NEUROSCIENCE

TIME: 10.15 – 11.15 LOCATION: SWAN ROOM

TREATING VISUAL HALLUCINATIONS IN THE VISUALLY IMPAIRED: A NON-INVASIVE BRAIN STIMULATION PILOT STUDY

Katrina da Silva Morgan, Institute of Neuroscience, Newcastle University

Charles Bonnet Syndrome (CBS) occurs in patients who experience recurrent visual hallucinations (VH) secondary to visual impairment in the absence of psychiatric illness or cognitive impairment. Approximately one-third of patients experiencing CBS report significant distress and disruption to their daily lives as a result of VH. However there are currently no effective treatments for this symptom. Current research suggests that loss of sensory information from the eyes results in increased spontaneous hyperexcitability in the visual cortex, contributing to the occurrence of VH. Non-invasive brain stimulation, including transcranial direct current stimulation (tDCS), can be used to modulate cortical activity by applying a weak electrical current to the scalp. However this technique has yet to be tested in CBS and the optimal stimulation parameters needed to produce a therapeutic benefit are unknown. Six patients diagnosed with CBS experiencing continuous VH attended King's College London to receive inhibitory stimulation of the occipital cortex. Patients received multiple stimulations across various occipital electrode locations and at varying intensities and were asked to report real-time changes to aspects of their VH during and after each stimulation. All patients tolerated stimulation well, including higher current densities (0.32mA/cm^2). Four patients reported positive changes to their VH following 1mA inhibitory stimulation of the primary visual cortex, including decreased size, movement, and intensity of VH. Additionally, four patients reported improved access to their remaining vision following stimulation. While this study provides tentative evidence for a beneficial therapeutic effect of tDCS in CBS, further placebo-controlled investigation is required.

STRUCTURAL BRAIN NETWORK CHANGES IN IDIOPATHIC GENERALISED EPILEPSY ANALYSED USING NETWORK BASED STATISTICS (NBS)

Andrea McKavanagh, Department of Molecular and Clinical Pharmacology, Institute of Translational Medicine, University of Liverpool

Idiopathic generalised epilepsy (IGE) is a collection of epileptic disorders characterised by bilateral epileptogenic brain networks. Around 30% of patients with IGE are refractory to anti-epileptic drugs (AEDs), the mechanisms of which are unknown. MRI techniques can be used to model brain networks with the opportunity of developing biomarkers for treatment outcome. Here, we characterise structural brain network alterations in patients with IGE and determine whether they differ between patients with well-controlled and poorly-controlled seizures.

34 patients with IGE (11 seizure free and 23 persistent seizures) and 39 age and sex-matched healthy controls were studied. Structural connectivity networks were built from T1-weighted and diffusion-weighted MRI data. For network nodes, 82 cortical and subcortical regions were segmented from T1-weighted images using FreeSurfer. Network connection strengths between regions were reconstructed using diffusion MRI data for mean diffusivity, radial diffusivity, fractional anisotropy and count (number of streamlines). Differences between IGE seizure free, IGE persistent seizures and control groups were computed using Network Based Statistics (NBS). All patients had significantly ($p<0.05$) decreased fractional anisotropy and count

measures of connectivity across both cerebral hemispheres compared to controls. Increased and decreased connectivity was found when comparing patients with persistent seizures and patients rendered seizure-free to healthy controls. No differences were found in direct comparisons between patients rendered seizure free and those with persistent seizures.

Although a non-lesional disorder, network analysis revealed bi-hemispheric structural network alterations in patients with IGE, which may provide some insight into the mechanisms of the disorder and patient treatment outcome.

A MONKEY MODEL OF AUDITORY SCENE ANALYSIS

Pradeep Dheerendra, Institute of Neuroscience, Newcastle University

More than half the world's population develop age-related hearing loss with difficulty understanding speech amidst background noise. However, we do not yet fully understand how the brain performs auditory figure-ground segregation (AFGS), a fundamental process of auditory scene analysis pertaining to transformation of an acoustic signal into object based representation. So we intend to record from neurons in a rhesus macaque model performing AFGS. Thus we need to establish that macaques utilize similar brain regions as humans to perform AFGS.

To compare macaque brain activations underlying AFGS with humans, we employ artificial sounds that are equally relevant to both species that simulate the challenges faced in real-world listening yet are devoid of semantic confounds. These synthetic stimuli have a 'figure' with simultaneous onset of numerous (defined coherence) tones repeating in time, which overlaps spectro-temporally with 'ground' made of randomly varying tones. Our behavioural experiment in two macaques showed increasing figure detection performance with increasing coherence as seen in humans. Thus macaques can segregate 'figure' from 'ground' in these stimuli.

We employed sparse temporal design to acquire fMRI in three visually fixating macaques presented with these artificial sounds. We used General Linear Model to reveal areas that systematically co-varied with coherence. We found that bilateral rostro-lateral belt and parabelt in macaque auditory cortex are employed in AFGS similar to non-primary auditory areas along bilateral superior temporal gyrus in humans. Thus our study has developed rhesus macaque as an animal model of human AFGS and provided spatial priors for targeted neurophysiology.

TIMELINE OF CHANGES IN SPINAL CORD MICROVASCULATURE FOLLOWING INJURY

Nicole Smith, School of Biomedical Sciences, University of Leeds

After spinal cord injury (SCI), capillary integrity is disrupted by the primary mechanical injury and secondary biological insult. This can slow or prevent neuronal regeneration, thus limiting functional recovery. Two waves of angiogenesis have been reported following SCI, however these vessels may not fully mature. To determine the best angiogenic target following SCI, accurately assessing the timeline of capillary changes in the spinal cord is essential.

Rats were injured using the SCI 200kDyn contusion model at T10 and perfuse fixed two, five, 15, and 45 days post injury. Injured and control spinal cords were sectioned at the injury epicentre and up to 1500µm rostral and caudal. Cords were immunohistochemically stained with laminin, collagen IV, and RECA and unbiased stereology was utilised to assess vessel number, volume, and surface area.

Adverse changes in injured spinal cord vasculature, present as much as 1500µm away from the injury, showed some recovery with time. Significant endothelial oedema present at day two partially resolved by day five; results which will be corroborated with electron microscopy. Lightsheet microscopy has been used to generate 3D images of the vasculature without the need to section the cord.

Future research will assess the potential of an angiogenic hydrogel introduced at day seven post

SCI to reduce regression of damaged capillaries and to encourage development of new capillaries at the injury site. This, combined with locomotor training, has the potential to promote a microenvironment more conducive to regeneration and repair, leading to an improvement in functional recovery following SCI.