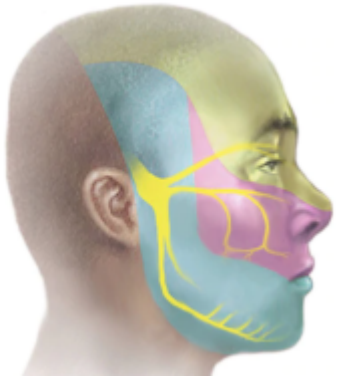
Trigeminal neuralgia pathophysiology



Although the trigeminal nerve has been extensively studied at the site of neurovascular compression, many pathophysiological factors remain obscure [1].

Cerebrospinal fluid S100B levels were significantly higher in patients with trigeminal neuralgia and hemifacial spasm than in controls, which suggests the involvement of S100B in the underlying pathophysiology of neurovascular compression syndrome [2].

Patients presenting with trigeminal neuralgia type 1 (TN1) without neurovascular compression (NVC) were predominantly females in their mid-30s with short symptom duration. In the absence of NVC, this subgroup of TN1 patients has limited surgical options, and potentially a longer condition duration that must be managed medically or surgically. This population without neurovascular compression (NVC) might provide insights into the true pathophysiology of TN1 [3].

Aberrant inflammatory mechanisms may be involved in the pathophysiology of TN but information about the role of inflammation in TN is scarce.

Ericson et al. used Proximity Extension Assay technology (PEA) to analyse the levels of 92 protein biomarkers related to inflammation in lumbar CSF from patients with TN (n=27) before and after MVD compared to individuals without TN. They aimed to analyse the pattern of inflammation-related proteins in order to improve our understanding of the pathophysiology of TN. The main finding was that immunological protein levels in the CSF from patients with TN decreased after surgery towards levels observed in healthy controls. Two proteins appeared to be of specific interest for TN; TRAIL and TNFβ. Thus, inflammatory activity might be one important mechanism in TN [4].

One theory suggests that peripheral injury or disease of the trigeminal nerve increases afferent firing in the nerve; failure of central inhibitory mechanisms may be involved as well. Pain is perceived when nociceptive neurons in a trigeminal nucleus involve thalamic relay neurons. An abnormal vascular course of the superior cerebellar artery is often cited as the cause, as well as other small arteries or veins compressing the trigeminal nerve. In about 85% of cases, no lesion is identified, even after

extensive investigations, and the etiology is labeled idiopathic (classic) by default.

Aneurysms, tumors, chronic meningeal inflammation, or other lesions may irritate trigeminal nerve roots along the pons, causing symptomatic trigeminal neuralgia. Uncommonly, an area of demyelination from multiple sclerosis may be the precipitant.

The ignition hypothesis of trigeminal neuralgia is based on recent advances in the understanding of abnormal electrical behavior in injured sensory neurons, and new histopathologic observations of biopsy specimens from patients with trigeminal neuralgia who are undergoing microvascular decompression surgery. According to the hypothesis, trigeminal neuralgia results from specific abnormalities of trigeminal afferent neurons in the trigeminal root or ganglion. Injury renders axons and axotomized somata hyperexcitable. The hyperexcitable afferents, in turn, give rise to pain paroxysms as a result of synchronized afterdischarge activity. The ignition hypothesis accounts for the major positive and negative signs and symptoms of trigeminal neuralgia, for its pathogenesis, and for the efficacy of treatment modalities [5)].

Thalamic-somatosensory function is thought to be altered in Trigeminal neuralgia (TN), but the abnormalities are inadequately characterized. Furthermore, there are few studies using 7-T MRI to examine patients with TN.

The purpose of a study of Rutland et al. was to use 7 Tesla magnetic resonance imaging to assess microstructural alteration in the thalamic-somatosensory tracts of patients with TN by using ultra-high field MRI.

Ten patients with TN and 10 age- and sex-matched healthy controls underwent scanning using 7-T MRI with diffusion tensor imaging. Structural images were segmented with an automated algorithm to obtain thalamus and primary somatosensory cortex (S1). Probabilistic tractography was performed between the thalamus and S1, and the microstructure of the thalamic-somatosensory tracts was compared between patients with TN and controls.

Fractional anisotropy of the thalamic-somatosensory tract ipsilateral to the site of neurovascular compression was reduced in patients (mean 0.43) compared with side-matched controls (mean 0.47, p = 0.01). The mean diffusivity was increased ipsilaterally in patients (mean 6.58 × 10-4 mm2/second) compared with controls (mean 6.15 × 10-4 mm2/second, p = 0.02). Radial diffusivity was increased ipsilaterally in patients (mean 4.91 × 10-4 mm2/second) compared with controls (mean 4.44 × 10-4 mm2/second, p = 0.01). Topographical analysis revealed fractional anisotropy reduction and diffusivity elevation along the entire anatomical S1 arc in patients with TN.

The present study is the first to examine microstructural properties of the thalamic-somatosensory anatomy in patients with TN and to evaluate quantitative differences compared with healthy controls. The finding of reduced integrity of these white matter fibers provides evidence of microstructural alteration at the level of the thalamus and S1, and furthers the understanding of TN neurobiology. [6)].

References

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