Single-pulse transcranial magnetic stimulation for the assessment and changes of cortical motor maps in subjects with low back pain, compared to healthy subjects

Published: 15-11-2019
Last updated: 10-04-2024

Primary Objective:Our primary objective is to investigate the changes in CSR of the lower trunk muscles in subjects with an episode of recurrent LBP and compare them with healthy subjects.Secondary Objective(s):Our secondary objective is to explore...

Ethical review	Approved WMO
Status	Pending
Health condition type	Other condition
Study type	Observational non invasive

Summary

ID

NL-OMON49299

Source
ToetsingOnline

Brief title
Single-pulse TMS in LBP

Condition

- Other condition

Synonym
non-specific Low Back Pain, recurrent a-specific low back pain

Health condition

Musculoskeletale aandoeningen

Research involving
Human

Sponsors and support

Primary sponsor: Vrije Universiteit
Source(s) of monetary or material Support: NWO lerarenbeurs op naam van Sabrine Pekaric-Klerx

Intervention

Keyword: cortical motor maps, low back pain, motor evoked potential, Transcranial magnetic stimulation

Outcome measures

Primary outcome

Corticospinal excitability (CSE) can be assessed using single-pulse TMS across the primary motor cortex (M1) with EMG surface electrodes placed on the target muscles of the contralateral limb. Stimulation of M1, at the site of representation of the target muscle, will elicit motor evoked potentials (MEPs) in the EMG signal. The peak-to-peak amplitude of a MEP is considered to quantify CSE, with the measured MEPs the CoG is calculated,, which is the main outcome measure of this study. A stimulation intensity of 130% RMT will be employed to obtain this outcome measure. When RMT is not enough to evoke a MEP, RMT will be aksed by letting the subject lean to the back. CSR of the lower back and abdominal muscles will be determined by measuring the cross sectional area of the hotspot leading to MEP*s in the lower back and abdominal muscles.

Secondary outcome

Differences in CSR changes in 4-6 week time between participants that recovered from an episode and participants who did not recover, and healthy participants, determined by the MEP amplitude of the back and abdominal muscles: CoG, latency

of the MEPs, discrete peaks and map volume; the sum of the mean normalize MEP peak-to-peak amplitude. The latency, the discrete peaks and the map volume of the MEPs are used as parameters to measure CSR. Furthermore Cchanges in CSR afterwill be measured in 4-6 week time will beand tested for correlation to perceived recovery of all subjects measured on a 7 point likert scale from completely recovered to absolute worse.
In addition, Ffive clinical motor and sensory control tests of the lower back will be performed. Leading to the following parameters:

- Good/ false sense of graphaesthesia (refined tactile information)
- Qualitative Sensory Testing (refined tactile information)
- Good/ false sense of two point discrimination (refined tactile information)
- Accurate precision of a motor performance task of the lower back (following a spiral on the computer screen)
- Accurate/ not accurate repositioning of the lower back with eyes closed
General Perceived Effect (GPE) scored on a 7 point likert scale from fully recovered to absolute worse.

Pain intensity, duration of complaints of the current episode of LBP and number of recurrent LBP periodes experienced will be measured using a questionnaire at the first measurement. Furthermore the neuronavigation software records the stimulation position at the cortex and the corresponding orientation of the coil at the moment of stimulation. These measures can be used to monitor a constant stimulation position and orientation

The usual care that the patients will receive, will be observed and reported.

Study description

Background summary

Low Back Pain (LBP) has a 1 year prevalence of more than 40% worldwide (Hoy et al., 2012). In more than 90% of all individuals suffering from LBP no cause can be identified. Therefore non-specific LBP is considered to be a symptom and not a disease. (Lancet pa-pers on LBP, 2018). Many people with LBP will experience another episode of LBP within 12 months (Cassidy et al., 2005, Wasiak et al., 2006) An explanatory model for the high recur-rence rate of LBP is the presence of an altered motor control of low back and abdominal muscles remaining after recovery of the LBP itself (Tsao et al., 2008). This altered behaviour of lower trunk muscles is associated with an altered Corticospinal representation (CSR) or cortical map on the M1 motor cortex (Tsao et al., 2008, Schaburn et al., 2017) The degree of enlargement and altered position of the CSR is correlated with pain intensity, localisation and duration of LBP (Wand 2010, Masse-Allerie 2012, Tsao 2011, Schabrun 2017). Furthermore it is suggested that also changes in the sensoric cortex will have a direct influence on the M1 cortex in LBP, resulting in a loss of re-fined tactile information and a loss of propriocepsis. (Wand, 2010, Masse-Allerie et al 2012, Stanton et al., 2013)) If an altered behaviour in the lumbar abdominal and back muscles remains present due to changes in the motor cortex, despite feeling recovered from LBP it might explain why LBP is often recurrent and becoming chronic (Lancet LBP papers, 2018). Until now only cross sectional studies have studied the relation between altered motor control of the low back and abdominal muscles and the CSR. It is unknown how the CSR alters over time, when subjects for instance, will LBP recover. Furthermore it is not known if recovery is related to improvement of motor control in those subjects recovering from LBP.

Study objective

Primary Objective:
Our primary objective is to investigate the changes in CSR of the lower trunk muscles in subjects with an episode of recurrent LBP and compare them with healthy subjects.

Secondary Objective(s):
Our secondary objective is to explore the association between changes in CSR related to recovery of an episode of LBP and changes on scores on clinical motor and sensory control tests of the lower back and compare these changes with healthy participants. Furthermore to determine the CSR of the abdominal muscles and the outcomes for CSR: CoG, latency, discrete peaks and map volume

as well, and to explore the association between changes in CSR related to recovery of an episode of LBP and changes on scores on clinical motor and sensory control tests of the lower back.

Study design

Design. Experimental longitudinal study with non-invasive measurements. Participants will first undergo a structural MRI scan at the VU Medical Centre. Subsequent TMS/EMG recordings will take place will take at the Vrije Universiteit Amsterdam, Department of Human Movement Sciences or Hogeschool Utrecht, University of Applied Sciences. Participants will be subjected to singlepulse TMS over M1 while lying. Recruitment and informed consent. Participants will be recruited by means of flyers dis-tributed over the VU and HU campus and via social media as well as in Physiotherapy clinics as part of the VU Science network and network of the HU physiotherapy educational pro-gramme. Flyers will contain a brief description of the experiment as well as contact details of the researcher. Every candidate participant will receive the information letter prior to partici-pation in the experimental sessions. An independent expert can be contacted for additional information. Candidate participants will be given sufficient time to consider participation (at least 7 days), after which the researcher will contact them for confirmation. To minimize risks (see also chapter 11.4), only
Healthy adults (18-65) will be included in the experiment. As soon as a candidate participant agrees to participate, s/he will first be asked to sign the in-formed consent form and return it to the researcher. Next, screening of participants will be done using general MRI and TMS screening questionnaires (Rossi et al., 2011, see also form F1 for the MRI questionnaire), supplemented by professional neurological consult in the case of any doubt. The experimental set-up will be shown to the participants, and single-pulse TMS will be verbally explained and/or demonstrated.
Magnetic Resonance Imaging. We will employ neural navigation (see: chapter 8.3). To do that in a subject-specific way, magnetic resonance imaging (MRI) will precede TMS proce-dures. An anatomical MRI-scan (T1/T2-weighted) will be acquired at the VU associated Medical Centre for Neuroimaging according to the standard imaging protocols of its MRI department. Following their procedures, in case of chance findings, a radiologist will assess the consequences for the participant*s health. This information will be communicated to the par-ticipant*s general practitioner, who will shortly inform the participant.

Experimental procedures. The TMS experiment will require localization of a stimulation hotspot and its resting motor threshold (RMT) as reference, before the right and left lumbar erector spinae will be targeted to assess CSE. The stimulation hotspot is defined as the site of stimulation at which the highest response can be evoked in the electromyography signal. The RMT is defined as the intensity at which motor evoked potentials (MEPs) with a peak-to-peak amplitude of at least 50 μV will be evoked in five out of ten stimulations (Rossini et al., 1994) at 2 different TMS stimulation intensities. After

determining the stimulation hotspot and RMT, the site of stimulation will be changed to measure the cross sectional area of the CSR of the lower back and abdominal muscles. This results in maximal (2 different localisations, left and right) x 2 (intensities) x 50 (maximum pulses to define CSR) x 2 (abdominal and low-er back muscles) = 400 stimulations in total. Together with finding the hotspot of the FCR, and determining its RMT, this leads to a number of stimulations per subject per experimental session (see Table 1) that is well below the maximum as suggested by existing TMS guide-lines (Rossi et al., 2009). When RMT is not enough to evoke a MEP, AMT wil be asked by letting the subject lean to the back.

5 clinical motor and sensory control tests of the lower back will be performed. Leading to the following parameters:
- Good/ false sense of graphaesthesia (refined tactile information)
- Accurate/ not accurate positioning of the lower back
- Accurate/ not accurate repositioning of the lower back with eyes closed
- Accurate/ not accurate tactile information of *sharp, vibration and soft stimulation.
- Accurate/ not accurate tactile 2 point discrimination
General Perceived Effect (GPE) scored on a 7 point likert scale from fully recovered to absolute worse. Pain intensity, duration of complaints of the current episode of LBP and number of recurrent LBP periodes experienced will be measured using a questionnaire at the first measurement.

Study burden and risks

NA

Contacts

Public
Vrije Universiteit

van der Boechhorststraat 7
Amsterdam 1081RT
NL
Scientific
Vrije Universiteit

van der Boechhorststraat 7
Amsterdam 1081RT
NL

Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adults (18-64 years)
Elderly (65 years and older)

Inclusion criteria

Participants experiencing episode of aspecific recurrent low back pain
Healthy participants that never experienced low back pain or experienced low back pain more than 3 years ago
Age 18-65 years
Informed consent signed

Exclusion criteria

(Family) history of epilepsy
Neurological disorder
Psychological disorder
Use of (epileptogenic) medication
Possessing a contraindication for single-pulse TMS (as determined by a TMS screening questionnaire: 'Fl .
Screening Questionnaire

Study design

Design

Study type:	Observational non invasive
Intervention model:	Other
Allocation:	Non-randomized controlled trial

Masking:	Open (masking not used)
Control:	Active
Primary purpose:	Diagnostic

Recruitment

NL

Recruitment status:	Pending
Start date (anticipated):	01-10-2019
Enrollment:	50
Type:	Anticipated

Medical products/devices used

Generic name:	Single pulse TMS with CE certified machine
Registration:	Yes - CE intended use

Ethics review

Approved WMO Date:	15-11-2019
Application type:	First submission
Review commission:	METC Brabant (Tilburg)
Approved WMO Date:	13-02-2020
Application type:	Amendment
Review commission:	METC Brabant (Tilburg)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
CCMO	NL70934.028.19