Effects of hypnosis on motor function and cortical activation in chronic stroke patients

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Introduction

Cerebral vascular accident, commonly known as stroke, is the leading cause of permanent disability and the third leading cause of death in the United States according to the National Stroke Association. A complementary approach to enhancing the recovery of motor function may be through the use of motor imagery [1, 2], which activates much of the same neural circuitry as actual motor function.

Methods

Study participants

Six patients with a single stroke that resulted in upper limb paresis

The stroke at least six months prior

Table 1. Patient characteristics.

<table>
<thead>
<tr>
<th>Number</th>
<th>Age</th>
<th>Gender</th>
<th>Side of paresis</th>
<th>Hemiplegia</th>
<th>Post-</th>
<th>UE-FM</th>
<th>HFIM</th>
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Repeated measures protocol

Three phases:

1. Baseline: each patient learned and practiced a hand-grip force-following task (Figures 1 and 2).

2. Hypnosis intervention: each patient performed the specified motor task before and after the hypnotic procedure three times.

3. Follow-up: track changes in motor task performance for 2 to 4 weeks post-intervention

MRI protocol

Two MRI sessions were conducted for each patient:

1. Baseline scan

2. Hypnosis intervention session with scans during motor functioning pre- and post-hypnosis

Some specifics

• Siemens Allegra 3.0 Tesla scanner with quadrature head coil

• Functional images: T2*-weighted gradient, blood oxygen level-dependent (BOLD), 22 slices, parallel to anterior and posterior commissures, 3 x 3 x 3.1 mm3 voxels, 200 acquisitions per scan.

• Structural images: T2-weighted gradient-echo, same slice specification

Experimental design

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   1. Baseline: each patient learned and practiced a hand-grip force-following task (Figures 1 and 2).

   2. Hypnosis intervention: each patient performed the specified motor task before and after the hypnotic procedure.

   3. Follow-up: track changes in motor task performance for 2 to 4 weeks post-intervention

Results

Nonparetic hand

Observations: fMRI images

- Right hemisphere motor and sensory activation appears similar between baselines (A) and hypnotic intervention (B).

- The activation map appears different post-hypnosis (D) with increased extent relative to pre-hypnosis (C).

- New left hemisphere activation appears post-hypnosis in MC and SC.

Paretic hand

Observations: fMRI images

- Activation map appears different post-hypnosis (D) with increased extent relative to pre-hypnosis (C).

- New left hemisphere activation appears post-hypnosis in MC and SC.

Discussion

Principle finding

The hypnotic intervention was found to improve the motor performance of chronic stroke patients who were not otherwise expected to make spontaneous improvements.

Findings from motor function testing

• Hypnosis appears to result in faster reaction time and faster grip contraction and release rates.

• Motor performance during 2 to 3 week follow-up testing was not significantly different from post-hypnosis results.

Two characteristics of hypnosis that may be involved in the response of the patients to the intervention are cognitive enhancement and the relaxation response. The observed effects of hypnosis on reaction time may be attributable to increased accuracy in the motor task. It is also possible that the relaxation elicited by hypnosis altered the muscle tone of the stroke patients resulting in increased muscle contraction and relaxation for the paretic limb.

Findings from fMRI

• The fMRI data for paretic hand movement showed increased activation extent in bilateral sensorimotor cortex

• There appears to be a lateralization shift in the fMRI activation toward cortical involvement.

The observed increases in activation extent and lateralization changes suggest that plasticity changes in the motor control system may have occurred in these stroke patients as a result of the hypnotic intervention. Recovery evidence suggests that plastic changes in motor activation contribute to motor recovery by compensating for damaged contralateral motor cortex in poorly recovered stroke patients.

References


Discussion

• Hypnosis appears to alter central nervous system function in ways that relate positively to motor function in chronic stroke patients.

• The potential of hypnosis for motor performance gains may be accessed through hypnosis.

• Many questions remain about the limits of recovery with hypnosis and whether the mechanism is a generalized effect of hypnosis or if more complex cognitive processes provide the impact.

Conclusions

• Hypnosis appears to alter central nervous system function in ways that relate positively to motor function in chronic stroke patients.

• The potential of hypnosis for motor performance gains may be accessed through hypnosis.

• Many questions remain about the limits of recovery with hypnosis and whether the mechanism is a generalized effect of hypnosis or if more complex cognitive processes provide the impact.