Transcranial magnetic stimulation essay sample

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A non-invasive method of studying the human brain using magnetic fields. An electrical current is passed through a wire coil placed near the scalp. The current induces a magnetic field which produces an electrical field in the brain. This creates a depolarization of nerve cells, causing changes in brain activity. The skull is a good insulator so other attempts to change the activity inside it have been less successful – such as electro-convulsive therapy (ECT). TMS allows magnetic fields to be changed very quickly – it can give a pulse every 3 seconds, and this stimulates a part of the brain such as a motor area. rTMS (rapid rate) can give up to 50 pulses per second.

The shape of the coil determines the properties of the magnetic field along with the way TMS is applied and where on the scalp. Either round of figure-of-eight coils are used.

Applications of TMS

Cortical stimulation such as of the motor cortex is possible with TMS, and is easy to study because the output is easily measurable – twitches in muscles. The Motor-evoked potential in the muscle produced by a stimulus (TMS) can be measured with electromyographic equipment.

Connectivity between areas of the brain can be studied, for example transcallosal inhibition (TCI) – an inhibitory signal from site of stimulation to motor cortex via the corpus callosum. It has been shown to need intact pathways in the corpus callosum. Also, connectivity between motor cortex and the cerebellum can be studied for example.

Cortical plasticity (the way the brain responds to repeated stimuli) can be studied with TMS, for example by looking at motor areas used for activation of a muscle and then studying the changes with exercise – this is useful in looking at stroke recovery.

TMS can be used to investigate cognitive functioning – such as enhancing functions – an increase in object naming has been seen with stimulation of auditory temporal cortex; motor reaction time when cortex is stimulated on the side of the movement etc. Other studies involve temporary ‘ virtual’ lesions and disrupt notmal brain functioning, such as stimulation of frontal cortex disrupting memory and recall; temporal cortex disruptions cause language related disruptions; the parietal lobe with visual processing etc.

TMS can be used in a therapeutic way for example in altering mood and depression – TMS has been found to alter mood, and some studies have found stimulation of prefrontal cortex (PFC) improved patients’ mood ratings.

Animals can be used to study the effects of TMS on altering depression and mood – recent work with rats using rTMS has shown increases in coping strategies for stress. However studies with TMS on altering mood are not conclusive in that they often use small sample sizes, little evidence and lack of detail.

Safety

TMS is generally shown to be a safe and relatively painless procedure. Som seizures have been found in epileptic patients but not normal ones – but a few have been found in normal patients using rTMS. However this depends

on many variables e. g. intensity, and guidelines have been produced for safety which reduces risk. Few side effects have been seen apart from mild headaches, and there have been no adverse effects on brain structure, hormone levels etc.

Combination with other methods

Combining TMS with EEG (Electroencephalogram) recording can recorde cortical potentials induced with TMS and look at sprerad of activity. It can also be combined with fMRI and PET – for example to look at activation of areas during stimulation to provide information about connectivity.

Disadvantages

Effects of TMS appear to be short-lived so repetitive treatment is necessary (when aiming to treat disorders). There can be side effects but these are mild and can be treated.

Advantages

Better than lesion studies which depend on many factors – chance lesions created by accidents etc., or using animals; there are not many studies and these cannot be repeated; lesions may cause other brain problems; comparisons can only be made to healthy control subjects; the lesions are non-reversible so the ‘ before’ state cannot be compared.

TMS reduces these problems by using normal subjects. Stimulation is focussed and so this reduces global impairments. Studies can be repeated.