Magnetisation transfer ratio in leg muscle, and sciatic nerve size in hereditary demyelinating and chronic inflammatory demyelinating polyneuropathy.

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Objectives

MRI is emerging as an important technique for the diagnosis and management of peripheral neuropathies. The purposes of this study were firstly to describe and compare the qualitative pattern of MRI abnormalities found in an hereditary (Charcot Marie Tooth type 1a - CMT1a) and an acquired peripheral neuropathy (chronic inflammatory demyelinating polyneuropathy - CIDP), and secondly to compare quantitatively magnetization transfer ratio (MTR) measures with clinical severity.

Methods

Ten adult patients suffering from CMT1a with proven duplication of the PMP gene, and 10 patients with CIDP fulfilling the AAN revisited criteria (1991) were compared with 10 healthy volunteers of matched age and sex. All subjects underwent MRI at 1.5T (GE Healthcare, Milwaukee, WI) including STIR (TR/TE 6000/60ms) and MTR (interleaved 2D gradient echo, TR/TE=1500/7ms, slice thickness 5mm, MT offset frequency 2 kHz) sequences yielding axial images of both calves (using an abdominal phased-array receive coil) and one thigh (using a flex RF receive coil). The cross-sectional area of the sciatic nerve in the thigh was estimated by manually defining an enclosing region of interest (ROI) on a STIR image. MTR maps were calculated and ROIs were placed manually on the areas of greatest pathological signal change within each muscle group in the calves. Clinical severity was assessed using modified MRC severity and impairment scores. Non-parametric statistical tests were performed using SPSS 14.0.

Results

The sciatic nerve cross sectional area in both pathologies was significantly enlarged compared to controls ($p<0.001$), CMT1a being associated with the greatest enlargement. Mean area for controls was 46.5 (SD 11.7) mm^2, for CIDP 65.8 (SD 7.9) mm^2, for CMT1a 147.8 (SD 41.4) mm^2.

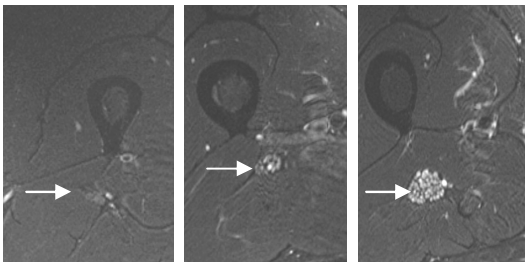

Figure 1 ***(left)****: STIR axial images of the thigh demonstrating the differences in cross-sectional area and appearance of the sciatic nerve (arrows) in Controls (A), CIDP (B) and CMT 1a (C).*

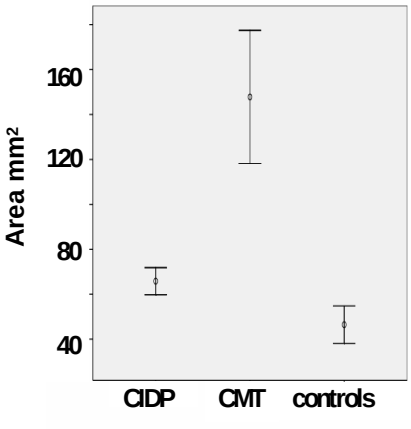

Figure 2 ***(right)*** *Sciatic nerve cross sectional area by disease (mean (SD)).*

In both pathologies MTR was reduced in comparison with controls, this being associated with abnormal appearance on STIR images in the affected muscle groups. Mean MTRs for all muscle groups combined were: for controls 50.2 (SD 3.3), CIDP 37.9 (SD 13.0) and CMT 38.6 (SD 13.0). The most affected muscle group was the posterior superficial compartment (PSC), and in particularly, the medial head of gastrocnemius**.** In CMT, where age is a strong marker of disease duration, the MTR in the PSC muscle group was inversely correlated with age ($p= 0.011$). A trend was seen for decreasing MTR in all muscle groups with duration of disease and clinical severity, however this did not reach statistical significance due to the heterogeneity of changes in CIDP and CMT.

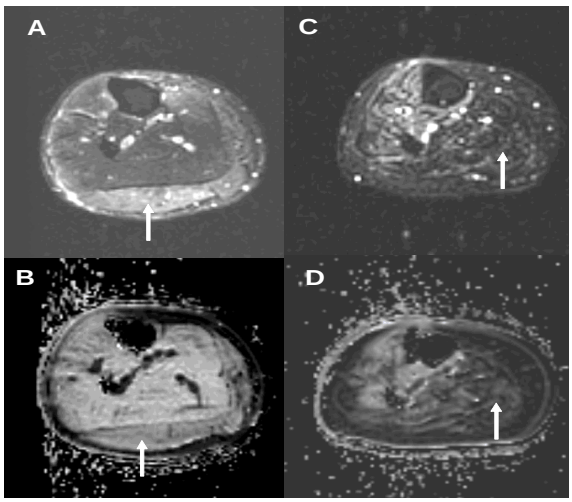

Figure 3 *STIR images (A,C) and corresponding MTR maps (B,D) from 2 CMT1a subjects. Areas of increased STIR signal intensity in A in the posterior superficial compartment (arrow) are associated with a decrease in MTR (B). In C chronic changes are associated with fatty infiltration and decreased STIR signal (arrow); this corresponded with a greater decrease in MTR (D).*

Conclusion

We have demonstrated quantitative and qualitative changes in the sciatic nerve and related muscle groups of the lower limb in both CMT1a and CIDP. Quantitative MRI provides information not accessible by conventional methods which may be valuable in the diagnosis of peripheral neuropathies. Such surrogate indices of disease severity may be useful for monitoring treatment response in future studies.