Self-regulation of rACC activation in patients with Postherpetic Neuralgia:A preliminary study using Real-time fMRI neurofeedback

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Introduction and Purpose

Postherpetic neuralgia(PHN) is defined as a chronic pain syndrome that can cause significant deleterious impacts on physical,emotional,and social functioning and therefore can have a widespread adverse effect on health-related quality of life.Currently there is no effective treatment because the specific mechanisms of the disease is still unknown.Real-time fMRI (rtfMRI) feedback is a potential tool for pain modulation that directly targets the brain with the goal of restoring regulatory function. Previous research had found that through rtfMRI neurofeedback training,subjects were able to learn to control activation in the rostral anterior cingulate cortex (rACC), a region putatively involved in pain perception and regulation[1-2].The primary objective of this study was to investigate whether patients with PHN can learn to control activation in rACC and regulate their perception of pain by using rtfMRI neurofeedback.And we futher want to explore the clinical application of rtfMRI neurofeedback in the treatment of PHN.

Subjects and method

This prospective study was approved by the appropriate ethics committee, and written informed consent was obtained from each participant.Five patients with PHN（all Males;Mean Age:66±2.4）   participate in this study. RtfMRI neurofeedback system was composed of a GE Discovery 750 3.0T scanner, Turbo-Brain Voyager Software and a Sinorad projection device.Also a home-written script was used for the purpose of real-time data transfering.The paradigm consisted of three sessions.In the first session,a block-designed localization task was conducted through a handmade painful stimulus.The purpose was to locate the target region- rACC precisely.In last two sessions, a pain imagery task was conducted using rtfMRI neurofeedback.That means,the time-BOLD signal curve of participant's rACC was projected to the participant in real-time and then participant was instructed to increase and decrease activation in rACC through using imagery strategy(such as imagine sports scene or fire). Before and after the training we evaluated the effect of self-regulation with Visual Analogue Score(VAS).

In all three sessions, Functional MRI imaging was acquired using an T2* weighted echo-planar imaging sequence sensitive to the BOLD contrast with the repetition time = 2000 ms, echo time = 30 ms, slice thickness = 4.0 mm with the interslice gap of 0 mm,slices = 33, field of view = 220 x 220 mm^2, matrix size = 64 x 64, and flip angle = 90°.The total scanning time of the three sessions were 5'06'' ,10'06'', 10'06'' separately.The data on-line analysis was conducted using Turbo-Brain Voyager and the off-line analysis was carried out using the Statistical Parametric Mapping(spm8) software((http://www.fil.ion.ucl.ac.uk/spm).

Results and Discussion

A part of individuals (3/5) were able to increase and decrease their own rACC activation level with intermittent feedback training, which was demonstrated by the increased or decreased level of the BOLD signal(Figure 1). When subjects deliberately induced increases or decreases in rACC fMRI activation, there was a corresponding change in the perception of pain.This study is consistent with the previous studies that subjects can be trained to control localized brain activation by using real-time neurofeedback[3-4].The rACC was chosen for this investigation was due to its significant role in various aspects of pain experience and assessment[5].
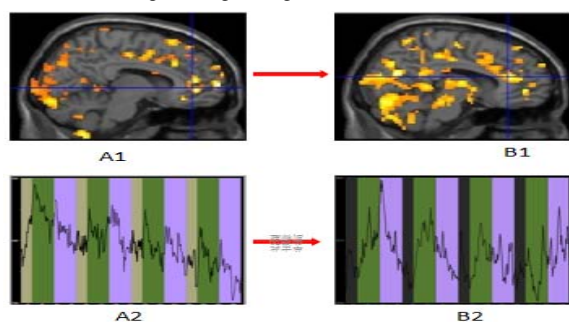

Figure 1:The effect of the training of self-regulation of the ROI(rACC), demonstrating that the level of rACC activation and the time-signal curves of the second training(B1、B2) are better than that of the first time(A1、A2)(p=0.005,non corrected).

Conclusion

Patients with PHN can learn to voluntarily control over activation in rACC through rtfMRI neurofeedback, leading to control over pain perception level. The present study may shed new light into the relationship between physiology and behavior through the effects of rtfMRI neurofeedback training,and futher may provide an alternative way for treatment of severe, chronic clinical pain.

References

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