Tracing premotor-motor connectivity during the phase of motor preparation in MS patients

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Introduction

Multiple Sclerosis (MS) causes a decrease of the volition drive during motor preparation, probably subsequent to dysfunctional cortical premotor and motor activity [1]. We apply a dual-site transcranial magnetic stimulation (dsTMS) [2] to test primary motor cortex (M1) excitability and ipsilateral premotor-motor functional connectivity (PMd-M1) during motor preparation in MS patients (MSP) and healthy controls (HC).

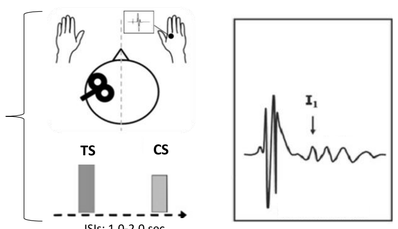
Methods

- **Subjects:**

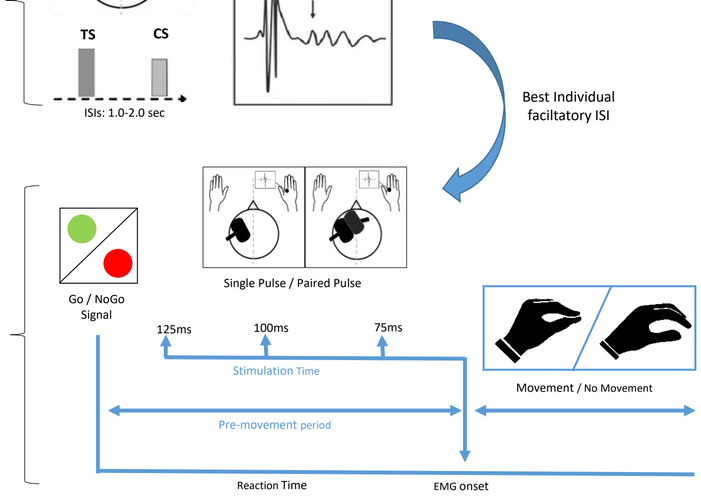
14 HC and 14 MS patients with a Relapsing-Remitting disease course (13 men and 15 women aged 37.6±9.6).

- **Experiment:**

-SICF: the Short-Intracortical Facilitation protocol [3] was used to individually define the best facilitatory interval (ISI).



-dsTMS: during a Go-NoGo task, in 50% of trials, a single test stimulus (TS) was given over left M1; in 50% a conditioning stimulus (CS) over ipsilateral PMd followed the TS at the ISI prior determined by the SICF protocol.



Stimuli were given pseudo-randomly at 125ms(t1), 100ms(t2) or 75ms(t3) during movement preparation, prior to mean response time (RT). The RT was previously individually determined in Go condition.

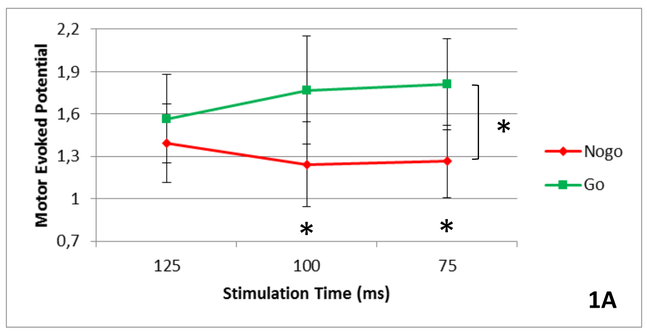
Discussion

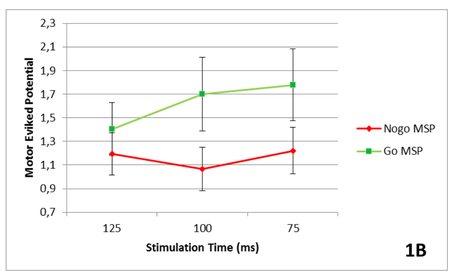
Our results show a normal build-up of corticospinal excitability during motor preparation (Go) and a normal attenuation during motor inhibition (NoGo) in MS patients, suggesting a normal functional activation of M1.
However, PMd-M1 stimulation yielded abnormal temporal modulation of corticospinal excitability in the NoGo condition in MS patients, indicating abnormal PMd-to-M1 effective connectivity during movement inhibition.

Results

- **Corticolspinal excitability:**

M1 stimulation alone revealed a consistent build-up of corticospinal excitability during the preparation to move (Go) and a consistent attenuation during movement inhibition (No-Go) which was similar in the two groups (Fig.1A).





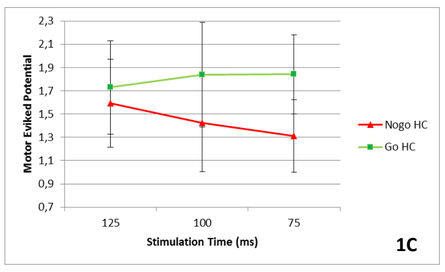


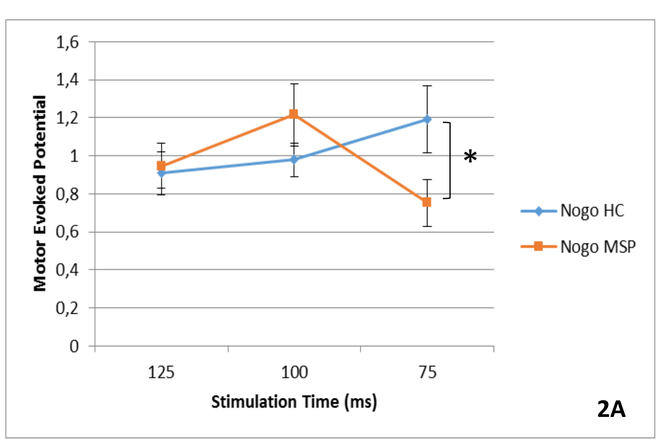
Fig.1A-The plot displays MEPs evoked by single pulse (sp) over the left M1 in three different time of motor preparation in all subjects (HC+MSP). There was no significant difference between MSP group and HC group. Analysis reveal a main effect in Time*Task (p=0.031) and TaskGo*TaskNogo (p=0.014).

The graphs on the right show the M1 excitability respectively in MSP group (Fig.1B) and in the HC group (Fig.1C).

Bars stand for SE and * indicate p≤0.05.

- **Premotor-motor functional connectivity:**

PMd-M1 stimulation yielded a different time course in the NoGo condition between groups. Patients presented a decrease in mean MEP amplitude in t2 and t3, while controls showed a slight increase (Fig.2A).



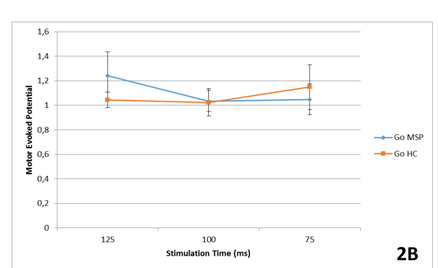


Fig.2A-2B-Effect of the PMd-M1 modulation prior to the movment respectively In the NoGo and Go condition. In the plots MEPs are normalized on the sp over M1. In the Nogo task (Fig.2A) is significative the difference between groups at 75 ms of stimulation (Time*Group p=0.048). Bars indicate SE and * stands for p≤0.05.

Conclusion

Corticospinal tract seems to be modulated by PMd-M1 connections during the motor preparation in the Go task as well as, in a mirrored manner, during a NoGo task.
Our results show an increased excitation in the later phases of movement preparation and an equally decrease during inhibition.
In MSP, an alteration of this inhibitory modulation could be responsible for the impaired central motor control.

Acknowledgment

The study has been supported by the Danish Multiple Sclerosis Society and Lundbeck Foundation.

References

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