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HISTOPATHOLOGICAL SPECTRUM OF LEPROSY IN A TERTIARY CARE CENTRE: A RETROSPECTIVE STUDY

Pathology

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ABSTRACT

Background: Leprosy remains a significant public health challenge in India, with nearly 60% of global cases. Histopathology is essential for definitive diagnosis and classification. **Aims:** To study the histopathological spectrum of leprosy using Ridley-Jopling classification, determine age-gender distribution, and assess bacteriological index across different types. **Materials and Methods:** This retrospective study analyzed 43 skin biopsies from clinically diagnosed leprosy patients at GMERS Medical College, Ahmedabad (January 2023-January 2024). Sections were stained with H&E, Ziehl-Neelsen, and Fite-Faraco stains. **Results:** Males predominated (M:F=2.9:1), with peak incidence in 21-40 years (60.4%). Indeterminate Leprosy was most common (27.9%), followed by Borderline Lepromatous (20.9%), Lepromatous and Borderline Tuberculoid (each 16.7%), Histoid (9.3%), Tuberculoid (6.9%), and ENL (2.3%). BI correlated with Ridley-Jopling spectrum position. **Conclusion:** Histopathological examination with bacteriological index assessment remains the gold standard for leprosy diagnosis. Early detection is crucial for appropriate treatment and transmission prevention.

KEYWORDS

Leprosy, Histopathology, Ridley-Jopling Classification, Bacteriological Index

INTRODUCTION

Leprosy (Hansen's disease) is a chronic infectious disease caused by Mycobacterium leprae, an obligate intracellular acid-fast bacillus with predilection for cooler body areas, primarily affecting skin and peripheral nerves. First described by Gerhard Henrik Armauer Hansen in 1873, the disease has plagued humanity for millennia. The World Health Organization estimates approximately 200,000 new cases annually, with India accounting for over half the global burden. Although India achieved the elimination target of <1 case per 10,000 population nationally in December 2005, disease persistence in several endemic states indicates ongoing transmission.

The clinical spectrum reflects host immune response to M. leprae, forming the basis of the Ridley-Jopling classification: Tuberculoid Leprosy (TT), Borderline Tuberculoid (BT), Mid-Borderline (BB), Borderline Lepromatous (BL), and Lepromatous Leprosy (LL), with Indeterminate Leprosy (IL) as the earliest stage. Additionally, reactive states including Type 1 lepra reaction and Type 2 reaction (Erythema Nodosum Leprosum) can complicate clinical course.

Accurate classification is essential for appropriate multidrug therapy (MDT) selection, as paucibacillary (PB) and multibacillary (MB) forms require different treatment durations. While clinical diagnosis remains the cornerstone in endemic areas, histopathological examination provides definitive confirmation, precise classification, assessment of nerve involvement, and bacteriological index (BI) quantification through special stains. The BI, quantifying acid-fast bacilli in tissue sections, serves as an important indicator correlating with immunity strength. This study analyzed the histopathological spectrum at a tertiary care hospital in Ahmedabad, Gujarat.

Aims

The primary aim was to analyze the histopathological spectrum according to Ridley-Jopling classification. Secondary objectives included determining age-gender distribution, evaluating bacteriological index across different types, and assessing clinico-pathological correlation.

MATERIALS AND METHODS

This retrospective observational study was conducted at the Department of Pathology, GMERS Medical College & Civil Hospital, Sola, Ahmedabad, a tertiary care teaching hospital serving diverse urban and semi-urban populations. Skin biopsies from 43 clinically diagnosed leprosy patients received between January 2023 and January 2024 were analyzed. All biopsies were obtained by dermatologists from representative lesions using standard punch biopsy technique or elliptical excision.

Specimens were fixed in 10% neutral buffered formalin for 12-24 hours, processed through graded alcohols, cleared in xylene, and embedded in paraffin wax. Serial sections of 4-5 microns were cut using rotary microtome. Three sections from each block were stained: H&E for general architecture and cellular infiltrate assessment; Ziehl-Neelsen for acid-fast bacilli identification; and Fite-Faraco for better visualization and BI determination.

Cases were classified according to Ridley-Jopling system based on granuloma characteristics, lymphocytic infiltration, nerve involvement, Grenz zone presence, and bacillary load. BI was assessed using Ridley's logarithmic scale: 0 (no AFB in 100 oil immersion fields) to 6+ (>1000 AFB per field with globi). Data were analyzed using descriptive statistics with frequencies and percentages calculated for categorical variables.

RESULTS

All 43 cases showed histopathological features consistent with leprosy. Patient age ranged from 16-80 years (mean 35.2±14.8 years). The 21-40 years age group showed highest incidence (60.4%, n=26), indicating disease predominantly affects economically productive individuals. This was followed by 41-60 years (20.9%, n=9), >60 years (16.3%, n=7), and ≤20 years (11.6%, n=5). Males predominated with M:F ratio of 2.9:1 (32 males, 11 females). Male predominance was observed across all leprosy types. Analysis revealed BL and LL types showed wider age range (19-65 years), while IL was more common in younger patients.

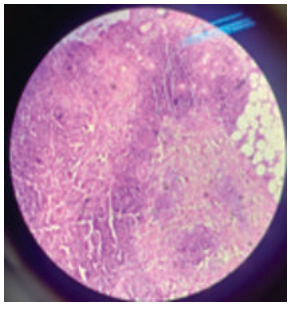
Table 1: Distribution of Histopathological Types of Leprosy (N=43)

Histopathological Type	Cases (n)	Percentage	Classification
Indeterminate (IL)	12	27.9%	Indeterminate
Tuberculoid (TT)	3	6.9%	Paucibacillary
Borderline Tuberculoid (BT)	7	16.7%	Paucibacillary
Borderline Lepromatous (BL)	9	20.9%	Multibacillary
Lepromatous (LL)	7	16.7%	Multibacillary
Histoid Leprosy	4	9.3%	Multibacillary
Erythema Nodosum Leprosum	1	2.3%	Reaction (Type 2)
Total	43	100%	-

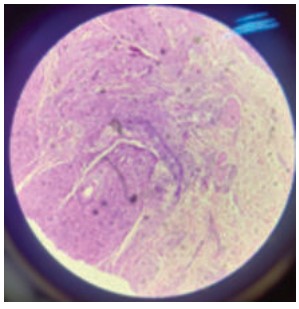
Note: Mid-Borderline (BB) cases were not separately identified and may have been classified within BT or BL categories based on predominant histopathological features.

Bacteriological Index correlated with spectrum position: Histoid Leprosy showed highest BI (6-8+), followed by LL (4-6+), BL (3-6+), BT (0-1+), and TT/IL (0-2+).

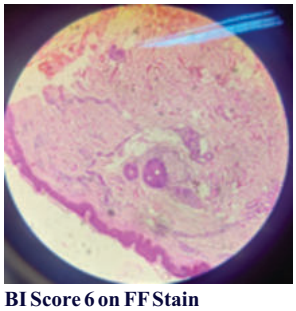
Histopathological Features: Histoid cases demonstrated characteristic spindle-shaped histiocytes arranged in whorls or storiform pattern forming well-circumscribed nodules with extremely high bacillary loads. LL showed extensive dermal infiltration by sheets of foamy macrophages (Virchow cells) separated from epidermis by prominent Grenz zone, minimal lymphocytes, and abundant AFB forming globi. BL revealed predominantly foamy macrophages with sparse lymphocytes, clear subepidermal zone, perineural infiltration, and numerous AFB (BI 3-6+). BT demonstrated less compact epithelioid granulomas with moderate lymphocytic infiltration, nerve involvement, and low BI (0-1+). TT exhibited well-formed compact epithelioid cell granulomas with dense peripheral lymphocytic cuffing, occasional Langhans giant cells, evident nerve destruction, and absent/rare AFB. IL showed mild non-specific perivascular and perineural lymphohistiocytic infiltration without well-formed granulomas. The single ENL case showed acute neutrophilic infiltration with vasculitis and bacillary fragmentation consistent with Type 2 reaction.



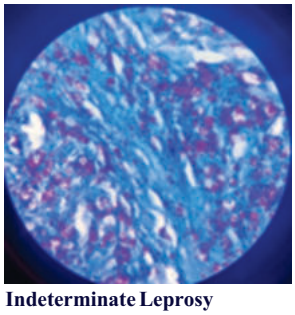
Lepromatous Leprosy



Tuberculoid Leprosy



BI Score 6 on FF Stain



Indeterminate Leprosy

DISCUSSION

The male predominance (M:F 2.9:1) is consistent with global literature, attributed to greater occupational exposure, differences in health-seeking behavior, and possible gender-based variations in immune response. Peak incidence in 21-40 years (60.4%) reflects M. leprae's long incubation period with disease manifestation typically occurring in young to middle-aged adults. The low proportion of cases ≤20 years (11.6%) is encouraging, as pediatric cases often indicate active community transmission.

Indeterminate Leprosy as the most common type (27.9%) is higher than some previously reported series but consistent with other tertiary center studies. This may reflect early presentation and increased awareness, or actual regional epidemiological patterns. IL represents the earliest disease stage where immune response is yet to polarize; cases may progress to either pole or undergo spontaneous resolution.

Borderline Lepromatous (20.9%) as the second most common type, followed by LL and BT (each 16.7%), suggests substantial multibacillary burden. Studies from Bihar and other endemic regions report varying proportions, likely reflecting differences in genetic susceptibility, environmental factors, healthcare access, and disease control program stages. The relatively low TT proportion (6.9%) may indicate delayed presentation or genetic factors influencing immune response.

The high Histoid Leprosy proportion (9.3%) is concerning, as this rare variant typically occurs as relapse in inadequately treated or drug-resistant cases, potentially indicating treatment compliance issues warranting investigation. The substantial multibacillary case proportion (BL, LL, Histoid: 46.9% combined) has significant public health implications as these are main transmission reservoirs requiring extended 12-month MDT, while paucibacillary cases (TT, BT: 23.6%) respond well to 6-month MDT with better prognosis.

BI analysis validated our classification, demonstrating expected correlation with the Ridley-Jopling spectrum. Highest scores in Histoid and LL reflect highly bacilliferous forms at the lepromatous pole. The progressive decrease toward tuberculoid pole reflects inverse relationship between bacillary load and cell-mediated immunity, fundamental to understanding pathogenesis with implications for treatment decisions and epidemiological control.

Histopathological examination provides several advantages: confirmation in suspicious cases, precise classification for MDT selection, nerve involvement assessment, BI quantification, reaction identification, and differentiation from other granulomatous conditions. Study limitations include retrospective design limiting clinical data completeness, relatively small sample size (n=43), and single-center nature potentially introducing selection bias toward complicated cases.

CONCLUSION

This study demonstrates diverse histopathological spectrum with Indeterminate and Borderline Lepromatous types most common in our tertiary care setting. The male predominance and peak incidence in 21-40 years age group are consistent with global epidemiological patterns. Histopathological examination combined with bacteriological index assessment provides definitive diagnosis and accurate classification, essential for appropriate multidrug therapy selection and monitoring treatment response.

The correlation between bacteriological index and position on the Ridley-Jopling spectrum validates the immunological basis of leprosy classification. Despite achieving elimination at the national level, leprosy remains a significant health concern in endemic regions of Gujarat and India. The presence of Histoid Leprosy cases warrants investigation of treatment compliance and possible drug resistance. Early detection through clinical suspicion followed by histopathological confirmation, appropriate classification-based treatment, contact screening, and comprehensive management remain cornerstones of leprosy control. Continued research, surveillance, and strengthening of diagnostic services are essential to achieve complete elimination.

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