Among the leprosy lesions, lepromatous leprosy (45.71%) was the most common lesion which is in concordance to the study done by Patel et al.^[5] with 40% cases. It is followed by indeterminate leprosy cases (14.28%) in our study, whereas in Patel et al^[5] study, second most common lesion was tuberculoid leprosy (21%). This discrepancy may be attributed to differences in regional disease patterns, diagnostic sensitivity, or sample size. Interestingly, studies by Thapa et al. noted **Borderline Tuberculoid (BT)** and Tuberculoid leprosy **TT** as the most common subtypes, further emphasizing the variability of leprosy's clinical profile across different populations. In the present study, Male predominance has been observed with male:female ratio of 1.7:1. The same observation was seen in Pokhrel et al^[6], Nadia et al^[7] and Moorthy et al^[8] studies. Male to female ratio observed in this study was 1.5:1 which is similar to that observed in above studies.

Semwal et al^[9] and Kumari et al^[10] al had similar observations. This could be attributed to the increased outdoor activity of males and greater interaction with the outside world, which

leads to a higher risk of contracting the infection.^[2] Most of the leprosy cases were seen in the age group of 21-40 years (57%) which is similar to the study done by Sanker et al^[11] with 55% cases in the same age group.

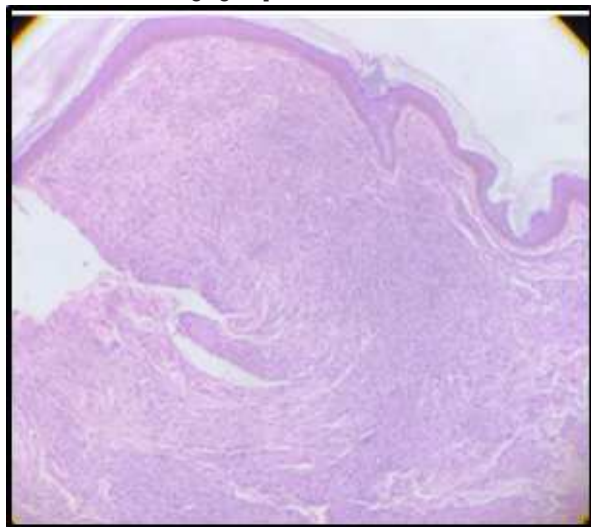


Figure 1: Histopathological Picture Of Lepromatous Leprosy (H&E, 10X)



Figure 2: Clinical picture of Lepromatous Leprosy

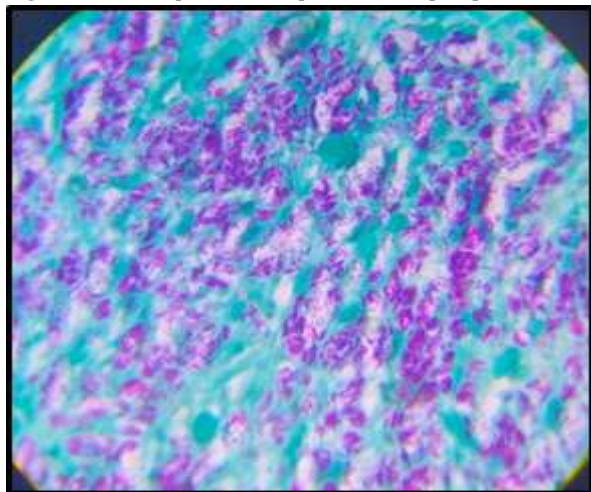


Figure 3: Special stain in lepromatous leprosy with BI 6 (FF, 100X)

Most common clinical feature was hypopigmented plaque (51.4%) followed by erythematous skin lesions (25.7%), nodules (14.28%) and macules (8.65%). Similar findings were seen in the study done by Mukherjee et al^[12] and Roy et al^[13].

In Patel et al study,^[5] tuberculoid leprosy contributed 21% of total leprosy cases whereas in the present study, it contributed only about 8.57% of total leprosy cases.

From a diagnostic perspective, the Fite-Faraco (FF) staining technique, utilized for identifying acid-fast bacilli, demonstrated 100% positivity in all Lepromatous Leprosy (LL) cases, indicating a heavy bacterial burden. In contrast, the stain yielded 100% negativity results in Borderline Tuberculoid (BT) and Indeterminate types, which aligns with their classification as paucibacillary variants. These findings underscore the importance of bacteriological evaluation in the precise classification of leprosy, essential for guiding appropriate therapeutic strategies.

CONCLUSION

Leprosy continues to present with a broad clinico-pathological spectrum, largely influenced by the host's immune response. In the present study, Lepromatous Leprosy emerged as the most prevalent subtype, reflecting a higher bacterial load and potentially delayed diagnosis. The predominance of cases among males and individuals aged 21–40 years underscores the need for targeted public health interventions in this demographic. Hypopigmented plaques were the most common clinical manifestation, reaffirming the diagnostic value of thorough dermatological examination. The Fite-Faraco stain provide a reliable tool for distinguishing multibacillary from paucibacillary forms, thereby reinforcing the necessity of bacteriological assessment for accurate classification and effective management. Early diagnosis, immunological classification, and appropriate therapeutic measures remain critical in preventing disabilities and reducing disease transmission.

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