

Case Series on Effect of Transcranial Magnetic Stimulation on Motor Recovery after Spinal Insult

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Abstract

Introduction The aim of this case series is to explore effect of transcranial magnetic stimulation (TMS) on motor recovery after spinal insult.

Method and material This is a retrospective single centre case series for spinal insult in Queen Elizabeth Hospital. There were 3 cases of spinal insult without significant neurological recovery receiving TMS with intermittent theta burst pattern in 2019. Total 10 sessions of TMS were performed for each cases. Limb power and functional level were analysed before treatment, immediate post-treatment, 3 months post-treatment and 6 months post-treatment.

Results All 3 cases had clinical and functional improvement after TMS and the effect could be sustained at 6 months.

Discussion and conclusion All 3 cases selected had already reached a plateau of motor rehabilitation with traditional physiotherapy for at least 2 months to unmask the effect of natural recovery or pure physiotherapy. In our cases, all 3 cases did not have any major side effects and could have sustainable improvement both clinically and functionally. TMS in spinal insult cases appeared to be safe and effective yet large scale randomised controlled trials are required for confirmation.

Keywords: Transcranial Magnetic Stimulation, Rehabilitation, Physiotherapy

Introduction

Transcranial magnetic stimulation modulate activity in cortical region via magnetic field induced by passing alternating current through metal coil. Compare with percutaneous electrical stimulation, it is a non-invasive and painless procedure. Since its introduction in 1980s, it has been widely applied in clinical practice as diagnostic tool, treatment for refractory depression.

In application as clinical rehabilitation tool, recent studies showed TMS applying to motor cortex has potential to lower chronic neuropathic pain [1,2]. TMS also reduced spasticity in patient with multiple sclerosis, cerebral palsy and spastic quadriplegia [3].

For motor function after spinal cord insult, traditionally, peripheral stimulation is advocated as previous literature review suggest peripheral magnetic stimulation showed improvement in spasticity and movement dynamics [4].

However, there is lack of evidence on transcranial magnetic stimulation (TMS) on motor recovery after spinal insult. In this case series, we aim to explore the effect of intermittent theta burst (iTBS) of TMS on motor recover after spinal insult.

Information about intermittent theta burst (iTBS)

Theta burst stimulation (TBS) represents Hebbian form cellular learning of long-term synaptic plasticity [5]. TBS mimics

endogenous theta rhythms therefore improve induction of synaptic long-term potentiation. TBS induces a potentiation and a depression of cortical excitability.

Method and Material

This is a retrospective single centre case series for spinal insult in Queen Elizabeth Hospital. Inclusion criteria includes case of spinal insult within 2019 with surgical excision under neurosurgical department. Exclusion criteria were: age under 18 years old, underlying neurological disease, concomitant cerebral insult.

There were 3 cases of spinal insult without significant neurological recovery receiving TMS with intermittent theta burst pattern in 2019. Standard post-operative nursing care and physiotherapy were provided. At least after 2 months of traditional physiotherapy, TMS was arranged.

Site of device will be over primary motor cortex. The primary motor cortex, or M1, is located on the precentral gyrus and on the anterior paracentral lobule on the medial surface of the brain. Of the three motor cortex areas, stimulation of the primary motor cortex requires the least amount of electrical current to elicit a movement (Fig. 1). over left or right side, depends on the laterality of defect.

Total 10 sessions of TMS were performed for each case. Limb power and functional level were analysed before operation, immediate post-operation, 3 months post-operation but before TMS and 6 months post- treatment, after TMS sessions.

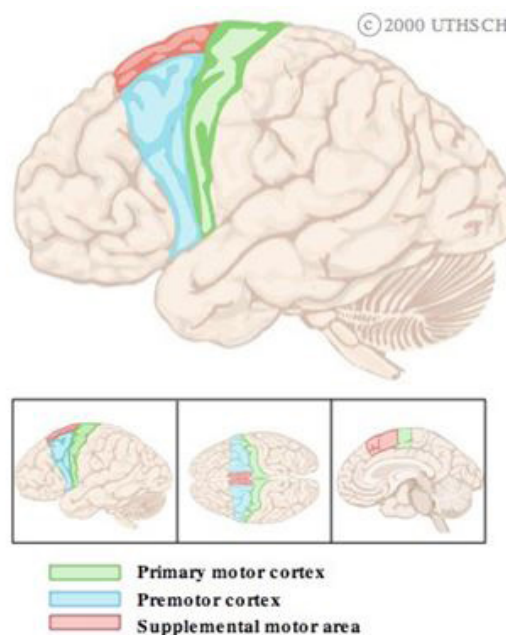


Figure 1: Over left or right side, depends on the laterality of defect

Results

All 3 cases had clinical and functional improvement after TMS and the effect could be sustained at 6 months.

Case 1 is cervical ependymoma at C1 to C4 level with surgical excision performed. There was improvement of patient's

right hand-grip power from not able to perform then 3 months post-operative as 9.6 kg/f to 10.4 kg/f in 6 months interval. Limb power remained 4 out of 5, MRC grading. Lower limb power is all along full with MRC grading 5 out of 5. Patient also volunteered some improvement in right upper limb control, compare with pre-operative and pre-TMS period. (Table 1)

Table 1

	Pre- operation	Immediate post- operation	3 months after operation (before TMS)	6 months after operation (completed course of TMS)
Right upper limb power (MRC grading)	4	4	4	4
Right lower limb power (MRC grading)	5	5	5	5
Right power grip	N/A	N/A	9.6 kg/f	10.4 kg/f

Case 2 is a thoracic meningioma over T10-T11 level with surgical excision performed. Patient initially present with bilateral lower limb weakness and reduced sensation over L1 dermatome. Patient's walking ability improved from chair-bound to walk with quadripod 3 months post-operation. He could walk with stick at 6 months, after course of TMS.

Hip flexion and extension improved from MRC grade 1 to grade 3 at 3 months post-operation, then improve to grade 4; knee flexion and extension improved from grade 0 to grade 3 at 3 months post-operation, then to grade 4 at 6 months interval; ankle dorsiflexion and plantarflexion improved from grade 0 to grade 2 at 3-month interval, then improved to grade 3 out of 5 in 6-month interval (Table 2).

Left lower limb power also showed significant improve-

Table 2

	Pre- operation	Immediate post-operation	3 months after operation (before TMS)	6 months after operation (completed course of TMS)
Left upper limb power (MRC grading)	5	5	5	5
Left lower limb power (MRC grading)	Hip: 1-2 Knee: 0 Ankle: 0	Hip: 3+ Knee: 3- Ankle: 1-2	Hip: 4- Knee: 3+ Ankle: 2	Hip: 4 Knee: 4 Ankle 3+
Functional	Unable to walk	Able to walk with frame with supervision, on AFO	Able to walk with quadripod with supervision, on AFO	Walk with stick with AFO

Case 3 is a thoracic syringomyelia over T4-T11 with surgical excision. Patient first presented with left lower limb weakness and overflow urinary incontinence. Patient can walk unaided before spinal insult but not able to run due to clonus. At 6 months post-insult, he is able to run on treadmill. Power of his left lower limb also improved from MRC grade 4 to grade 5. (Table 3)

No major side effect was recorded in these three patients. One of the patients complained of non-specific somatic complaint like neck pain, shoulder tightness and tingling sensation during TMS but spontaneously resolved after session.

Table 3

	Pre- operation	Immediate post- operation	3 months after operation (before TMS)	6 months after operation (completed course of TMS)
Left upper limb power (MRC grading)	5	5	5	5
Left lower limb power (MRC grading)	4+	5-	5	5
Functional	Able to walk unaided independent, clonus of right ankle in stairs walking, unable to run	Able to walk unaided independent, occasionally mild clonus of right ankle in stairs walking, unable to run	Able to walk unaided independent, no more clonus of right ankle in stairs walking, able to run on treadmill	Able to walk unaided independent, no more clonus of right ankle in stairs walking, able to run on treadmill

Discussion and Conclusion

All 3 cases selected had already reached a plateau of motor rehabilitation with traditional physiotherapy for at least 2 months to unmask the effect of natural recovery or pure physiotherapy before starting course of TMS.

Traditionally peripheral stimulation is advocated in spinal insult cases. We postulate that by stimulating the any part of the motor pathway can induce similar motor rehabilitation effect as peripheral stimulation. This postulation is echoed by different papers. In our cases, all 3 cases did not have any major side effects and could have sustainable improvement both clinically and functionally. TMS in spinal insult cases appeared to be safe and effective yet large scale randomised controlled trials are required for confirmation.

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