Evaluation of the motor recovery following spinal hemisection by transcranial electrical stimulation in macaque monkey

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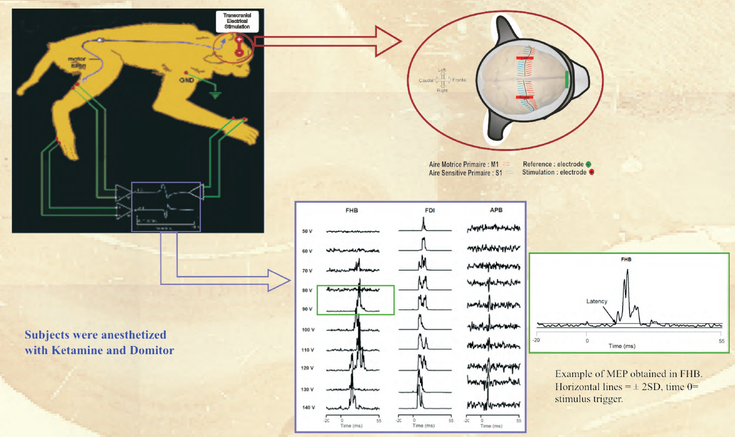
INTRODUCTION

The anti-Nogo-A antibody treatment has shown improvement of the recovery of hand dexterity in non-human primate following spinal hemisection. Such improvement of recovery parallels enhanced sprouting of CS axons caudal and rostral to the lesion in anti-Nogo-A treated animals. In clinical practice, motor evoqued potential (MEP) induced by transcranial electric stimulation (TES) is commonly used to document changes in conduction time of motor tracts in neurological diseases. Using TES, the present study aimed to assess the functional properties of this CS sprouting. Moreover, in this study, we used anti-Nogo-A treatment combined with brain-derived neurotrophic factor (BDNF).

MATERIAL AND METHODS

Experiments were conducted on four adult monkeys (*macaca fascicularis*)

1. Behavioral training for various manual dexterity tasks.
2. Hemisection of the spinal cord in the four monkeys at the cervical segment C7.
3. Four weeks intrathecal treatment with anti-Nogo-A antibody and BDNF in two monkeys (MK-2 and MK-3) and control antibody in the other two (MK-1 and MK-4). Treatment starts immediately after the spinal hemisection.
4. TES starts few weeks before and after the lesion. One session a week.
6. TES was done under anesthesia (a mixture of Ketamine and Domitor). TES consisted of a single pulse (0.2 ms duration) starting at 50 volts up to 500 volts. Subjects were placed in ventral decubitus inside a Faraday cage. A custom software program (Neural Average, University of Washington, Seattle, WA) was used for data acquisition and averaging.
7. EMG was recorded from intrinsic hand muscles (FDI: *first dorsal interosseus*, and APB: *abductor polliciss brevis*) and intrinsic foot muscle (FHB: *flexor halluciss brevis*), using pairs of multi-stranded stainless steel wires.

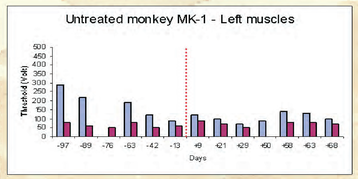


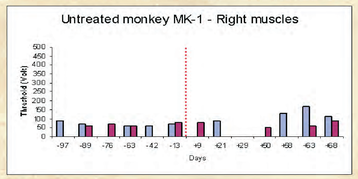
Subjects were anesthetized with Ketamine and Domitor

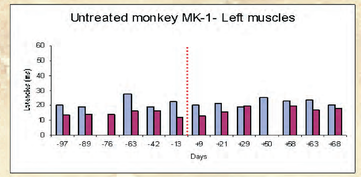
Example of MEP obtained in FHB. Horizontal lines = ± 2SD, time 0= stimulus trigger.

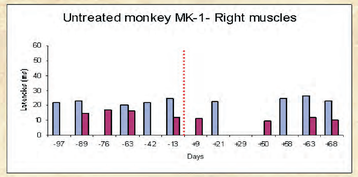
RESULTS

Untreated monkey

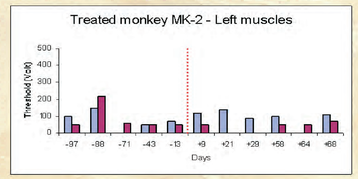


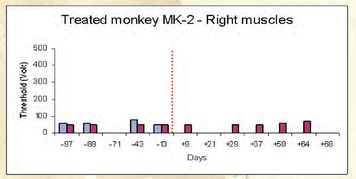


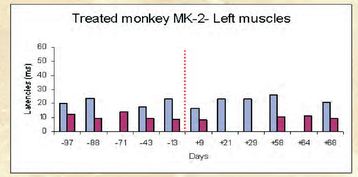


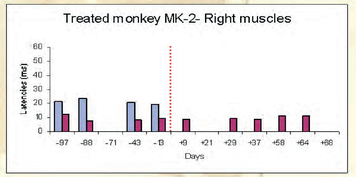


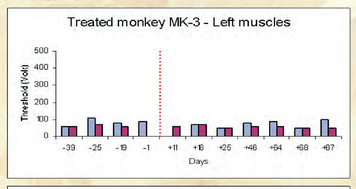
Anti-Nogo-A antibody and BDNF treated monkeys

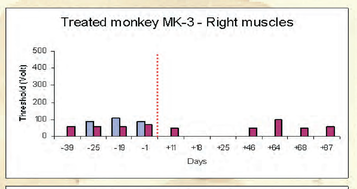


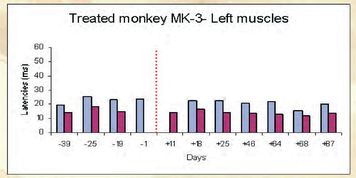


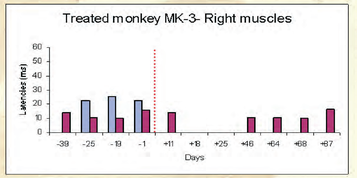






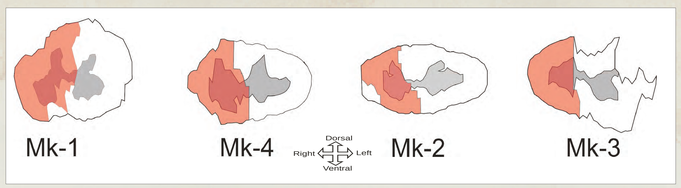






FHB
Intrinsic hand muscles

Lesion day



Reconstruction of transversal section of the spinal cord at the level of the lesion site for two treated monkeys (MK-1 and MK-4) and two untreated monkeys (MK-2 and MK-3).

CONCLUSION

These preliminary data show that:

1- The inter-sessions variability of the data is considerable when using data from a limited number of muscles. Moreover, the TES effect may be influenced by other parameters such anaesthesia for example.
2- At the present state of the analysis, no significant differences could be found between treated and untreated monkeys. More monkeys are needed to complete this study.
3- A comparison with monkeys treated only with anti-Nogo-A antibody will be of interest (see poster M.L. Beaud et Al.).

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