Transcranial ultrasonic stimulation of the primary motor cortex

Published: 22-06-2021
Last updated: 04-04-2024

Our primary objective is to replicate two experiments conducted by Fomenko and colleagues (2020), the first investigating whether TUS over M1 decreases excitability, and the second investigating whether varying TUS sonication duration significantly…

Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Other condition
Study type	Interventional

Summary

ID

NL-OMON51013

Source
ToetsingOnline

Brief title
Transcranial ultrasonic stimulation of the primary motor cortex

Condition

- Other condition

Synonym
brain

Health condition

Neuroscience research (basic science)

Research involving
Human

Sponsors and support

Primary sponsor: Radboud Universiteit Nijmegen
Source(s) of monetary or material Support: Ministerie van OC&W

Intervention

Keyword: corticospinal excitability, primary motor cortex, transcranial magnetic stimulation, transcranial ultrasonic stimulation

Outcome measures

Primary outcome

We will use electromyography (EMG) to measure motor-evoked potentials (MEPs)

over the first dorsal interosseous (FDI) elicited by TMS applied over M1. Here,

MEP peak-to-peak amplitude is our primary outcome measure.

Secondary outcome

Our secondary outcome is establishing the technical feasibility of combining

TMS and TUS. Here, we will test the technical operation of the combined TMS-TUS

equipment and write a technical report on its operation.

Study description

Background summary

Transcranial ultrasonic stimulation (TUS) is a non-invasive brain stimulation (NIBS) technique characterised by its superior spatial focality and ability to reach both superficial and deep regions of the brain. At present, it is important to confirm the fundamental neurophysiological effects of TUS. This can be achieved by measuring the impact of TUS on the excitability of the primary motor cortex (M1). Previous research has combined TUS with transcranial magnetic stimulation (TMS) and observed a reduced amplitude of TMS-elicited muscle twitches with TUS than without TUS. Considering the fundamental nature of these findings, independent replications are required to confirm and expand our understanding of the fundamental neurophysiological effects of TUS. Therefore, we hypothesize that in two replication experiments, we will solidify previous findings on the inhibitory outcome of TUS on M1 excitability and its

relationship with TUS sonication duration. Furthermore, previous research has found that a blocked rather than an interleaved presentation of TUS parameter conditions resulted in more robust effects. Therefore, we further hypothesize that in a novel experiment, we may find differences in the magnitude of effect of varying TUS sonication durations. This effort may indicate potential cumulative effects of TUS and will further serve to inform the experimental design of future studies.

Study objective

Our primary objective is to replicate two experiments conducted by Fomenko and colleagues (2020), the first investigating whether TUS over M1 decreases excitability, and the second investigating whether varying TUS sonication duration significantly affects M1 excitability. Here, we will additionally conduct a novel investigation of whether a more robust effect of varying TUS sonication durations is observed when parameters are presented in a blocked versus interleaved design.
Our secondary objective is to establish the technical feasibility of combining TMS and TUS at Radboud University.

Study design

The present study will be a single-blind randomized sham-controlled trial. The study consists of two sessions. In the first, participants* resting motor threshold will be measured and structural MRI scans will be obtained. The second session is the intervention session. There will be two within-subject factors. The first is TUS (passive sham / active sham / verum TUS). The second is Parameter Presentation (blocked / interleaved).

Intervention

Participants will receive TMS at standard supra-threshold intensity and TUS at standard sub-threshold intensity.

Study burden and risks

Participants will receive no direct benefit from participating, though participants will be financially compensated where applicable. However, participants may see benefit in gaining first-hand experience with TUS. Before participation, all subjects will be thoroughly screened for contraindications for NIBS and MRI. TMS is a widely used NIBS technique and is associated with minimal risk. There have been no reports of serious adverse events in healthy participants when using protocols in accordance with published safety guidelines (i.e., Rossi et al., 2020; see Donders NIBS SOP). The estimated risk for participating in TUS experiments is minimal. TUS for human neuromodulation has never resulted in serious adverse events (Pasquinelli et al., 2019). In

fact, there have been no reports of serious adverse events related to diagnostic ultrasound either (ter Haar, 2010). Safety is further secured by adherence of TUS experiments to internationally recognized guidelines (e.g., from the Food and Drug Administration) for diagnostic ultrasound. For both TMS and TUS, minor side effects may include light transient headache and fatigue. All in all, the risk and burden associated with participation can be considered minimal, and we do not expect any serious adverse events during the project.

Contacts

Public
Radboud Universiteit Nijmegen

Thomas van Aquinostraat 4
Nijmegen 6525GD
NL
Scientific
Radboud Universiteit Nijmegen

Thomas van Aquinostraat 4
Nijmegen 6525GD
NL

Trial sites

Listed location countries

Netherlands

Eligibility criteria

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

Inclusion criteria

- Between 18-40 years of age
- Right handed
- The ability and agreement to provide informed consent, and the ability to

fulfil the study's requirements

Exclusion criteria

* Under 18 years of age
* Current or planned pregnancy
* Claustrophobia
* A history or brain surgery or serious head trauma
* A history of or any close relatives (parents, siblings, children) with epilepsy,
convulsion, or seizure
* Predisposition for fainting spells (syncope)
* A cardiac pacemaker or intra-cardiac lines
* An implanted neurostimulator
* Implanted medication infusion device
* Implanted metal devices or large ferromagnetic fragments in the head or upper body (excluding dental wire), or jewellery/piercing that cannot be removed
* Use of a medical plaster that cannot or may not be taken off (e.g., nicotine plaster)
* Cochlear implants
* Metal in the brain, skull, or elsewhere in your body (fragments, clips, etc.)
* Diagnosed neurological or psychiatric disorders
* Use of psychoactive (prescription) medication (excluding anti-conception)
* Skin disease at intended stimulation sites
* The consumption of more than four alcoholic units within 24 hours before participation or any recreational drugs within 48 hours before participation
* All other criteria relevant to non-invasive brain stimulation as reported in the
Donders Standard Operating Procedures for Non-Invasive Brain Stimulation

Study design

Design

Study type: Interventional

Masking:	Single blinded (masking used)
Control:	Uncontrolled
Primary purpose:	Other

Recruitment

NL

Recruitment status:	Recruitment stopped
Start date (anticipated):	01-11-2021
Enrollment:	12
Type:	Actual

Medical products/devices used

Generic name:	NeuroFUS Pro - low intensity transcranial ultrasonic stimulation
Registration:	No

Ethics review

Approved WMO Date:	22-06-2021
Application type:	First submission
Review commission:	CMO regio Arnhem-Nijmegen (Nijmegen)

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	NL76920.091.21