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GAIT ABNORMALITIES: A NEUROLOGIC OR MUSCULOSKELETAL PROBLEM?
TRANSCRANIAL MAGNETIC STIMULATION AS AN USEFUL AID!

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Introduction
A normal locomotion depends on the integrity of the central and peripheral nervous system, the skeleton and its associated soft tissues, e.g. ligaments, tendons and muscles. Lameness can be defined as an abnormal modification of normal gait. A broad range of conditions causing gait abnormalities are known. Among these conditions two large groups can be differentiated: neurological and musculoskeletal conditions. Several tests, such as the clinical examination, flexion tests, ultrasound, radiography, scintigraphy and electromyography, are useful in the exam of a "lame" horse in order to obtain a definite diagnosis.

Paresis or paralysis will sometimes limit muscular contraction in the same manner as a lesion of a tendon or a focal pain. By performing a clinical neurological examination most of these cases will be diagnosed as neurological. However, the results of the subjective visual observation on hard and soft surfaces, on circles and straight lines, in hand and under saddle, can not in all patients make a clear distinction between a musculoskeletal or neurological cause. Moreover, young and fast-growing horses are sometimes moving unstable because of joint or tendon laxity.

Transcranial magnetic stimulation of the motor cortex of the brain and subsequent recording of the electromyographic responses (magnetic motor evoked potentials, MMEPs) in the peripheral musculature is known to be useful in assessing objectively the functional integrity of the motor pathways of the spinal cord in horses (Nollet et al., 2002, 2003). The aim of this paper is to determine if the test is also useful to demonstrate very mild lesions along the spinal cord that have an influence on gait and on performance.

Material and methods
Transcranial magnetic stimulation
All horses were sedated with a combination of detomidine (Domosedan®, Pfizer, Belgium; 1 mg/100 kg) and buprenorphine (Temgesic®, Schering-Plough, Belgium; 0.12 mg/100 kg) and underwent transcranial magnetic stimulation, using a Magstim 200. The circular coil was centered over the forehead. The stimulus intensity was 100% of maximal output. Electromyographic responses (MMEPs) were recorded bilaterally from needle electrodes in the extensor carpi radialis muscle and the tibialis cranialis muscle. Four potentials were obtained from each recording site and superimposed to evaluate reproducibility of the recordings.

Onset latency (in ms) was measured as the shortest distance between the trigger point and the take-off of the initial phase (negative or positive).
MMEP amplitude (in mV) was measured between the two largest peaks of opposite polarity (peak-to-peak amplitude).
Normal values for onset latency and peak-to-peak amplitude have been described (Nollet et al., 2004).

Clinical patients
The study involved 20 warmblood horses referred to the Faculty of Veterinary Medicine (University of Ghent, Belgium) because of suspicion of lameness (loss of performance) (n=16) or for veterinary examination as part of a prepurchase examination or stallion approval test (n=4).

The horses aged from 2 to 13 years (mean age: 6,05). Six horses were stallions, nine were geldings and five were mares. During the clinical examination no clear distinction could be made between a neurological or orthopaedic problem by means of the regular orthopaedic exam. Symptoms as very mild signs of circumduction, sporadic stumbling, episodic hypermetria, …seen in some horses make raise doubts about presence of low grade ataxia. Therefore a transcranial magnetic stimulation was performed on all these patients in order to
measure the conduction along the descending motor tracts of the spinal cord. In the horses where normal MMEPs were measured, the lameness examination was continued in order to find a cause for the abnormal gait. In some of these horses also a radiography or a scintigraphy of suspected body areas was performed.

Results
Six of the sixteen horses referred for lameness had normal MMEPs. A final diagnosis of narcolepsy (complaints of falling) (n=1), tarsal joint problem (n=1), distal interphalangeal joint problem (n=1), iliosacral joint problem (n=2) and unknown cause (n=1) was made in these horses.

In the remaining ten of the sixteen horses abnormal MMEPs (prolonged onset latency and/or small peak-to-peak amplitude and/or abnormal configuration of the potentials) were measured. Based on the MMEPs a cervical spinal cord problem (abnormal MMEPs in forelimbs and hindlimbs) or a spinal cord lesion caudal to T2 (abnormal MMEPs only in the hindlimbs) was suspected in respectively seven and three horses.

In two of the four cases referred for a veterinary examination as part of a prepurchase or stallion approval test abnormal MMEPs could be measured in the fore- and hindlimbs. Also in these cases a cervical spinal cord lesion was suspected.

Conclusions
In twelve of the twenty cases where the examiner suspected mild symptoms of incoordination or could not indicate a distinct orthopaedic problem, abnormal MMEPs could be registered.

We can conclude that the subjective clinical evaluation of the gait can not always give us a decisive answer about the origin of the gait abnormality. In these cases the objective measuring of the conduction along the descending motor tracts by evaluation of MMEPs can be helpful to make definitive conclusions. Also in prepurchase examinations or stallion approval tests where sometimes very young and fast-growing animals are presented, the test can help to differentiate between joint or tendon laxity and a neurological problem.

References
