

Evaluation of nerve involvement in Hansen's disease by a newer technique - high resolution ultrasonography (HRUS)

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Abstract

Background Hansen's disease is a chronic inflammatory disease caused by *Mycobacterium leprae* which primarily affects skin and peripheral nerves. The presence and degree of nerve involvement is usually evaluated by clinical assessment which has an inherent limitation of being highly subjective and by nerve biopsy which has risk of increasing the neurological deficit. HRUS and Colour Doppler (CD) is shown to be a useful technique to detect nerve damage in leprosy.

Aims and Objective To study the size, echotexture, morphologic alteration and vascularity of peripheral nerves in patients with leprosy by HRUS.

Material and Methods The study was conducted in the departments of Dermatology and Radiology at Dr. PSIMS & RF over a period of 6 months from March 2018 to August 2018. Sample size included 30 clinically diagnosed cases of Hansen's disease as per Ridley-Jopling classification and these patients were subjected to HRUS and CD to study the nerve involvement.

Results Of the 30 leprosy patients scanned all of them had morphological alterations like increased focal hypoechoic areas, loss of fascicular architecture, thickened epineurium and 3 cases with clinical evidence of reaction showed increased endoneural vascularity.

Conclusion HRUS is a noninvasive, cost effective tool that gives significant information on nerve structure, morphology and vascularity in the nerve and this adds a new dimension in diagnosing leprosy particularly pure neuritic type and assessment of nerve damage which can prevent disabilities.

Key words

Hansen's disease, HRUS, CD.

Background

Hansen's disease is a chronic inflammatory disease caused by *Mycobacterium leprae* which

primarily affects skin and peripheral nerves.¹ It can affect the sensory, motor or autonomic functions of peripheral nerves.

Nerves that are commonly involved include the ulnar nerve (UN), median nerve (MN), radial nerve (RN), common peroneal nerve (CP), posterior tibial (PT) and greater auricular nerve, with or without skin lesions. The presence and degree of nerve involvement is usually evaluated by clinical assessment which has an inherent

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limitation of being highly subjective and by nerve biopsy. Nerve biopsy is an invasive procedure and its histological interpretation needs specific skills² and due to the risk of increasing the neurological deficit, a biopsy on a nerve having motor component cannot be performed.³ Nerve conduction studies does not provide spatial information about nerve anatomy and its surroundings. Evidence of neuropathy may appear late even in the presence of nerve damage hence assessment of functional impairment clinically is not complete.⁴ Immunocytochemical tests are useful in the above scenario but their cost is prohibitive and availability limited.

Nerve damage may be increased during lepra reactions in 15–50% of patients during the disease or after the completion of multidrug therapy. Nerve damage should be diagnosed as early as possible as condition is reversible with steroid therapy. The role of non-invasive imaging techniques, including ultrasonography (USG) and magnetic resonance imaging (MRI) is under exploration and can serve in diagnosing both silent and active nerve involvement, thereby preventing deformity and disability.⁵ It is difficult to follow the peripheral nerves along its superficial course for identification of pathology with MRI which can be done easily with USG. Imaging of peripheral nerves can be done with reasonable precision with HRUS and CD.

Aims and objectives

To study the size, echotexture, morphologic alteration and vascularity of peripheral nerves in patients with leprosy by HRUS.

Material and Methods

The study was conducted in the departments of Dermatology and Radiology at Dr. PSIMS & RF

over a period of 6 months from March 2018 to August 2018. Sample size included 30 clinically diagnosed cases of Hansen's disease.

Inclusion criteria

All newly diagnosed cases of Hansen's disease as per Ridley-Jopling classification.

Exclusion Criteria

1. Patients with a previous history of mechanical trauma or surgery around the region of the nerve.
2. All study subjects with associated neurological disorders such as familial neuropathies, or having a systemic disorder known to cause peripheral neuropathy, including alcoholism, diabetes, amyloidosis, and neurofibromatosis.

After obtaining written informed consent from all the patients, detailed history and clinical examination was done. Clinical findings with particular reference to enlargement of various peripheral nerves have been recorded and later subjected to detailed sonographic assessment (HRUSG and CD) of the nerves which was carried out by an experienced radiologist blinded to all the clinical details. All peripheral nerves like the MN at the wrist and forearm, the UN at the elbow and proximal to the medial epicondyle, CP at the fibula head and PT nerves at the ankle and proximal to the medial malleolus were imaged using a linear array transducer with broadband frequency of 15–18 MHz and Colour Doppler. On the gray scale imaging, the measurement of size [Cross sectional area (CSA)] of the nerves, alterations in nerve morphology, echo texture, fascicular pattern and vascularity was made.

Results

30 patients have been included in our study among which 18 were males and 12 were females and most of them were in the age group of 20–40 years.

Among 7 patients out of 30, we could not appreciate nerve thickening on clinical examination but thickening was observed according to USG criteria. Thus, a sonographic scan could detect an abnormal nerve in the absence of any clinical or neurological manifestation.

According to the sonographic criteria of cross sectional area of nerve, among 30 patients 17 had UN, 8 patients had both UN and CP nerve, 4 patients had CP and 1 patient had UN, MN, RN, CP and PT nerve enlargement.

Of the 30 leprosy patients scanned all of them had morphological alterations like increased focal hypoechoic areas, loss of fascicular architecture and thickened epineurium.

Only 3 cases showed increased endoneural vascularity. All 3 cases clinically showed evidence of reactions.

Table 1 Age and sex distribution

Age range	Males	Females	Total
20 – 40	11	4	15
40 - 60	5	7	12
60 - 80	2	1	3
TOTAL	18	12	30

Table 2 Type of Hansen’s disease

Type of Hansen’s disease	Number of patients
Pure neuritic type	9
BT	9
TT	3
BL	3
LL	3
BT with type 1 reaction	2
BL with type 2 reaction	1

Table 3 Clinical, HRUSG and CD correlation of peripheral nerves enlargement

Type of Hansen’s disease	No. of patients with nerve involvement	Clinical	HRUSG	CD (Vascularity)
1. Pure neuritic type (9)	UN nerve (7)	5	7	-
	CP nerve (1)	1	1	-
	UN + CP nerve (1)	1	1	-
2. BT(9)	UN nerve (5)	3	5	-
	UN + CP nerve (2)	2	2	-
	CP nerve (2)	1	2	-
3. TT (3)	UN nerve (3)	2	3	-
4. BL (3)	UN + CP nerve (2)	2	2	-
	UN nerve (1)	1	1	-
5. LL (3)	UN + CP nerve (2)	1	2	-
	UN+MN+RN+CP+PT(1)	1	1	-
6. BT with Type 1 reaction(2)	UN nerve (1)	1	1	+
	CP nerve (1)	1	1	+
7. BL with Type 2 reaction (1)	UN + CP nerve (1)	1	1	+
TOTAL	30	23	30	3

UN-ulnar nerve, CP- Common peroneal nerve, MN- median nerve ,RN- radial nerve ,PT – posterior tibial nerve



Figure 1 HRUS axial image of ulnar nerve shows increased focal hypoechoic areas, loss of fascicular architecture and thickened epineurium



Figure 2 HRUS longitudinal image shows thickened common peroneal nerve

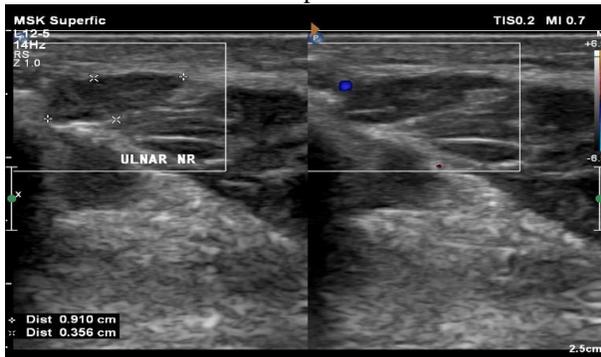


Figure 3 HRUS longitudinal image shows thickened radial nerve

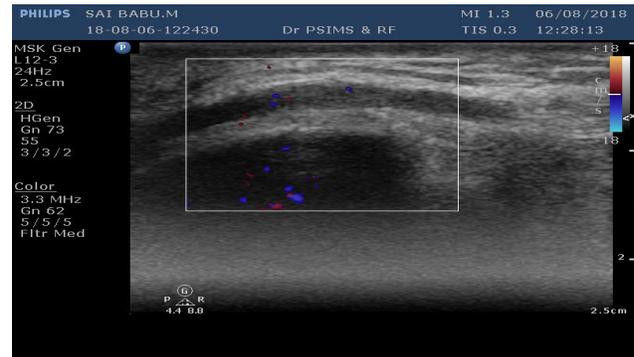


Figure 4 HRUS and CD image of thickened ulnar nerve with increased vascularity

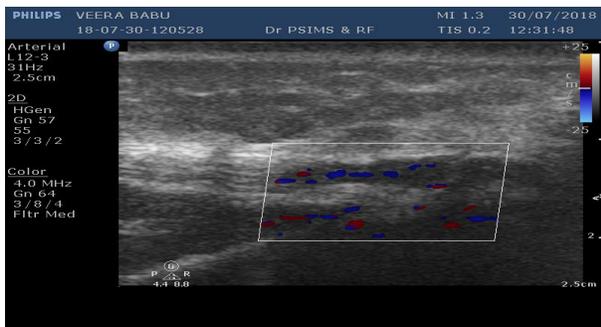


Figure 5 HRUS and CD longitudinal thickened common peroneal nerve with increased vascularity

Discussion

High-resolution ultrasonography is a non invasive, imaging technique, which provides real time examination of deeper tissues including peripheral nerves in static and dynamic states such as blood flow.⁶ There are many studies that highlight the use of HRUS in leprosy.⁷⁻⁹ It was found to be useful in imaging of all the commonly involved nerves in leprosy.

In our study, out of 30 patients most patients were having pure neuritic and BT type of Hansen's disease. Among pure neuritic, we could clinically diagnose only 7 (77.7%) cases out of 9 and among BT type only 5 (55.5%) cases had nerve enlargement out of 9. In rest of BT cases nerve enlargement was identified by HRUS .

Thus HRUS is especially useful in the confirmation of diagnosis of pure neuritic leprosy (PNL) as it not only confirms the nerve thickening but also provides information on the exact location of nerve enlargement in its course apart from other morphological alterations. This information brings a new dimension to the diagnosis of PNL.¹⁰

HRUSG and CD helps in studying size, echotexture, morphologic alteration and vascularity of peripheral nerves. In this study,

we found that nerve dimensions i.e., Cross Sectional Area (CSA) was significantly greater in all leprosy patients compared with set of reference values reported by Cartwright MS et al.¹¹ Ulnar nerve CSA values were similar to those reported by Gupta et al¹² and greater than the mean ulnar nerve CSA $4.7 + 0.6\text{mm}^2$ at the tip of the medial epicondyle and $4.4+0.6\text{mm}^2$ 5 cm proximal to tip of the medial epicondyle reported by Bathala et al.¹³ All patients showed increased focal hypoechoic areas, loss of fascicular architecture.

In this study, we have studied the correlation between clinical signs and sonographic findings and observed that in patients with known leprosy and no thickening of nerves, enlarged dimensions or thickening was identified by HRUSG and this was in accordance with the results reported by Gupta et al.¹²

Visser et al. have reported that “strikingly thickened epineurium” was important finding in leprosy and our study has also shown similar results.¹⁴

Nerves of all patients with lepra reactions in our study have shown increased blood flow signals on colour Doppler in the endo/ perineurium, indicative of increased vascularity, giving a clue to the diagnosis of persistent reaction in them and these findings were in accordance with results by Gupta et al.¹²

Therefore, it is of no doubt that HRUSG is accepted as a useful tool in the diagnosis of primary neuritic leprosy.¹⁵ Using this tool can help early identification of abnormal nervous structure. Slim et al. proposed that “this is important, because when nerve involvement is diagnosed in time, it may be reversible with adequate treatment.”¹⁶

HRUS provides an objective assessment of nerve thickening where extensive lengths of the nerve can be studied even in the muscular planes or under retinacula, with no limitation to its subcutaneous course. In addition, availability of high resolution probes enables us to assess even small anatomical and morphological variations which would otherwise be impossible to ascertain by routine clinical examination.¹⁷ With increased experience of HRUS use in leprosy, it is now becoming possible to actually visualize and study individual fascicles in more detail.

HRUS also demonstrates early hemodynamic changes in the nerve progressing to develop reaction which could be useful once standardized, as an early sign to alert the physician/ leprologist to start corticosteroid therapy.

Conclusion

HRUS is a noninvasive and cost effective tool that gives significant information on nerve structure, morphology and vascularity in the nerve and this adds a new dimension in diagnosing leprosy particularly pure neuritic type and assessment of nerve damage which can prevent disabilities.

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