Functional Connectivity Changes in Failed Back Surgery Syndrome Patients After Spinal Cord Stimulation Therapy with Bursting vs. Non-Bursting Stimulation Patterns

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Introduction

Chronic back pain (CBP) has been associated with alterations in functional connectivity (FC) but data is limited and based on heterogeneous populations.[1-5] Based on our previous work, we hypothesize that FBSS patients have altered FC across networks involving emotion and reward/aversion functions, and that these changes may be correlated with spinal cord stimulation (SCS) outcomes.

Methods

Five, non-pregnant, adult FBSS patients with implanted SCS systems (Medtronic) were enrolled. All imaging protocols were approved by our MRI Safety committee. Anatomical and resting state (RS) fcMRIs were obtained during two separate visits. The subjects underwent off-and-on testing with non-bursting and bursting SCS at visits 1 and 2, respectively. Patient surveys were administered before and after SCS. Outcome measures focused on FC patterns, STM-index,

Results

FcMRI sequences were safely acquired for all patients with implanted SCS systems using 3T-MRI. Off-and-on testing of non-bursting stimulation resulted in a significant decrease of STM indices when non-bursting SCS was restored (mean STM-index 0.25 vs 0.13, p=0.006). No significant difference was seen in STM indices during on-and-off testing of bursting stimulation (mean STM-index 0.20 vs 0.19, p=0.67). The bursting pattern was preferred by 4 of 5 patients. All reported pain scores decreased during on testing. Pain catastrophizing scores (PCS) were significantly lower after switching from non-bursting to bursting pattern stimulation (mean PCS 17.6 vs 14.6, p=0.02).

Figure 1. Relationship between STM index and pain scores with non-bursting pattern of SCS.

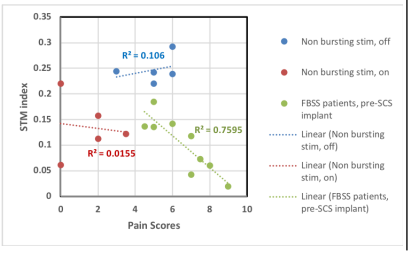
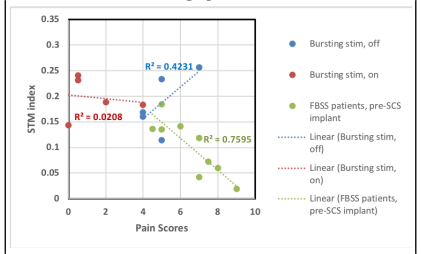


Figure 2. Relationship between STM index and pain scores with bursting pattern of SCS



A negative linear relationship was found between the STM index and the corresponding pain scores of FBSS patients before SCS system implantation (data from our previous study, Green). The negative correlation between STM index and pain scores is lost in patients with implanted SCS systems after 2 weeks of bursting pattern stimulation (Blue, Red). The reported pain scores with SCS turned off prior to image acquisition (Bursting stimulation turned off, Blue) decreased when the SCS system was turned on prior to image acquisition (Bursting stimulation turned on, Red). The STM indices are higher with therapeutic SCS (bursting stimulation, Red) and appear to cluster around the levels seen for control non-FBSS patients (mean STM index for control group was 0.27, STD 0.13, data not shown in graph). However, no significant difference (p=0.67) is seen in this group when stimulation is turned off for several hours (Bursting stimulation turned off, Blue).

Conclusions

Preliminary results suggest there is no correlation between the instantaneous pain scores and STM-index for patients with implanted therapeutic SCS systems which contrasts with findings from our previous study in FBSS patients after a successful SCS trial. STM indices for SCS-treated FBSS patients appeared to cluster around the normal levels seen in control non-FBSS patients. The STM-index may represent a biomarker specific to FBSS patients, which may help guide patient selection for SCS and treatment optimization.

References

1.Baliki, M. N., A. R. Mansour, A. T. Baria and A. V. Apkarian (2014). "Functional reorganization of the default mode network across chronic pain conditions." PLoS One 9(9): e106133.

2.Baliki MN, Apkarian AV. (2015). Nociception, pain, negative moods and behavior selection. Neuron 87 (3): 474-491.

3.Baliki MN, Petre B, Torbey S, Herrmann KM, Huang L, Schnitzer TJ, Fields HL, Apkarian AV. (2012). Corticostriatal functional connectivity predicts transition to chronic back pain. Nature Neurosci 15 (8): 1117-1119.

4.Hashmi JA, Baliki M, Huang L, Baria AT, Torbey S, Hermann KM, Schnitzer TJ, Apkarian AV. (2013). Shape shifting pain: chronification of back pain shifts brain