EEG-studies about sleeping behaviour of horses

Anna-Caroline Wöhr, Kai-Uwe Güntner and Michael Erhard
Institute for Animal Welfare, Ethology and Animal Hygiene, Ludwig-Maximilians-University Munich,
Veterinary Faculty, Schwere-Reiter-Str. 9, 80637 Munich, Germany; woehr@lmu.de

1 Introduction

In the context of the ongoing discussion about keeping horses in individual stable boxes vs. in groups the lack of relaxation of the horse as a flight animal is an argument often put forward against individual housing. The long-term objective of our investigations is to determine the sleep phases and the hypnogram (overnight sleep-profile) in various housing systems in order to find a scientifically founded answer to that issue. For that purpose, the sleep waves previously measured by a Electroencephalogram have to be defined and allocated to the individual stages of sleep. The experiments described here are intended to support this effort.
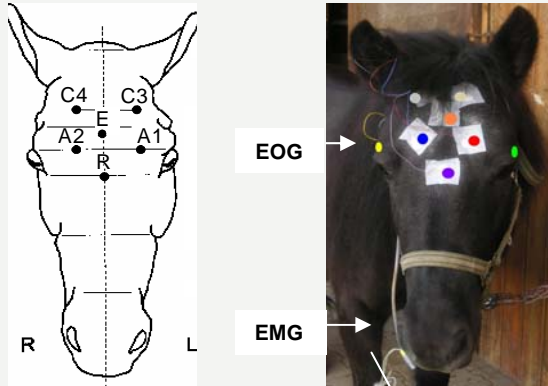

Figure 2: position of the electrodes

3 Results

In humans, according to Rechtschaffen and Kales (1968), we differentiate between 4 stages of sleep plus the REM (rapid eye movement) phase. The individual phases are characterized by typical criteria of EEG, EOG and EMG. As with humans, various stages of sleep can be defined for horses as well using the human definitions. The waking condition is characterized by alpha waves, which just like in humans are within a range of 8-12 Hz. Typical REM phases as in humans were also detected, although not only stretched completely on their side, as has hitherto been described, but also lying on their chest (see Fig. 3). Phases of deep sleep (stage 4) can also be measured, with the horses mostly in a standing position.

The multi-stage human sleeping pattern, which is made up of 4-6 repeat phases of sleep (waking stage eyes open – waking stage eyes closed – REM phase – stage 1 – stage 2 – stage 3 – stage 4 – return to REM phase etc.) was found to be similar in horses in individual sequences (see Fig. 4). However, the sleep phases are shorter and more frequently interrupted by waking phases.

4 Discussion

Horses are flight animals, which is why they have to be "on eye" in every situation so as to be able to flee in the face of danger. In a natural herd lying positions are only assumed if one or more members watch over the herd. In some publications the REM phase is treated as equivalent to the deep sleep phase. Although the REM phase is a phase of total muscle relaxation it is at the same time the dream phase and due to the high frequencies and the low amplitudes in the EOG resembles Stage I. This means that the sleeping horse can be awakened quickly even in this stage similar to the human REM phase in order to react to any dangerous situation. It therefore makes sense for the horses to assume a lying position during REM phases as the muscles are relaxed, but a waking condition can be reached very quickly. A standing position seems to be preferred during deep sleep phases, where waking takes rather long, so that at least the position will not have to be changed. Whether the sleeping behavior changes depending on age and race has yet to be investigated.
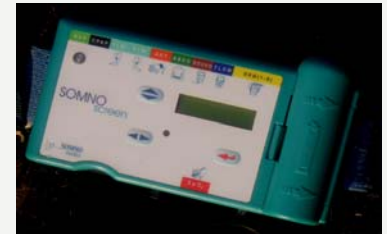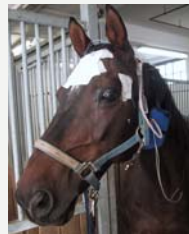

Figure 1: Polysomnograph `Somnoscreen™´

2 Materials and methods

With the Polysomnograph `Somnoscreen™´ by Somnomedics the sleep profile of 10 Icelandic ponies aged 5-10 years was recorded and evaluated for 4-5 nights per horse. `Somno-screen™´ is a complete portable polysomnograph which offers wireless online data transmission of all signals to a PC as well as wireless online transmission and synchronisation of digital video (see Fig. 1).

The following parameters were assessed: EEG (electroence-phalogram), EOG (electrooculogram), EMG (electromyogram) and the sleeping behaviour of the horses by video recordings. EEG, EOG and EMG recordings were obtained through gold-coated disk electrodes with long flexible cables, applied and secured to the scalp. The positioning of the electrodes are shown in Figure 2. After degreasing the skin with alcohol the electrodes are fixed to the scalp with a plaster-like paste (collodium).
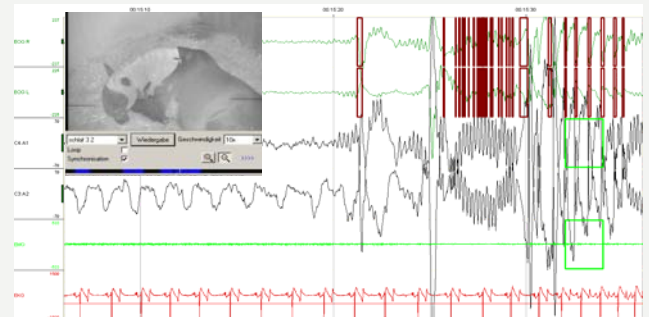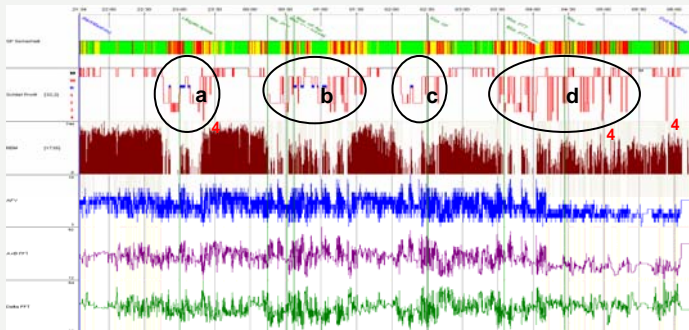

Figure 3: REM-sleep of a horse in a chest position

a-d:	four sleeping phases during the night
4:	deep sleep phases
AFV:	average frequency value of the EEG
A+B FFT:	share of Alpha- and Beta-frequency (**F**ast **F**ourier **T**ransformation)
Delta FFT:	share of Delta-frequency

Figure 4: Hypnogramm of a horse (over 8h 26min)

Rechtschaffen A and Kales A 1968 A Manual of Standardized Terminology, Techniques and Scoring System for Sleep Stages of Human Subjects. Washington, DC: US Government Printing Office, US Public Health Service.