Letter

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Effects of dry needling on post-stroke brain activity and muscle spasticity of the upper limb: a case report

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Background

Spasticity is a common disorder of motor control following stroke. It can lead to movement constraints and disability, if uncontrolled. More than 60% of stroke survivors suffer from spasticity.[1] As spasticity frequently causes problems in daily activities, adequate control is imperative.

Dry needling (DN) is a relatively new treatment for controlling spasticity after a stroke. The evidence suggests that DN may have central effects.[2,3] To our knowledge, there have been no functional magnetic resonance imaging (fMRI) reports on the effects of DN on brain activity of stroke patients with spasticity. Herein, we introduce a patient with stroke who was suffering from upper limb spasticity and present the changes in brain activity on fMRI after DN.

Case report

The subject was a right-handed 54-year-old man suffering from chronic ischemic stroke with right hemiplegia and upper limb spasticity for 2 years. The patient was able to walk independently. He had no comorbidities such as cardiovascular disease, diabetes or hypertension. Prior to being treated with DN, he had received several other treatments, including physiotherapy, medications and exercises.

Wrist flexors on the affected side were assessed for spasticity using the reliable and validated Modified Modified Ashworth Scale (MMAS), which uses a 0 to 4 scale to grade the intensity of spasticity.[4] Hand function was assessed using the validated Brunnstrom Recovery Stage (BRS) measure.[5] A standard goniometer was used to measure the active and passive range of motion (ROM) of wrist extension.[2]

Imaging was conducted in two steps before and immediately after DN using a task-based approach consisting of a right-hand thumb tapping task along with a physical examination before and 1.5 h after DN.

DN was performed for 1 min on the dorsum of the hand, at the site of the proximal angle formed between the first and second metacarpal bones, using stainless steel needles (0.25 mm × 25 mm; SMC, Seoul, Korea).[2,3]

The MMAS score for wrist flexors improved to "0" after DN. Active wrist extension ROM improved 10° after DN. The hand BRS improved to "4" after DN (Table 1).

Baseline fMRI showed activation of the motor system during the finger tapping task before the DN of the upper limb. There was a low level of activation of the primary motor cortex of the affected and unaffected hemispheres, the affected primary somatosensory cortex and the affected supplementary motor cortex.

The post-treatment fMRI revealed higher activation of both the affected and unaffected primary motor cortices, affected primary somatosensory cortex and affected supplementary motor cortex (Table 2).

Commentary

To the best of our knowledge, this is the first neuroimaging study to provide evidence of the effect of DN on brain activity of a stroke patient with spasticity. Based on the fMRI images in the pre- and post-DN stages, it appears that DN was effective at improving brain activity of this stroke patient with spasticity.

Table 1. Pre- and post-DN outcomes.

Variable	Before	After
MMAS (wrist flexor)	1	0
Wrist extension AROM (degrees)	50	60
Wrist extension PROM (degrees)	70	70
Brunnstrom recovery stages (hand)	3	4

DN: dry needling; MMAS: Modified Modified Ashworth Scale; AROM: active range of motion; PROM: passive range of motion.

Table 2. Magnitude and location of fMRI clusters during a finger tapping task pre- and post-DN.

Time point	Anatomical region	Voxels count	Peak MNI space coordinate (mm)			Maximum Z
			X	Y	Z	
Pre	Left cerebrum, frontal lobe, gray matter		–74	–12	32	5.4065
	Precentral gyrus (primary motor cortex)	275				
	Postcentral gyrus (primary somatosensory cortex)	238				
Post	Left cerebrum, frontal lobe, gray matter		–64	–12	38	6.3258
	Precentral gyrus (primary motor cortex)	397				
	Postcentral gyrus (primary somatosensory cortex)	72				

fMRI: functional magnetic resonance imaging; DN: dry needling; MNI: Montreal Neurological Institute. Maximum Z: the voxel with highest BOLD (blood oxygen level dependent) activity.

Improvements in hand function and active wrist extension might have been due to effective stimulation of the related motor cortex area after DN treatment. As expected, the changes in brain activity coincided with clinical improvements, as demonstrated previously.[2,3] Normalized spasticity of wrist flexors and simultaneous increases in the affected motor cortex may explain the benefits observed in this patient with spasticity after stroke.

In addition to increased activation of the sensory and motor areas in the affected hemisphere after DN, the activation and intensity of activation in the primary motor cortex of the unaffected hemisphere also increased. Even though the function of the affected arm after stroke is mostly dependent on the integrity of the pathway from the affected hemisphere, the post-DN increased activation in the primary motor cortex of the unaffected hemisphere could have a role in hand recovery through the ipsilateral pathway connected to the paretic muscles of the affected arm.

DN increased the activity in the affected primary motor cortex with motor improvement in a patient with post-stroke spastic hemiparesis. This case report used fMRI to reveal significant brain changes after DN that supports the beneficial effects of DN for stroke patients with spasticity. Based on these preliminary findings, further studies are needed including randomized controlled trials with a greater number of subjects.

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Declaration of conflicting interests

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Ethical approval

This case study was approved by the Ethical Committee of Tehran University of Medical Sciences.

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