An Investigation into Caffeine as a Migraine Treatment and Its Effects on the Severity of Spreading Depolorizations

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Migraines are the third most prevalent illness, affecting one billion people worldwide. Migraine symptoms may include a severe throbbing headache, disturbed vision, nausea, and sensitivity to light, sound, and smell, which all impede daily life. At the neurological level, migraines are caused by a slowly progressing, coordinated depolarization of neurons that behave like a wave, referred to as spreading depolarization (SD). SD places enormous energy demands on the brain causing the dilation of blood vessels to provide the necessary energy to repolarize. The dilation of blood vessels produces the migraine pain while the depolarization causes the mental effects. SD is caused by overstimulation of neurons and an imbalance of highly regulated substances including glutamate and potassium. The byproduct of regular cellular respiration is adenosine. In the brain, adenosine binds to adenosine 1 (A1) receptors and slows the release of glutamate, which is necessary for recovery. Caffeine is thought to be an A1 receptor antagonist and binds to the same receptors as adenosine, interfering with the regulation of glutamate. Dipropylcyclopentylxanthine (DPCPX), an A1 receptor antagonist is known to interfere with the regulation of glutamate and increase the severity of SD. In this work, the effects of caffeine and DPCPX were compared. SD was quantitatively evaluated by fluorescence imaging of glutamate, and by measuring the electrical activity of the tissue. Results suggest caffeine only has some of the characteristics of DPCPX and may extend recovery time.

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