Bayesian comparison of transcranial magnetic stimulation, cervical radiography and clinical examination to diagnose spinal cord dysfunction in horses

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Introduction

Spinal cord dysfunction, frequently caused by cervical vertebral malformation (CVM), is common in Warmblood horses. However, in subtle cases, differentiation from orthopaedic causes may be challenging. Neurological examination, cervical X-rays and transcranial magnetic stimulation (TMS) with recording of magnetic motor evoked potentials (MMEP) are used for diagnosis of spinal cord dysfunction. But, as there is no gold standard, diagnostic accuracy of all 3 tests are currently unknown. Therefore, the objective of this study was to determine their sensitivity and specificity, using a Bayesian framework to adjust for the absence of a gold standard.

Material and methods

A diagnostic test study was performed on data from 174 horses. Clinical grade of ataxia (0-1=normal, 2-5=ataxia), presence of spinal cord compression on cervical X-rays (any compressive abnormalities or minimal intra-vertebral ratio <0.485=positive) and mean pelvic limb MMEP latencies (>42ms=positive) were determined. A Bayesian latent class model was used, considering the 3 tests independent. Three models were built: an uninformed model, a model with prior information on CVM prevalence (Mode: 2%; 95% percentile=10%) and a model with prior info on CVM prevalence and diagnostic accuracy of X-ray (Sensitivity (Mode= 47%; 95% percentile=80%); specificity (Mode=78%; 95% percentile=90%)).

Results

The prevalence of spinal cord dysfunction was estimated at 45.7 (95% CI 35.9-54.3) %. In all models, TMS-MMEP had the highest sensitivity followed by the neurological examination and finally cervical X-rays. Also specificity of MMEP was superior to the specificity of X-rays and clinical examination. In the model with all informative priors, sensitivities of TMS-MMEP, clinical examination and X-rays were 98.1 (91.4-99.9)%, 94.7 (87.0- 99.7)% and 45.0 (34.5-55.6)%. The specificities were 90.7 (71.6-99.6), 74.7 (60.2-86.4)% and 81.5 (70.3-90.5)% respectively.

Conclusion

TMS-MMEP appears a very valuable, non-invasive test for spinal cord dysfunction, by far exceeding diagnostic accuracy of X-ray.