Psychiatria Danubina, 2013; Vol. 25, Suppl. 2, pp 366–367 *Conference paper*

ADULT-ADHD AND POTENTIAL ROLE OF TRANSCRANIAL MAGNETIC STIMULATION (TMS & RTMS) INVESTIGATION AND TREATMENT

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SUMMARY

This short paper reviews the case for the use of Transcranial magnetic stimulation in the treatment of Adult-ADHD, summarising present knowledge and making the case for future studies.

Key words: *Adult-ADHD - Transcranial magnetic stimulation*

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ADHD

Attention deficit hyperactivity disorder (ADHD) is a disorder that has its onset at or before or at the age of 7 and is characterized by inattention hyperactivity and impulsivity of significant magnitude to cause problems both at home and at school (or work in case of adults. Indeed it often leads to clinically significant distress or impairment in social, academic, or occupational functioning. The long-term consequences of ADHD include, lower educational and vocational outcomes, increased risk for antisocial behaviour and drug abuse in adulthood. Unsurprisingly, the proportion of young offenders suffering from ADHD is significantly higher then that in the general population.

Like many psychiatric disorders, ADHD results form a complex interplay of genetic and environmental factors. Whilst the understanding of the neurobiology of this disorder, continues to evolve, the evidence so far suggests abnormalities in the fronto-striatum- cerebellum circuit, mainly in the right side being responsible for most of the disturbed motor control and the abnormal sensory motor program.

The attention deficits, impulsiveness and hyperactivity relate to the disordered executive functions.

Some of the PET, fMRI studies in ADHD have shown atypical function of the fronto-striatal circuit, decreased blood flow in the striatum and prefrontal regions, decreased metabolism of frontal-cerebral circuits. Whilst, Evoked potential studies have shown smaller amplitude and longer latencies, which correlate with attentional dysfunction, steady state visual EP have strongly supported right frontal dysfunction in ADHD.

Dopamine seems to be the main neurochemical alteration underlying these morphologic alterations. Indeed, stimulants, to date, have been the most successful as well as the most controversial therapy for ADHD. Stimulants such as Methylphenidate (MPH) are the most commonly prescribed drug for ADHD with response rate of 80%. MPH increases the striatal and frontal activation capturing DA transporter.

TMS

Transcranial Magnetic Stimulation (TMS) is a non-invasive, safe and relatively cheap tool for studying pathophysiological abnormalities in various neuro-psychiatric disorders.

It is useful for detecting clinical and subclinical abnormalities in number of neuropsychiatric disorders including ADHD. Indeed, it is also useful for studying the maturational process of motor pathways as it can be used to excite the cortico-motoneuronal system thought to be involved in ADHD.

Unlike, other neuropsychiatric disorders such as depression, the use of TMS in ADHD has been relatively rare. However, TMS findings have demonstrated a delay in the maturation of the cortico-motoneuronal system in patients with ADHD (Uclés 2000).

Whilst, Moll et al. have reported that children with ADHD have significantly reduced intra-cortical inhibition (lCl) with normal intra-cortical facilitation when compared to normal controls.

This abnormality has been shown to have improve with 10mg of MPH (Moll 2000)

Buchmann et al. found that intra-cortical silent period (iSP)-latencies were significantly longer and their duration shorter in ADHD. They suggested that shortened duration of iSP in ADHD children could be explained by an imbalance of inhibitory and excitatory drive on the neuronal network (Weaver 2003).

Hoeppner et al. suggested that in adults, disturbed facilitatory and inhibitory motor circuits as found in ADHD children could not be shown, possibly due to a development-dependent normalization of motor cortical excitability (Hoeppner 2008).

Gilbert et al. compared of the Inhibitory and Excitatory effects of ADHD medications Methylphenidate and Atomoxetine on Motor Cortex. They found, that in healthy adults, both stimulant and non-stimulant medications for ADHD decreased cortical inhibition and increased cortical facilitation and suggested that the cortical inhibition, shown previously to be abnormal in

ADHD, perhaps was playing a key role producing behavioral pathology (Gilbert 2011).

As for repetitive TMS (rTMS) use as a therapeutic tool, numerous studies have been carried out in depression with many positive results leading to approval of its clinical use by the FDA in USA.

Strafella et al. have shown that rTMS when applied to the left mid-dorsolateral prefrontal cortex (MDL-PFC) has led to the release of endogenous dopamine from the left caudate nucleaus as a consequence of direct corticostriatal axon stimulation, increasing the extracellular DA concentration (Strafella 2001)

So far only 2 small studies have been reported where rTMS has been used for therapeutic purpose in ADHD.

Bloch et al, in their crossover double blind randomized, sham controlled pilot study showed positive effects of high frequency rTMS on attention in 13 adult ADHD patients (Bloch 2010).

Whilst, Niederhofer applied rTMS (low frequency, 1Hz, 1200 stim/daily for five days) on the "impending scalp additional motor area", in ADHD subjects. The results showed a "significant improvement" that lasted for at least 4 week, however, the placebo control did not show any improvement (Niederhofer 2008)

CONCLUSION

Clearly there is limited published work on the use of TMS and rTMS in ADHD, suggesting that significantly more work is required to utilize this useful tool to further our understanding of neuropathophysiological basis of ADHD.

Acknowledgements: None.

Conflict of interest: None to declare.

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