Medical Xpress

Connecting the dots in the migraine brain

January 13 2020

Credit: Sasha Wolff/Wikipedia

A neuroimaging study recently published in the journal *Cephalalgia*, the official journal of the International Headache Society, shared more evidence of structural changes in the brain of migraine patients. The

study, entitled "Structural connectivity alterations in chronic and episodic migraine: A diffusion magnetic resonance imaging connectomics study", was conducted by a multidisciplinary team of neurologists and bioengineers, coordinated by Dr. Ángel Luis Guerrero, from the Headache Unit, Department of Neurology, University of Valladolid, Spain.

Migraine is one of the most disabling diseases in the world. To date, it is only diagnosed based on self-reported clinical symptoms, with no overt biomarker identified yet. As a neurological disorder, migraine is known to result from an aberrant central nervous system functioning. On the other hand, it may itself impact brain functioning with increased frequency of headache attacks (e.g., in chronic migraine patients).

Different research groups all around the world are attempting to uncover a brain signature of migraine patients, and nowadays brain connectivity is in the spotlight. Brain connectivity is obtained by neuroimaging techniques capable of mapping a full set of patterns of anatomical links in the brain and the strengths of these links (connectomes). The interpretation of these interactions follows the functional characteristics of each brain structure linked.

Dr. Guerrero's team assessed brain images from 160 volunteers; fifty healthy participants, 54 episodic migraine patients, and 56 chronic migraine patients. Migraine patients were assessed in the interictal period (headache-free days). Using a whole-brain tractography approach from diffusion magnetic resonance imaging (dMRI) and diffusion tensor imaging (DTI) techniques, a total of 620 connections between 84 cortical and subcortical gray matter regions were analyzed.

The researchers found structural brain connectivity changes between migraine patients and healthy volunteers, as well as between episodic and chronic migraine patients. Based on the number of streamlines from the

anatomically-constrained tractography analysis and DTI descriptors, they found the following main patterns of structural changes:

Migraine Patients vs Controls

Simultaneous higher and lower number of streamlines in migraine patients, suggesting respectively coexistent strengthening and weakening structural connectivity changes in migraine. Strengthening connectivity was observed in many areas deeply implicated in migraine's pathophysiology, such as the caudate nucleus, thalamus and hippocampus, and other regions such as the insula, the superior frontal gyrus, and the precentral gyrus. The authors contextualized the role of the thalamus in the symptomatology of migraine such as photophobia, allodynia, and central sensitization processes, and the role of insula as the "hub of activity" in migraine. Strengthening connectivity in the hippocampus is akin to its role in pain processing and pain-related attention and anxiety.

For weakening connectivity patterns, the authors underscore the changes in the temporal lobe of migraine patients, which may represent a feature of interictal malfunctioning with other pain processing areas in these patients.

Episodic vs Chronic Migraine

Compared to episodic migraine patients, chronic migraine showed more streamlines, but decreased DTI descriptors (in axial and radial diffusivity), suggesting two different mechanisms connectivity alteration; more streamlines meaning potential adaptation to painful stimuli, and reduced diffusivity meaning possible axonal disturbance.

Moreover, in chronic migraine patients, DTI descriptors were positively

correlated with the time from migraine onset, suggesting white matter plastic adaptation to highly recurrent painful stimuli. When adding the history of chronic migraine (the duration of chronic migraine) as a covariate in the statistical analyses, they found reduced streamlines of connections with the insula and thalamus, which was interpreted as indicative of temporal changes in pain processing areas throughout the course of migraine, resulting in plastic maladaptive changes.

According to Álvaro Planchuelo-Gómez, a bioengineer and the first author of the study, "This kind of study is very important to further investigate other aspects of the disease, such as identifying patterns of changes in patients who revert from the chronic to the episodic form of the disease, and treatment effects". Finally, another relevant aspect of this research is underscored by Dr. David García-Azorín, a neurologist and co-author of the study, "Migraine has no biomarker yet, therefore, more studies engaging the effort of a multidisciplinary team are needed to better understand the complexity of this disease, and, hopefully, establish a brain signature of migraine patients".

More information: Álvaro Planchuelo-Gómez et al, Structural connectivity alterations in chronic and episodic migraine: A diffusion magnetic resonance imaging connectomics study, *Cephalalgia* (2019). DOI: 10.1177/0333102419885392

Provided by International Headache Society

provided for information purposes only.