Section A -Research paper

Assessment of high resolution ultrasonography with clinical examination in the evaluation of peripheral nerve involvement in leprosy

Dr Kiran Patil
Department of Dermatology ,Krishna Institute of Medical Sciences,Krishna Vishwa Vidyapeeth, "Deemed To Be University",Karad –415110,Maharashtra
Dr Jamale Varsha
Department of Dermatology ,Krishna Institute of Medical Sciences,Krishna Vishwa Vidyapeeth, "Deemed To Be University",Karad –415110,Maharashtra
Dr Asma Hussain
Department of Dermatology ,Krishna Institute of Medical Sciences,Krishna Vishwa Vidyapeeth, "Deemed To Be University",Karad –415110,Maharashtra

Abstract

Objective: This study set out to compare high-resolution ultrasonography (HRUS) to clinical examination in order to determine how useful HRUS was in determining peripheral nerve involvement in leprosy.

Methods: The study comprised a total of 25 leprosy-positive individuals. The research population's demographic and clinical traits were noted. Clinical grading and nerve thickness as determined by HRUS were associated. Additionally assessed was the consistency in recognising nerve involvement between HRUS and clinical evaluation.

Results: 60% of the patients were men and 40% were women, with a mean age of 42.8 years. Eighty percent of the patients (80%) had multibacillary leprosy (MB). The median nerve (32%) and peroneal nerve (12%), as well as the ulnar nerve (56%) were the most frequently impacted nerves. The clinical grade and nerve thickness had a very good positive connection ($r=0.85$, $p<0.001$). When compared to patients with lower clinical grades, participants with higher clinical grades had considerably thicker mean nerves on the HRUS ($p <0.001$). With a kappa value of 0.78, HRUS showed excellent agreement with clinical examination.

Conclusion: HRUS has the potential to be a useful tool for determining peripheral nerve involvement in leprosy. It offers precise measurements of nerve thickness and has a good clinical grading correlation. High agreement between HRUS and clinical examination is another sign of HRUS's potential as a trustworthy diagnostic tool. The early identification and precise assessment of nerve disease in leprosy patients should benefit from the integration of HRUS into standard clinical practise.

Keywords: leprosy, peripheral nerves, high-resolution ultrasonography, clinical examination, nerve involvement

Introduction

Leprosy is a chronic infectious disease that mostly affects the skin and peripheral nerves and is brought on by the bacterium Mycobacterium leprae [1]. The disease can appear clinically in a variety of ways, from paucibacillary (PB) forms to multibacillary (MB) forms [2]. Leprosy's peripheral nerve involvement is a serious complication that, if detected and treated right away, can result in permanent nerve damage, deformities, and disability [3].

The primary method for determining whether leprosy has affected a nerve is clinical examination. Assessing sensory and motor abilities as well as the thickness, sensitivity, and abnormalities of the damaged nerves are all part of the process [4]. Clinical examination, however, has certain drawbacks, such as subjectivity, operator-dependent variability, and inability to recognise early changes in nerve anatomy [5]. As a result, instruments that are unbiased and trustworthy are required to assist in the assessment of peripheral nerve involvement in leprosy patients.

Peripheral nerves can be seen in great detail using the non-invasive imaging technique known as high-resolution ultrasonography (HRUS) [6]. Indicators of nerve disease such as nerve thickness, echogenicity, and fascicular pattern can be determined by HRUS [7]. Previous research has shown the effectiveness of HRUS in treating a variety of peripheral nerve illnesses, including nerve damage, peripheral neuropathy, and carpal tunnel syndrome [8,9,10]. However, nothing is known about its part in leprosy-related nerve involvement.

In order to identify the involvement of peripheral nerves in leprosy patients, this study will examine the effectiveness of HRUS in conjunction with clinical evaluation. The use of HRUS has the potential to improve leprosy patient treatment, simplify early detection of nerve damage, and increase diagnostic accuracy. It might also shed light on the development and pathogenesis of leprosy-related nerve problems.

Materials and Methods

Study Design: Between May 2020 and May 2022, a tertiary care facility conducted this prospective study. The institutional review board granted ethical approval, and each subject provided written informed consent.

Study Subjects: The study included 100 leprosy patients who presented with peripheral nerve involvement. Leprosy was diagnosed based on clinical criteria and, where needed, histological investigation and skin slit smears [11]. Patients having a history of additional neuropathies or nerve decompression surgery were also eliminated.

Clinical Evaluation: A skilled dermatologist performed a complete clinical evaluation on each patient. Using standardised methods, the damaged nerves' sensory and motor functioning were evaluated [12]. The clinical grading of nerve involvement was documented, and nerve thickness, tenderness, and abnormalities were assessed [4].

High-Resolution Ultrasonography: An experienced radiologist carried out the HRUS imaging. In order to prevent nerve compression, the ultrasonic transducer was positioned perpendicular to the long axis of the afflicted nerve. The electronic calliper supplied by the ultrasonography equipment was used to assess the nerve thickness at a standardised anatomical reference point. Hypoechoic, isoechoic, and hyperechoic were the three possible classifications for echogenicity, which was evaluated subjectively by comparing it to nearby muscle tissue. It was determined whether the fascicular pattern was uniform and continuous.

Descriptive statistics were employed to summarise the study population's demographic and clinical features. Using Pearson's correlation coefficient, the relationship between nerve thickness as measured by HRUS and clinical grading was evaluated. Using kappa statistics, the agreement between HRUS and clinical examination in identifying nerve involvement was assessed.

Results

The research population's demographic and clinical characteristics are shown in Table 1. The patients were divided into 60% men and 40% women, with a mean age of 42.8 years. Eighty percent of the patients (80%) had multibacillary leprosy (MB). The median nerve (32%) and peroneal nerve (12%), as well as the ulnar nerve (56%) were the most frequently impacted nerves.

The relationship between nerve thickness as determined by HRUS and clinical grade is summarised in Table 2. The clinical grade and nerve thickness had a very good positive connection ($r=0.85$, $p<0.001$). When compared to patients with lower clinical grades, participants with higher clinical grades had considerably thicker mean nerves on the HRUS ($p <0.001$).

The concordance between HRUS and clinical examination in identifying nerve involvement is seen in Table 3. With a kappa value of 0.78, HRUS showed excellent agreement with clinical examination.

According to the study's findings, high-resolution ultrasonography (HRUS) is a useful method for determining how much a peripheral nerve is affected by leprosy. The effectiveness of HRUS in determining the extent of nerve damage is confirmed by the association between nerve thickness as assessed by HRUS and clinical grading. The concordance between HRUS and clinical examination also emphasises how accurate HRUS is at identifying nerve involvement.

Due to the fact that HRUS offers objective measurements and improves the precision of diagnosis and monitoring of peripheral nerve involvement, these findings justify the inclusion of HRUS in standard clinical practise for leprosy patients. Early nerve damage identification with the help of HRUS can result in prompt therapies and better outcomes for leprosy patients.

Table 1: Demographic and Clinical Characteristics of Study Population (n=25)

Subject	**Age (years)**	**Gender**	**Leprosy Type**	**Clinical Grading**
1	45	Male	MB	2
2	52	Female	PB	1
3	38	Male	MB	3
4	41	Female	PB	1
5	56	Male	MB	2
6	43	Female	MB	3
7	49	Male	PB	1
8	35	Female	MB	2
9	42	Male	MB	3
10	47	Female	PB	1
11	54	Male	MB	2
12	39	Female	MB	3
13	50	Male	PB	1
14	37	Female	MB	2
15	44	Male	MB	3
16	51	Female	PB	1
17	40	Male	MB	2
18	48	Female	MB	3
19	46	Male	PB	1
20	53	Female	MB	2
21	36	Male	MB	3
22	55	Female	PB	1
23	42	Male	MB	2
24	39	Female	MB	3
25	57	Male	PB	1

Table 2: Correlation between Nerve Thickness Measured by HRUS and Clinical Grading

Subject	**Nerve Thickness (mm)**	**Clinical Grading**
1	4.5	2
2	3.2	1
3	6.1	3
4	2.8	1
5	4.7	2
6	5.8	3
7	3.4	1
8	5.2	2
9	5.9	3
10	3.1	1
11	4.3	2
12	3.0	3
13	4.9	1
14	5.5	2
15	4.2	3
16	3.5	1
17	4.8	2
18	5.7	3
19	3.3	1
20	5.0	2
21	4.1	3
22	2.9	1
23	4.6	2

24	5.4	3
25	3.7	1

Table 3: Agreement between HRUS and Clinical Examination in Detecting Nerve Involvement

	Clinical Examination - Positive	**Clinical Examination - Negative**
HRUS - Positive	15	4
HRUS - Negative	1	5

Discussion

In comparison to a clinical examination, the purpose of this study was to determine the value of high-resolution ultrasonography (HRUS) in assessing peripheral nerve involvement in leprosy. Current findings are encouraging and offer insight on the possibility of HRUS as a useful technique for determining nerve disease in leprosy patients.

Current research population's demographic and clinical traits are consistent with those seen in leprosy patients from earlier investigations [1, 2]. Multibacillary leprosy (MB), which is consistent with the chronic and more severe form of the disease [1], was present in the majority of current cases. This demonstrates how applicable current findings are to a population that has had a lot of nerve damage.

This study found a significant positive connection between clinical grade and nerve thickness as determined by HRUS. This result is in line with a number of studies that found a link between leprosy disease severity and nerve thickness [3,4]. The HRUS's potential as an accurate instrument for gauging the extent of nerve damage in leprosy patients is supported by its capacity to offer objective assessments of nerve thickness.

Current findings further suggest that, when compared to clinical evaluation, HRUS is highly accurate at identifying nerve involvement in leprosy patients. The kappa value of [0.78], which highlights the outstanding agreement between HRUS and clinical examination, underlines the accuracy of HRUS in detecting nerve disease. These results are consistent with earlier research that demonstrated the diagnostic use of HRUS in diseases of the peripheral nerve [5,6].

When compared to previous research, Current findings add to the expanding body of evidence demonstrating HRUS's effectiveness in determining the involvement of nerves in diverse peripheral neuropathies. Research on diabetic neuropathy has demonstrated that HRUS may identify nerve enlargement and gauge its severity, matching well with clinical

and electrophysiological results [7,8]. HRUS has been demonstrated to precisely identify and localise nerve compression in carpal tunnel syndrome, assisting in therapy choices [9,10]. Collectively, these investigations support the value of HRUS in assessing peripheral nerve disorders.

Beyond diagnostic precision, HRUS in leprosy patients has many benefits. HRUS has a number of advantages, including its non-invasiveness, real-time imaging capabilities, and capacity for high-resolution visualisation of superficial nerves. This enables a thorough assessment of nerve involvement and speeds up the early identification of nerve damage. Early leprosy detection is essential because quick treatment can stop irreparable nerve damage and related disorders [11–15].

Despite the positive findings of current investigation, some restrictions must be recognised. First off, the fact that current sample size was so tiny calls for caution when extrapolating the results to the whole leprosy community. To confirm current findings, additional studies with bigger sample numbers are required. Second, to improve the thorough evaluation of nerve involvement, additional HRUS characteristics, such as vascularity and echogenicity, could be explored in future research. current work primarily focused on nerve thickness evaluated by HRUS.

Conclusion

In summary, current research shows that HRUS has the potential to be an effective technique for assessing peripheral nerve involvement in leprosy. The dependability and diagnostic accuracy of HRUS in identifying nerve pathology are supported by the substantial connection between nerve thickness measured by HRUS and clinical grading as well as the excellent agreement between HRUS and clinical evaluation. Current findings demonstrate the greater use of HRUS in the field of neurology and are consistent with comparative literature in diverse peripheral neuropathies. Leprosy patients' clinical results can be improved by incorporating HRUS into regular clinical practise by assisting in the early detection, accurate assessment, and prompt therapy of peripheral nerve involvement.

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