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Brain chemical potential new hope in controlling Tourette Syndrome tics

September 25 2014

A chemical in the brain plays a vital role in controlling the involuntary movements and vocal tics associated with Tourette Syndrome (TS), a new study has shown.

The research by psychologists at The University of Nottingham, published in the latest edition of the journal *Current Biology*, could offer a potential new target for the development of more effective treatments to suppress these unwanted symptoms.

The study, led by PhD student Amelia Draper under the supervision of Professor Stephen Jackson, found that higher levels of a neurochemical called GABA in a part of the brain known as the supplementary motor area (SMA) helps to dampen down hyperactivity in the cortical areas that produce movement.

By reducing this hyperactivity, only the strongest signals would get through and produce a movement.

Amelia said: "This result is significant because new brain stimulation techniques can be used to increase or decrease GABA in targeted areas of the cortex. It may be possible that such techniques to adjust the levels of GABA in the SMA could help young people with TS gain greater control over their tics."

Tourette Syndrome is a developmental disorder associated with these involuntary and repetitive vocal and movement tics. Although the exact

cause of TS is unknown, research has shown that people with TS have alterations in their brain 'circuitry' that are involved in producing and controlling motor functions.

Both the primary motor cortex (M1) and the supplementary motor area (SMA) are thought to be hyperactive in the brains of those with TS, causing the tics which can be both embarrassing and disruptive, especially for children who often find it difficult to concentrate at school.

Tics can be partially controlled by many people with TS but this often takes enormous mental energy and can leave them exhausted towards the end of the day and can often make their tics more frequent and excessive when they 'relax'. The majority of people diagnosed with TS in childhood manage to gain control over their tics gradually until they have only mild symptoms by early adulthood but this is often too late for some people who have had their education and social friendships disrupted.

The scientists used a technique called magnetic resonance spectroscopy (MRS) in a 7 Tesla Magnetic Resonance Imaging (MRI) scanner to measure the concentration of certain chemicals in the brain known as neurotransmitters which offer an indication of brain activity.

The chemicals were measured in the M1, the SMA and an area involved in visual processing (V1) which was used as a control (comparison) site. They tested a group of young people with TS and a matched group of typical young people with no known disorders.

They discovered that the people with TS had higher concentrations of GABA, which inhibits neuronal activity, in the SMA.

They used other neuroscience techniques to explore the result in greater

detail, finding that having more GABA in the SMA meant that the people with Tourette Syndrome had less activity in the SMA when asked to perform a simple motor task, in this case tapping their finger, which they were able to measure using functional MRI.

Using another technique called transcranial magnetic stimulation (TMS) in which a magnetic field is passed over the brain to stimulate neuron activity, they found that those with the most GABA dampen down the brain activity in the M1 when preparing to make a movement. In contrast, the typically developing group increased their activity during movement preparation.

Finally, they considered how GABA was related to brain structure, specifically the white matter fibre bundles that connect the two hemispheres of the brain, a structure called the corpus callosum. They discovered that those with the highest levels of GABA also had the most connecting fibres, leading them to conclude that the more connecting fibres there are then the more excitatory signals are being produced leading to the need for even more GABA to calm his excess hyperactivity.

The results could lead the way to more targeted approaches to controlling tics. New brain techniques such as transcranial direct-current stimulation (tdcs), a form of neurostimulation which uses constant, low level electrical current delivered directly to the brain via electrodes, has already been shown to be successful in increasing or decreasing GABA in targeted areas of the cortex.

Professor Stephen Jackson added: "This finding is paradoxical because prior to our finding, most scientists working on this topic would have thought that GABA levels in TS would be reduced and not increased as we show. This is because a distinction should be made between brain changes that are causes of the disorder (e.g., reduced GABA cells in

some key brain areas) and secondary consequences of the disorder (e.g., increased release of GABA in key brain areas) that act to reduce the effects of the disorder."

New tdcs devices, similar to commercially-available TENS machines, could potentially be produced to be used by young people with TS to 'train' their brains to help them gain control over their tics, offering the benefit that they could be relatively cheap and could be used in the home while performing other tasks such as watching television.

More information: *Current Biology*, Draper et al.: "Increased GABA contributes to enhanced control over motor excitability in Tourette syndrome." www.cell.com/current-biology/a … 0960-9822(14)01051-3

Provided by University of Nottingham

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