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Research Article

High Resolution Ultrasonographic Evaluation of Peripheral Nerves in Leprosy- A Prospective Study

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Abstract
Leprosy, also called Hansen's disease is a chronic slow growing treatable disease that involves skin and peripheral nerves. If not treated will progress to produce permanent damage of peripheral nerves resulting in paralysis of muscles and limbs affected. In the present study high resolution ultrasound along with Color Doppler evaluation of commonly affected peripheral nerves in 40 leprosy patients with controls was done to assess the morphological changes in them.
Keywords: *leprosy, peripheral nerves- ultrasound.*

Introduction

Nerve involvement in leprosy can affect the sensory, motor or autonomic functions of Peripheral nerves. The manifestations include sensory loss, motor loss in the distribution of the affected nerves, glove and stocking neuropathy and anesthesia on soles of feet etc. The most common nerves involved in leprosy are posterior tibial nerve and followed by ulna, median, lateral popliteal, facial, great auricular, radial and radial cutaneous nerves.

High resolution ultrasound (HRUS) of the nerves affected is highly sensitive in identifying the disease process. HRUS also detects the complications of leprosy like intraneural abscess. leprosy causes diffuse or focal enlargement of the involved nerves along with inflammation.

The normal values of the sizes of peripheral nerves was described among the European population[1]. The normal appearance of peripheral nerve on high resolution ultrasound is described as "honeycomb appearance "on transverse section and "bundle of straws " on longitudinal sections due to the presence of hypoechoic fascicles separated by hyperechoic septae. The nerve is more echogenic than the adjacent muscle[2]. There

will be no color Doppler signals in the normal nerve. The enlargement of the peripheral nerve is the most important finding in leprosy. The echogenicity in leprosy varies from mild degree of loss of hypo reflectivity to complete loss of reflectivity. The internal fascicular pattern changes from being totally edematous, partial or complete loss of fascicular pattern and also show epineural thickening. The nerve may show increased vascularity.

Material and Methods

High resolution ultrasound study with colour Doppler using 14MHz linear probe was performed on 40 clinically diagnosed leprosy patients along with 20 controls. The most common group of leprosy in the study was borderline tuberculoid (17 no., followed by borderline lepromatous 11 no, lepromatous type 10 and 2 cases are of pure neurotic type. The peripheral nerves selected in all cases include bilateral ulnar, median, radial cutaneous nerves in the upper limb and lateral popliteal and posterior tibial nerves in lower limbs. The peripheral nerves were identified based on the anatomical landmarks described. Each nerve was evaluated for the size, extent of enlargement, internal architecture and echotexture and also its vascularity on colour Doppler. The nerve enlargement is measured by taking the AP and transverse diameter and cross sectional area into consideration. Out of the 40 patients in the study 38 are males and rest are females. The age varied between 18 years and 70 years with peak incidence between 26-45 years.

Observations

1) Cross sectional area (sq mm) of all the selected nerves were recorded in both leprosy and control groups. In both groups the posterior tibial nerve was found to have largest cross sectional area.

Table 1: cross-sectional area of peripheral nerves (sq mm) in controls and leprosy

		median N	ulnar N	radial cutaneous N	post.tibial N	Lateral popliteal N
Controls (20)						
mean		6.5	5.6	1.1	9	8.9
range		3-10	3-10	1-2	3-18	4-17
leprosy(40)						
mean		10.3	12.9	2	13.4	12.3
range		3-45	3-46	1-7	3-51	4-38

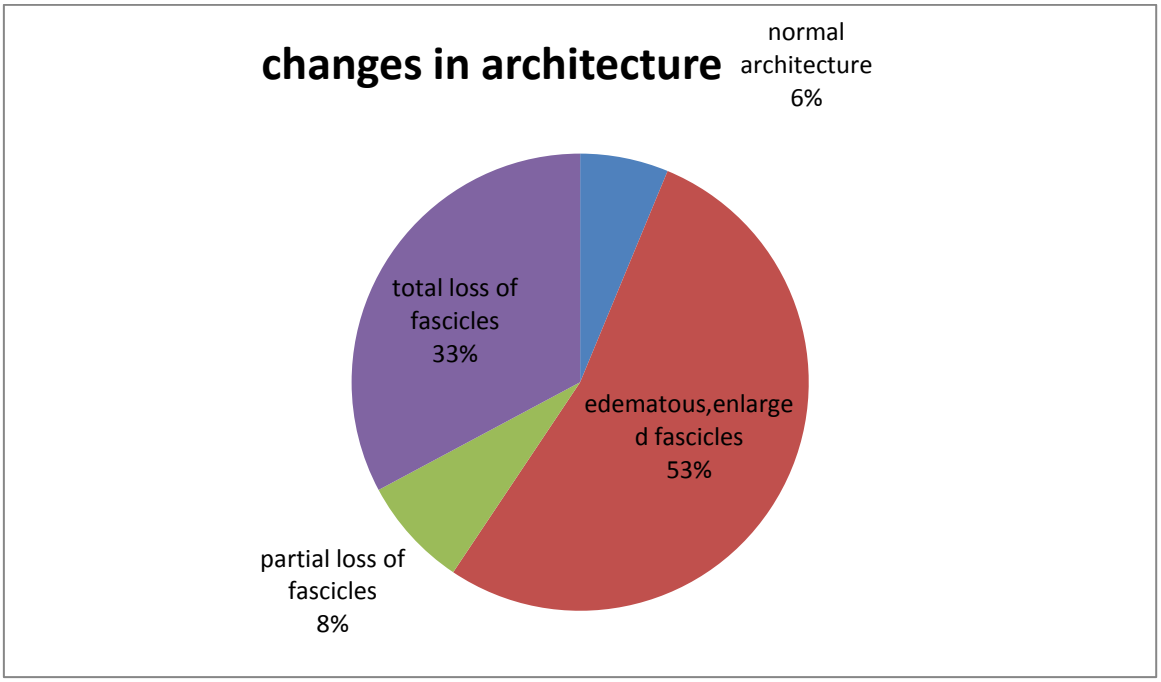
2) Nerve thickness: out of the 400 nerves examined in leprosy patients, 128 nerves (32 %) are abnormally thickened. Of the 5 pairs of nerves in the study ulnar nerve was most frequently affected (35 %). Bilateral involvement was also most common in ulnar nerves.

Table 2: Thickness of peripheral nerves

nerve thickened	no. of nerves	percentage(n=128)	B/I Involvement (no.of cases)
median nerve	15	11.70%	4
radial cutaneous nerve	27	21.10%	11
ulnar nerve	46	35.90%	17
posterior tibial nerve	21	16.40%	7
lateral popliteal nerve	19	14.80%	7

3) Nerve echotexture: compared to the nerves in control group, all the nerves in leprosy group showed varying degrees of hypo reflectivity.

4) Nerve architecture: the normal 'honeycombing, bundle of straws' pattern of nerve fascicles are replaced by enlarged and edematous fascicles in majority of nerves in leprosy (53.1%). The other abnormalities noted are partial or complete loss of fascicles pattern. In a small percentage of cases the architecture was normal.



5) vascularity of nerves: normally there will be no intraneural blood flow on colour Doppler. In leprosy patients, intraneural vascular flow was detected in 43 nerves out of 128 cases, which was seen mostly in lepromatous leprosy with type 1 reaction.

6) Epineural thickening was noted in 5 cases of leprosy.

7) One case of borderline tuberculoid leprosy had an abscess in lateral popliteal nerve.

8) 3 cases of borderline lepramatous leprosy and 1 case of borderline tuberculoid leprosy showed completely normal peripheral nerves on ultrasound.

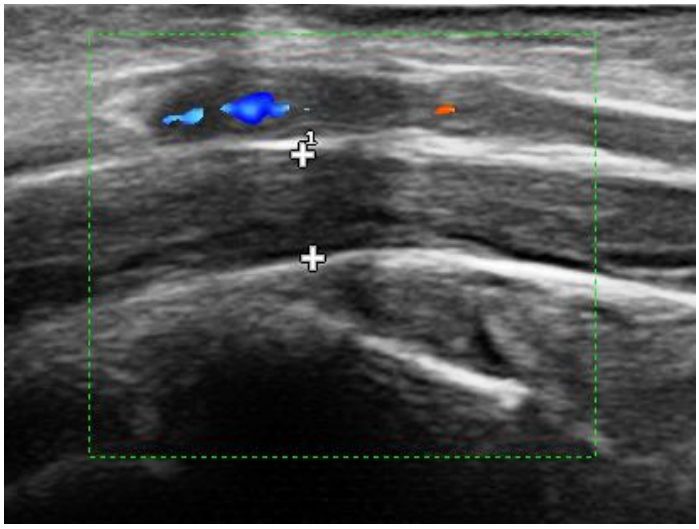


Fig 1 HRUS longitudinal image shows thickened ulnar nerve

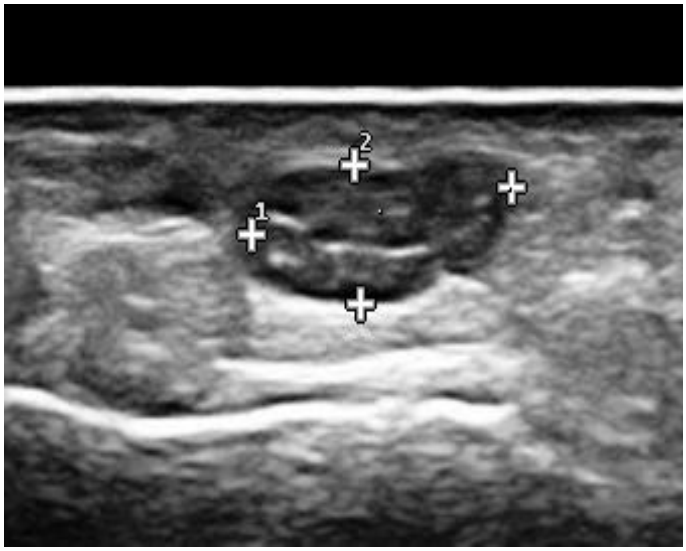


Fig 2 axial image show thickened median nerve

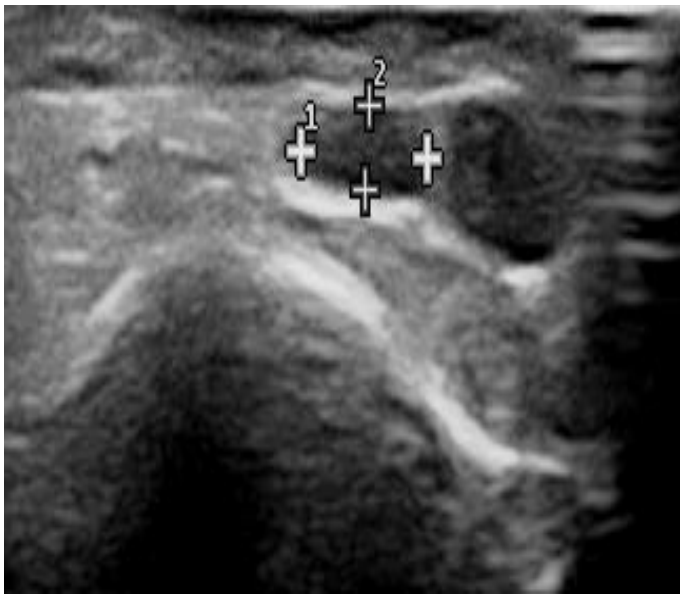


Fig 3. Axial image shows thickened radial cutaneous nerve.

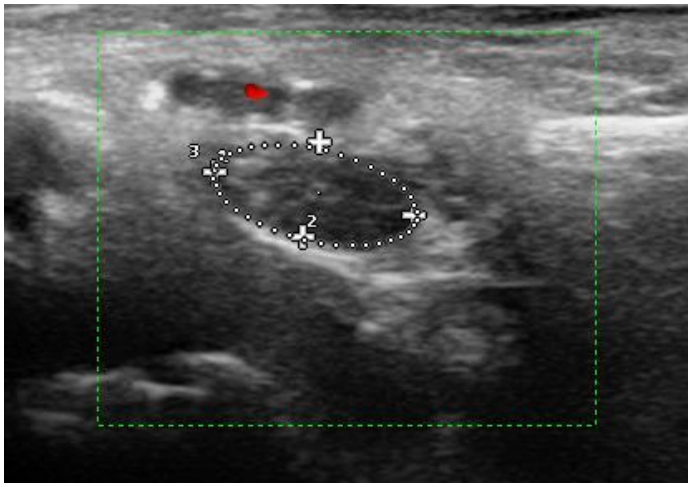


Fig 4 axial image shows thickened posterior tibial nerve

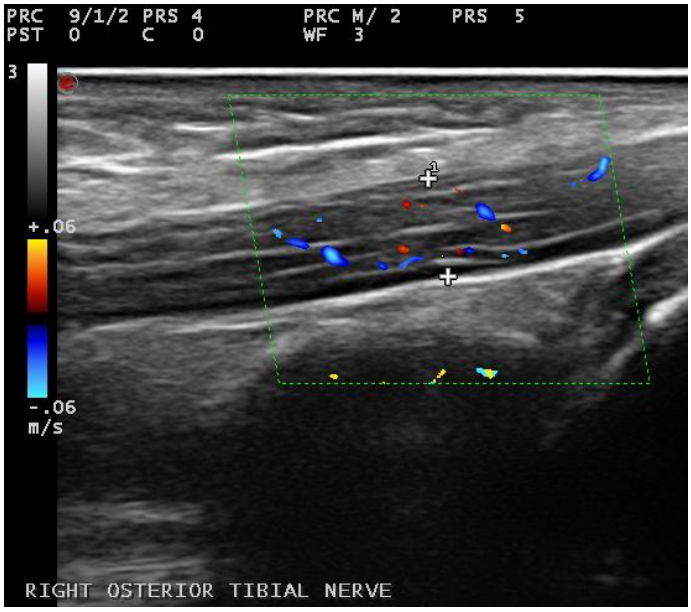


Fig 5. longitudinal image of thick posterior tibial nerve with vascularity

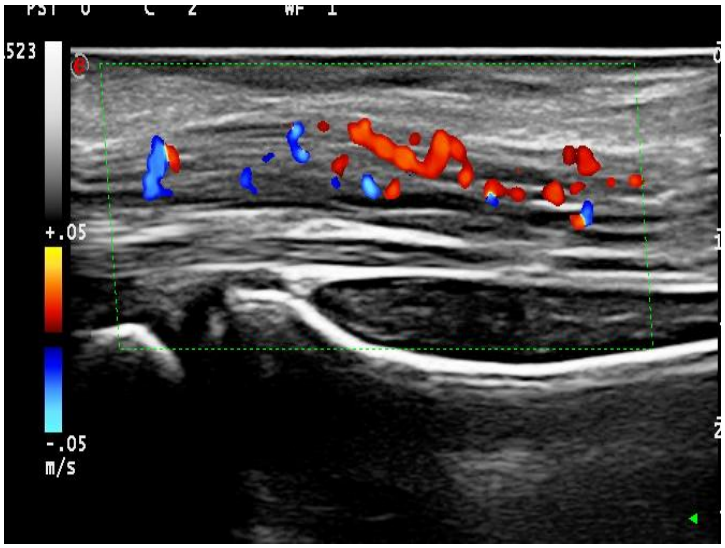


Fig 6 Thick median nerve with vascularity

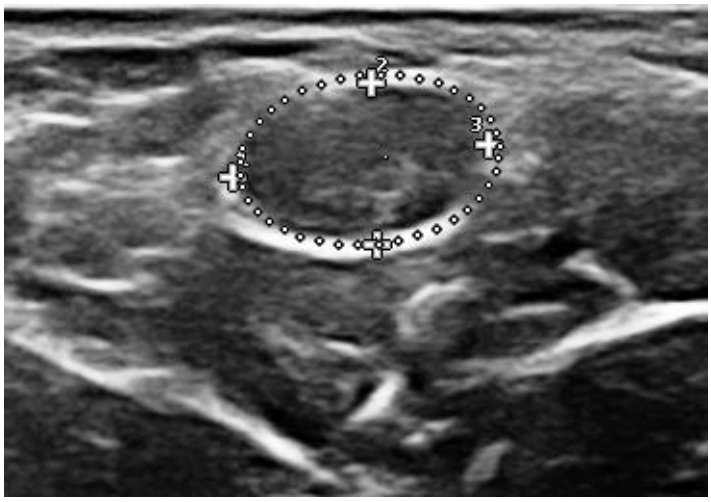


Fig 7. axial image show thick epineurium

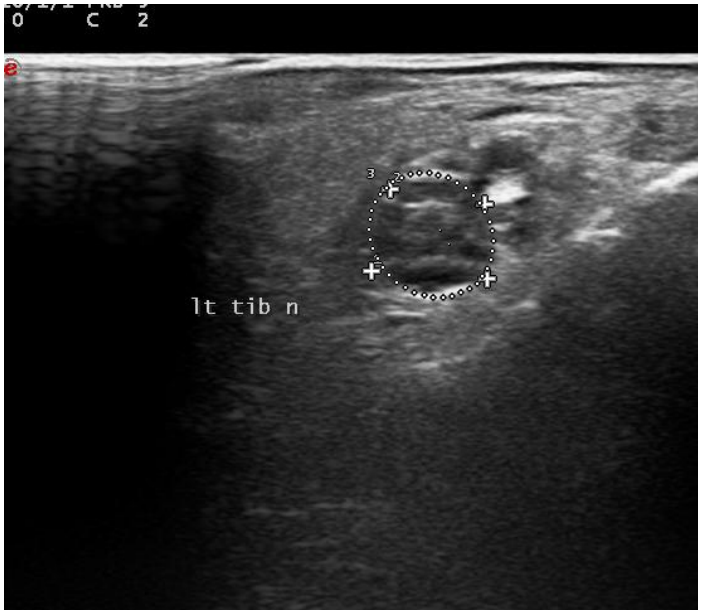


Fig 8 axial image of posterior tibial nerve showing swollen fascicles.

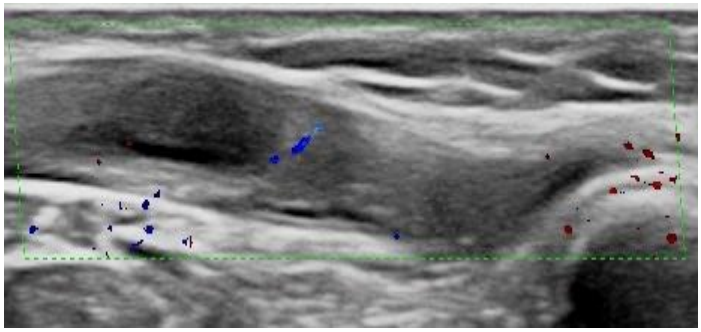


Fig 9 HRUS image of intraneural abscess peroneal nerve

Discussion

Depending on the bacillary load leprosy is classified into paucibacillary (PB) and multibacillary (MB) types. Paucibacillary type is characterized by the presence of fewer skin lesions (<5) and multibacillary show multiple skin lesions, plaques, thickened dermis, and nodules. Leprosy mainly involves skin, nerves and mucous membranes. Involvement of nerves cause enlargement which results in numbness of the affected areas, paralysis and muscle weakness. If not diagnosed in the early stage it will lead to permanent paralysis and deformities of the hands and feet involved with resorption of fingers and toes.

Use of high resolution ultrasonography (HRUS) in the evaluation of peripheral nerves was extensively described in the literature by many authors[1,2,3,4,5]. A simplified technique of examination of peripheral nerves and its normal and abnormal appearance was nicely elaborately described[2]. J.Boehm and others[1] evaluated peripheral nerves in 56 healthy subjects and established reference values for the most frequently evaluated nerves. Afsal M and others [4] performed HRUS and Colour Doppler study on 30 patients with peripheral nerve lesions and found that HRUS is highly useful in characterizing different peripheral nerve lesions and is complementary to other investigations. They found that ulnar nerve which was not palpable clinically had shown significant thickening on ultrasound which indicate that clinical examination is not that reliable. The median and ulnar nerves showed focal and multifocal thickening in leprosy unlike diffuse thickening seen in diabetic peripheral neuropathy. They also detected the complications of leprosy like intraneural abscess and perineural inflammation on ultrasound very clearly. Martinoli .C et al[6] compared ultrasound and MR imaging of peripheral nerves in 23 leprosy patients with clinical findings and found that both gray scale ultrasound including Doppler and MR are able to detect the nerve abnormalities in leprosy and also indicated the response to treatment. Suman J et al[3] performed HRUS of peripheral nerves in 20 leprosy patient and found significant correlation between ultrasound findings (cross sectional area, nerve echotexture, endoneural vascular flow) and clinical parameters that include nerve thickening, sensory loss and muscle weakness and concluded that ultrasonography exhibits more nerve damage than clinical examination. Suman Jain et al[7] described the nerve damage on HRUS in a case of pure neural or primary neurotic leprosy where nerve involvement is seen without skin lesions. Kharat A[8] emphasized the role of HRUS in the diagnosis and follow up of leprosy patients especially in identifying the thickened nerves away from those clinically affected. It is more reliable than palpation where thickened nerves

travel deeper within the fascial planes. Lugao HB and others[9] analysed the peripheral nerves in 96 leprosy patients using HURS, and found that the nerve thickening was more frequent in multibacillary type than panbacillary type of leprosy and also in those patients with previous reactions. Asymmetric nerve enlargement was also more common in patients with previous reactions. Asymmetry is a characteristic feature of leprosy neuropathy and do not differ significantly between paucibacillary and mutibacillary leprosy. In the present study we compared the typical changes in the peripheral nerves seen in leprosy with that of the normal nerves in control group by HRUS, Colour Doppler. Nearly one third of the peripheral nerves in leprosy were thickened (32 %), of which ulnar nerve was most frequently affected. Bilateral involvement was also more common in ulnar nerves. The cross sectional area of the peripheral nerves was also proportionately increased in leprosy which was correlating with similar study[3]. Alteration in the fascicular architecture pattern was seen in significant percentage of patients (30%) of which edematous and enlarged fascicles was most common finding noted. Lepromatous leprosy group of patients showed the presence of intraneural blood flow. Follow up ultrasound peripheral nerves can be well correlated with treatment response and clinical improvement as it a non invasive investigation and can be included in assessing the nerve function of leprosy patients[10]. HRUS will be definitely suitable to study the structural changes at the nerve sites that is not suitable for biopsies and also very cost effective than MRI in the evaluation of nerves [11].

Conclusion

Since leprosy commonly presents with peripheral neurological problem, identification of the morphological changes in the involved nerve is very important in the diagnosis at an early stage to prevent permanent neurological deficits. HURS and Doppler which is available everywhere can be included in the management protocols. The main advantage is that it is a simple technique, can be performed at bed side and also assess the linear extension of the involved thickened peripheral nerves which is sometimes clinically inaccessible.

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