The effect of capsaicin-induced pain on homeostatic plasticity

Priscilla G Wittkopf, Dennis B Larsen, Luisina Gregoret, Thomas Graven-Nielsen

Center for Neuroplasticity and Pain (CNAP), Department of Health Science & Technology, Aalborg University, Fredrik Bajers 7D3, 9220 Aalborg, Denmark

Center for Neuroplasticity and Pain

AALBORG UNIVERSITY

Danmarks Grundforskningsfond
Danish National Research Foundation

INTRODUCTION

- Synaptic plasticity is an efficient mechanism, which enforces (long-term potentiation) or weakens (long-term depression) synaptic transmission.[1]
- A range of regulatory mechanisms, termed homeostatic plasticity, maintain synaptic excitability within a physiological range.[2]
- In humans, homeostatic plasticity can be investigated using two blocks of non-invasive brain stimulation with an interval of no stimulation in between blocks (Fig. 1).[2]
- Impaired homeostatic plasticity has been observed in pathological states such as migraine, dystonia, and chronic low back pain and hypothesized to be a marker of neuroplastic manifestations in pain conditions. However, the effect of tonic painful states on homeostatic plasticity is unclear. [2]

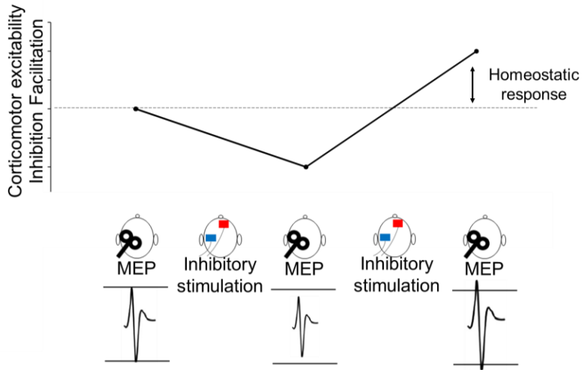

Figure 1. Homeostatic response induction and assessment schematic. MEP, motor evoked potentials.

AIM

The aim of this study was to investigate the effect of capsaicin-induced pain on homeostatic plasticity in healthy participants.

METHODS

- This was a single group crossover study including 12 healthy right-handed participants (4 women, mean age 25.17 ± 2.04 years).
- A placebo patch or an 8% capsaicin patch was applied on the right hand and kept in place over 24 hours.

METHODS (CONT.)

- Interval between capsaicin and placebo patch applications was two weeks and the order was counterbalanced.
- Homeostatic plasticity was induced in the left primary motor cortex using cathodal transcranial direct current stimulation (tDCS) applied for 7 minutes followed by an interval of 3 minutes of no stimulation and another block of 5 minutes of stimulation.
- Corticomotor excitability was assessed recording motor evoked potentials (MEPs) of the first dorsal interosseous muscle using single pulse transcranial magnetic stimulation at 120% of resting motor threshold.
- Prior findings indicate reduced MEPs following capsaicin-induced pain, therefore, MEPs were recorded at baseline and 30 minutes post patch application. The intensity of the stimulation was then altered to match baseline values of MEPs.
- Homeostatic reponses were assessed using 10 consecutive MEPs recorded pre homeostatic plasticity induction, immediately post, and every 15 minutes up to 45 minutes post induction.
- Homeostatic plasticity (HP) induction and assessment took place at three time points:
  - HP1: 30 minutes post patch application
  - HP2: immediately after HP1
  - HP3: 24 hours post patch application
- Pain was assessed using an 11-point (0-10) numerical rating scale every 10 minutes post patch application.
- Three separate repeated measures ANOVAs were conducted considering condition (placebo and capsaicin) and time point (pre, 0 min, 15 min, 30min and 45 min post induction) as factors.

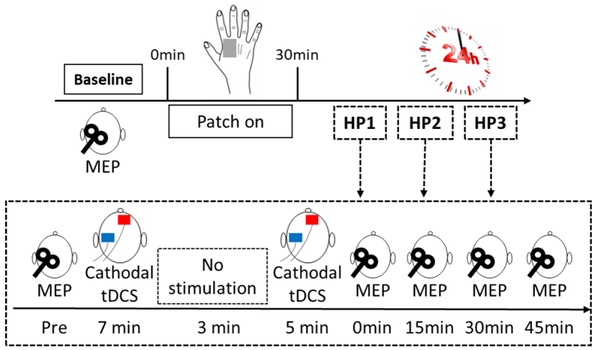

Figure 2. Experiment timeline

RESULTS

- Pain intensity progressively increased reaching stability 60 minutes post patch application. While none of the participants reported pain during the placebo condition.

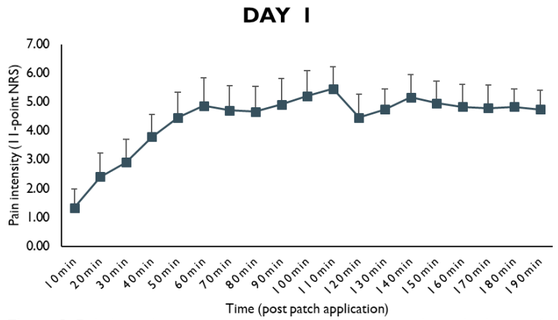

Figure 3. Pain intensity post capsaicin application, mean and standard error of the mean.

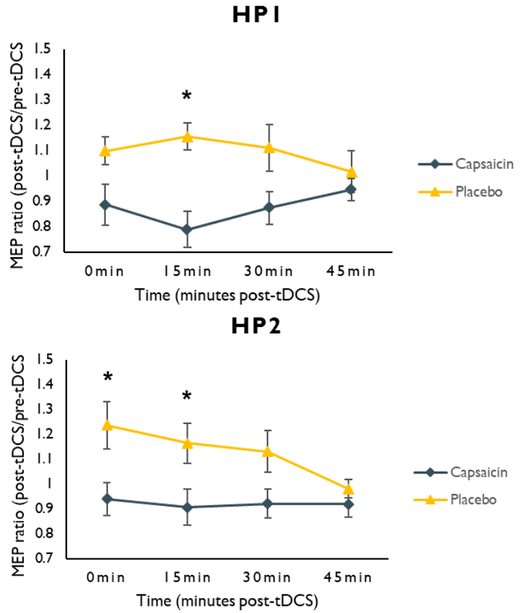

Figure 4. Motor evoked potential ratios for each time point at each homeostatic response assessment, mean and standard error of the mean. (* p ≤ 0.05).

RESULTS (CONT.)

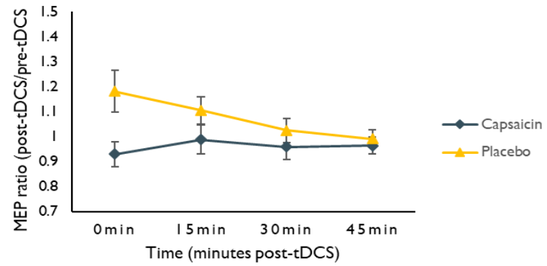

Figure 5. Motor evoked potential ratios for each time point for homeostatic response assessment 24 hrs post patch application, mean and standard error of the mean. (* p ≤ 0.05).

- When homeostatic plasticity was induced 30 minutes post patch application (HP1), a significant increase in MEPs 15 minutes post induction was found for the placebo condition compared with the capsaicin condition.
- When homeostatic plasticity was induced after HP1 (HP2), a significant increase in MEPs up to 15 minutes post induction was found for the placebo condition compared with capsaicin.
- When homeostatic plasticity was induced 24 hours post patch application (HP3), no significant differences were found.

CONCLUSIONS

- Homeostatic response in the placebo condition was successfully induced and assessed at the primary motor cortex.
- Preliminary analyses indicate that capsaicin-induced pain affected homeostatic response immediately post patch application persisting up to two hours post patch application.
- Homeostatic response was not significantly changed after 24hours of patch application.
- Future studies should focus on investigating homeostatic responses in other brain regions such as somatosensory cortex.

REFERENCES

[1] Abraham, W. C., Metaplasticity: tuning synapses and networks for plasticity. Nat Rev Neurosci 2008, 9, 387 DOI: 10.1038/nrn2356.

[2] Karabanov, A., Ziemann, U., Hamada, M., George, M. S., Quartarone, A., Classen, J., Massimini, M., Rothwell, J., Siebner, H. R., Consensus Paper: Probing Homeostatic Plasticity of Human Cortex With Noninvasive Transcranial Brain Stimulation. Brain Stimul 2015, 8, 993-1006 DOI: 10.1016/j.brs.2015.06.017.

Poster ID: 1038274
pgw@hst.aau.dk

This study was supported by the Danish National Research Foundation (DNRF121)