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Preservation of thalamic volume in painful diabetic peripheral neuropathy

Aim: To compare the volume of the thalamus in patients with painless and painful diabetic peripheral neuropathy (DPN).
Methods: Twenty-eight participants with type 1 diabetes and DPN (Painless-DPN, n=15; Painful-DPN n=13) were recruited and underwent structured neurological assessments, including: Michigan Neuropathy Screening Instrument (MNSI); Leeds Assessment of Neuropathic Symptoms and Signs (LANSS); and Douleur Neuropathique en 4 Questions (DN4). Participants underwent brain Magnetic Resonance Imaging at 3 Tesla. Volumetric analysis of 3D T1 weighted images using MRIcron software was performed for the thalamus. Visual ratings scales were also performed to assess for medial temporal lobe and global cortical atrophy.
Results: There were no significant differences in demographic or metabolic parameters between the Painful- and Painless-DPN groups. The MNSI score was greater in the Painful-DPN group, which is to be expected as this scoring system evaluates neuropathic symptoms, including pain. A volumetric difference of approximately 15% was found between the Painless- (mean=5072 mm^3, SD=528.1) and Painful-DPN (mean=5976 mm^3, SD=643.1) groups ($P<0.001$). There were no significant differences in the subjective assessment for medial temporal lobe and global cortical atrophy. Further, there were correlations between thalamic volume and age, but not MNSI, LANSS, DN4 or numeric rating scores of pain.
Conclusions: Patients with type 1 diabetes and Painless-DPN have a lower thalamic volume in comparison to those with Painful-DPN.

Comments. The findings of this study provide further evidence for central nervous system differences between Painful- and Painless-DPN. The thalamus is recognized as a key node within the pain matrix in the brain. It is responsible for the modulation of impulses from ascending sensory pathways before transmitting signals to other areas of the brain involved in somatosensory perception. Several studies have found altered structure and function of the thalamus in patients with DPN compared with patients with diabetes without DPN, and with healthy volunteers. This study adds to other studies which have shown functional and vascular differences in the thalamus in Painful- compared with Painless-DPN. Persistence of painful impulses to the thalamus in Painful-DPN may lead to neuronal hyperactivity and preservation of thalamic volume. The study is limited in its sample size, the lack of detailed clinical phenotyping and the absence of non-DPN control groups. Also, this study is cross-sectional in its design, similarly to other studies investigating the central nervous system involvement in Painful-DPN and is therefore unable to comment on causality of the results. Larger studies are now required using multimodal neuroimaging techniques which examine different bran regions to further advance our understanding of the cerebral mechanisms of Painful-DPN.

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Reference. Novo JL, Ruas JL, Ferreira LM, Carvalho D, Barbosa M, Brandão S, de Bastos-Leite AJ. Thalamic volumetric abnormalities in type 1 diabetes mellitus and 'peripheral' neuropathy. Sci Rep. 2022 Jul 29; 12(1). doi: 10.1038/s41598-022-16699-x.

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