

Test Question 1

Amyotrophic lateral sclerosis (ALS) is a progressive lethal motor neuron disease for which there is no adequate treatment yet. Both the peripheral α -motoneurons, and the cortico-spinal neurons die. One of the causes of this cell death is thought to be excitotoxicity. This refers to a process in which increased concentrations of the excitatory neurotransmitter glutamate destroy neurons by abundant excitatory synaptic transmission to the peripheral neurons. This suggestion is supported by the effect of the antiglutamate drug riluzole, which does not cure, but delays the disease progress significantly.

Repetitive transcranial magnetic stimulation (rTMS) is a technique that can change cortical excitability.

- a) Assume that the effects of rTMS in ALS patients are the same as in healthy subjects. Which rTMS protocol(s) can then potentially be beneficial for ALS patients? Explain your answer.

AW: rTMS with inhibitory effects (e.g. rTMS with 1 HZ or cTBS)

- b) rTMS is ethically acceptable for neuroscientific studies in healthy subjects. This is among others because of a specific property. In therapeutic applications this property is problematic. Which property is that and what is its inconvenient consequence of it in therapy?

AW: Transient effects. Has to be repeated (too) often

Test Question 2

MRI is used for different purposes. One is to make static images.

- a) Explain how both the position and the density of a certain group of spinning H^+ atoms can be identified within an MRI scanner.

AW: Signal strength represents H^+ concentration. Signal frequency is determined by the specific local magnetic field strength. With frequency encoding or phase encoding the spatial origin of the signal can be determined in a 2-dimensional plane

It is also possible to measure increased local neural activity with fMRI.

- b) Explain on which principle fMRI is based and why this technique is both relatively slow and indirect.

AW: Blood flow increase follows the increased neural activity relatively slowly. Blood flow increase is not per definition spatially there "where the action is". There is also a chance that activity does not affect blood flow

- c) Why do researchers not always use more direct representations of the neural activity from EEG or MEG?

AW: Less good spatial resolution. Does not see the deeper sources very well

Test Question 3

Why is the term "EMG investigation" strictly speaking not correct for a routine electro-diagnostic investigation in patients with complaints that might be related to the peripheral neuromuscular system?

AW: Most of the time the properties of nerve bundles, not of muscles are investigated

Test Question 5

MRI-DTI measurements are used to predict structural elements of brain tissue.

On which physical principle are these measurements based and how is that applied?

AW: Diffusion. Shift of spin phase after a nucleus has moved in the changing magnetic field

Test Question 6

To predict electric currents in the brain during tDCS, whereby a constant small electric current is passed to the brain via large skin surface electrodes on the head, one needs to consider the electric conductivities (inverse of resistances in 3D) of the different tissues . These conductivities can also be anisotropic (different in different directions).

Give your estimate of which three conductivities are important for tDCS

Explain your answer.

AW:

- *A lot of current passes the high conductive skin*
- *The skull has a low conductivity preventing current to flow into the brain compartment;*
- *CSF tends to make short cut because it has a high conductivity*
- *Anisotropy of the white matter directs the current substantially*