ORIGINAL RESEARCH

A comparative analysis of high-resolution ultrasound and magnetic resonance neurography in peripheral nerve pathologies

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ABSTRACT

Background: Peripheral nerve pathologies refer to a variety of disorders and conditions that affect the peripheral nervous system, which consists of nerves outside of the brain and spinal cord. The present study compared high-resolution ultrasound (HRUS) and magnetic resonance neurography (MRN) in peripheral nerve pathologies. **Materials & Methods:** 70 patients diagnosed with peripheral nerve pathologies of both gendersunderwent high-resolution ultrasound using Siemens MAGNETOM 3 or 1.5T MR and HRUS imaging with a 14 MHz linear transducer. **Results:** Out of 70 patients, males were 40 and females were 30. The sensitivity of MRI was 94.8% and USG was 82.4%, specificity was 68.4% and 100%, PPV was 95.2% and 100% and NPV was 58.8% and 46.4% respectively. Out of 15 cases of fascicular change, MRI detected 13 and USG all 15 correct. 14 cases of caliber change, MRI detected 8 and USG 12 correctly, out of 20 cases of nerve discontinuity, MRI assessed 15 and USG 18 accurately. Out of 12 cases of increased nerve signal, MRI detected all correctly and USG detected 9 correct and 8 cases of neuroma/mass lesions, MRI detected 9 and USG 8 correctly. The difference was significant ($P< 0.05$). **Conclusion:** In order to assess peripheral nerve diseases, the first-line imaging modality may be HRUS, which shown good accuracy and is a potent tool.

Key words: HRUS, Peripheral nerve pathologies, MRI

INTRODUCTION

Peripheral nerve pathologies refer to a variety of disorders and conditions that affect the peripheral nervous system, which consists of nerves outside of the brain and spinal cord. These pathologies can lead to a wide range of symptoms, including pain, weakness, numbness, tingling, and impaired motor or sensory function.[1]In general, nerves travel along the edges of other structures, particularly between various muscle groups. Every nerve should have a well-established survey pattern employing landmarks and borders that one can use repeatedly.[2] The survey must be restarted from the beginning if one loses the nerve while tracing it.[3] While color doppler aids in distinguishing nerves from arteries, movement of the leg aids in separating tendons from nerves. By virtue of their spherical shape, fatty hilum, and inability to be traced along a longitudinal axis, lymph nodes can be easily distinguished from nerves.[4]

According to the clinical question, the best option should be chosen from magnetic resonance neurography (MRN) and HRUS, which are now regarded complimentary to clinical and neurophysiological testing for neuropathies.[5]Both techniques are one-of-a-kind in their own right, with HRUS being more patient-friendly, affordable, and accessible whereas MR has a steep learning curve and is highly operator reliant. HRUS also offers greater picture quality than MR.[6] The patient may not always feel comfortable during an MRI, but it is pricey, operator-independent, and has a high spatial resolution.[7] The present study compared high-resolution ultrasound (HRUS) and magnetic

resonance neurography (MRN) in peripheral nerve pathologies.

MATERIALS & METHODS

The present study consisted of70 patients diagnosed with peripheral nerve pathologies of both genders. All were informed regarding the study and their written consent was obtained.

Demographic data such as name, age, gender etc. was recorded. All underwent high-resolution ultrasound using Siemens MAGNETOM 3 or 1.5T MR and HRUS imaging with a 14 MHz linear transducer. A grading system (score 0–3) was used for image interpretation to look for neuroma/mass lesions as well as nerve continuity/discontinuity, increased nerve signal/edema, fascicular change, and caliber change. Score 3 indicated the highest level of confidence, while score 1 indicated the lowest. Depending on the size of the region scanned, MRN was performed utilizing body coil and different sequences.Results of the study was compiled and was statistically analyzed. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of patients

Total- 70		
Gender	**Males**	**Females**
Number	40	30

Table I shows that out of 70 patients, males were 40 and females were 30.

Table II Accuracy of imaging modality

Parameters	MRI	USG
Sensitivity	94.8%	82.4%
Specificity	68.4%	100%
PPV %	95.2%	100%
NPV %	58.8%	46.4%

Table II, graph I show that the sensitivity of MRI was 94.8% and USG was 82.4%, specificity was 68.4% and 100%, PPV was 95.2% and 100% and NPV was 58.8% and 46.4% respectively.

Graph I Accuracy of imaging modality

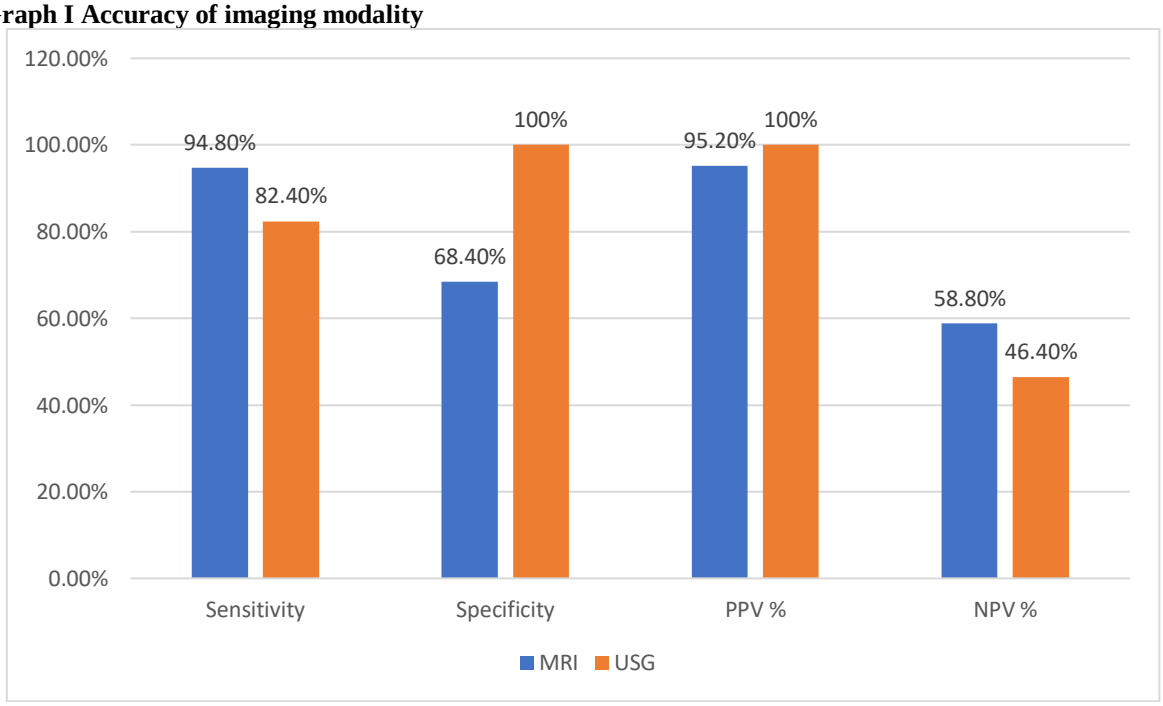

Table III Confidence level for parameters

Parameters	Number	MRI	USG	P value
Fascicular change	15	13	15	0.94
Caliber change	14	8	12	0.01
Nerve discontinuity	20	15	18	0.17
Increased nerved signal	12	12	9	0.05
Neuroma/ mass lesion	9	7	8	0.94

Table III shows that out of 15 cases of fascicular change, MRI detected 13 and USG all 15 correct. 14 cases of caliber change, MRI detected 8 and USG 12 correctly, out of 20 cases of nerve discontinuity, MRI assessed 15 and USG 18 accurately. Out of 12 cases of increased nerve signal, MRI detected all correctly and USG detected 9 correctand 8 cases of neuroma/mass lesions, MRI detected 9 and USG 8 correctly. The difference was significant ($P< 0.05$).

DISCUSSION

Pathologies of the peripheral nerve are a regular occurrence for surgeons. For the assessment and therapy of such patients, they mostly rely on the data obtained by non-anatomical tests such clinical examination, neurophysiological assessment, and clinical history.[8,9] It is possible to obtain spatial data, which is essential for future management, relating to the precise location and type of pathology as well as the nearby structures.[10]Transverse sections of the normal nerve have tiny hypoechoic regions that are divided by hyperechoic septae, giving the structure a "honeycomb-like" appearance. While the echogenic septae indicate the interfascicular perineurium, the hypoechoic regions represent nerve fascicles.[11] The fascicular architecture is also visible in the longitudinal sections, giving the structure a "bundle of straws" appearance. In contrast to the muscle, which has hypoechoic muscle fiber bundles with intervening echogenic perimysium, the nerve is more echogenic.8 Compared to the nerve, the tendon is more echogenic and has a compact arrangement of echogenic fibrils. When examined dynamically, the nerves slide across the muscles and tendons. We can diagnose pathology by looking for a changed nerve movement or contour deformity.[12]The present study compared high-resolution ultrasound (HRUS) and magnetic resonance neurography (MRN) in peripheral nerve pathologies.

We observed that out of 70 patients, males were 40 and females were 30. Kuntz et al[13]described the clinical application and utility of high-resolution magnetic resonance neurography (MRN) techniques to image the normal fascicular structure of peripheral nerves and its distortion by mass lesions or trauma in the lower extremity.MRN images were obtained using a standard 1.5 Tesla magnet and custom built phased-array coils. Patients were imaged using T1-weighted spin echo without and with gadolinium, T2-weighted fast spin echo with fat peripheral nerve tumors (three neurofibromas and one schwannoma), two with intraneural cysts, and three with traumatic peripheral nerve lesions. Six patients with peripheral nerve mass lesions underwent surgery, thereby allowing MRN images to be correlated with intraoperative and pathological findings.Preoperative MRN accurately imaged the normal fascicular anatomy of peripheral nerves and precisely depicted its relation to tumor and cystic lesions. Increased signal on T2-weighted fast spin-echo and short tau inversion recovery fast spin-echo pulse sequences was seen in the peripheral nerve fascicles of patients with clinical and electrodiagnostic evidence of nerve injury.

We found that the sensitivity of MRI was 94.8% and USG was 82.4%, specificity was 68.4% and 100%, PPV was 95.2% and 100% and NPV was 58.8% and 46.4% respectively. Out of 15 cases of fascicular change, MRI detected 13 and USG all 15 correct. 14 cases of caliber change, MRI detected 8 and USG 12 correctly, out of 20 cases of nerve discontinuity, MRI assessed 15 and USG 18 accurately. Out of 12 cases of increased nerve signal, MRI detected all correctly and USG detected 9 correct and 8 cases of neuroma/mass lesions, MRI detected 9 and USG 8 correctly.To choose the best investigation to enable quick patient management, Nischal et al[14] compared the efficacy of HRUS and MRN for diagnosing diverse peripheral nerve diseases. They evaluated these modalities' precision, sensitivity, and specificity in relation to the diagnostic benchmark established by surgical and/or histological, and if those procedures weren't carried out, then by clinical and/or electrodiagnostic evaluation. MRN's overall accuracy was 89.3% (specificity: 66.6%, sensitivity: 92.6%, NPV: 57.1%, PPV: 95%), while HRUS's accuracy was 82.9% (specificity: 100%, sensitivity: 80.4%, NPV: 42.8, PPV: 100). Ultrasonography was reported to have a greater confidence level than magnetic resonance imaging (MRI) for detecting nerve discontinuity and change in nerve caliber (100 vs. 70% and 100 vs. 50%, respectively). Submillimetercaliber pathologynerves was accurately detected by HRUS and these could not be well-visualized on MRI.

CONCLUSION

Authors found that in order to assess peripheral nerve diseases, the first-line imaging modality may be HRUS, which shown good accuracy and is a potent tool.

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