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Equine sleep behavior and physiology based on polysomnographic examinations

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Equestrian sports enjoy an increasing popularity in Germany in recent years. The horse population has risen sharply, as has the number of people engaged in equestrianism. With the growing interest in the horse as a partner, the awareness of a proper housing and handling grows. And yet sleep is, although it occupies a considerable part of the day and meanwhile important physiological processes take place, considered very poorly so far.
Compared to humans and especially to predators, the flight animal horse sleeps significantly less and with a different pattern, but it also requires a more or less regularly recurring regeneration period. Sleep while standing is an equine exceptionality, which is very rare in mammals and nowhere near conclusively studied. For a long time the sleep behavior of the horse could only be assessed by observation. Thanks to the introduction of portable polysomnographs from human medicine, the drawing up of an equine sleep profile with precise details of the brain`s activity state is now possible.

In this study the sleep physiology of horses over four consecutive nights and under highly standardized conditions was examined by use of polysomnography for the first time. The EEG (Electroencephalogramm) of seven horses -all based for at least one year in the same stable- with similar physical conditions and with the same daily routine, was analyzed from a total of 27 nights (one horse only three nights).
Aim of this study was to investigate and evaluate equine sleep behavior with respect to duration and quality of sleep stages, nocturnal distribution and function of the body position, as well as influence of physical exercise on equine sleep. Investigation also focused on the existence of an intra- or interindividual, more or less daily recurrent sleep pattern which could be characteristic for this species. The differences in sleep behavior after rest and athletic effort (riding, lunging, etc.) , which is always associated with a certain mental and physical stress for horses, were investigated as well as the question whether there is a higher need for sleep after exercise or not.

Based on the results of this study it can be hypothesized that a relatively fixed total sleep time (TST) of 3.5 hours per night exists in horses housed in individual stalls with the daily option for free, self-determined movement and that horses sleep an average of 50 % of the night. Even the duration of the different sleep stages appears to be relatively constant. REM-sleep (Rapid-Eye-Movement-Sleep) was detected every night in every horse and occured mainly after midnight. With about 30 min/night and 15 % of the total sleep time REM-sleep occupied the smallest amount, SWS-sleep (Slow-Wave-Sleep) took up the most time with 65 % of the total sleep time and 130 min/night. The rest of the total sleep time was spent in Light Sleep (LS), which was redefined and consists of sleep stages 1 and 2. Total and percentage data of sleep duration and sleep stages showed significantly lower intraindividual differences than the times between individuals. The same was shown by the distribution of sleep over the night. This poses the question if a horse-specific and an individual sleep profile may exist.

One of the most interesting facts is related with REM-sleep, which requires a complete muscle relaxation. Although horses have a special anatomical feature (an apparatus of tendons and ligaments in the hind limb for fatigue- free standing), REM-sleep occurred only in recumbency.
The amount in sternal recumbency with the head rested on the ground prevailed significantly. Although a transition state in connection with a lowering of the head and greater muscle relaxation could be observed in the EEG while horses were standing, these phases were never longer than 5-10 seconds, so they were not counted as REM-sleep. This transition state never entirely merged into REM-sleep. The identification of precisely these transition states could serve as a basis for the diagnosis of narcoleptic horses. Also a suspected sleep deficit could be confirmed in horses that do not or only rarely lay down. Another interesting fact is that REM-sleep occurred especially in the early morning hours (from 3 o`clock on). This complies with the statement of most authors according to which horses would primarily use this period of the day for "deep sleep".

Besides brain activity the recumbency behavior was analyzed by video recordings. The horses studied mainly laid down after midnight and each night they spent a total of about 2.5 hours recumbent in up to five periods. About 20 minutes or 15 % of the total lying time (TLT) was spent in lateral and the rest in sternal recumbency. With recumbency it did stand similar as with sleep. Some horses lay down every night for very long periods, others more frequently and for shorter and "uneasier" periods. Some horses changed frequently between lateral and sternal recumbency, others remained for a long time in one position. The variations of inter-and intraindividual time spent recumbent suggest that even different types of recumbency behavior may exist.

Sleep stages generally showed large differences depending on the body position. About half of total sleep time was spent standing, the other half recumbent. The majority of sleep, as already described above, was spent in SWS-sleep (>60%). Thereof the major part took place while standing (40%), much less in sternal recumbency and only very little in lateral recumbency. REM- and Light Sleep in sternal recumbency follow on a percentage basis. Fewest of all time was spent in Light Sleep and lateral recumbency. This matches with the role of the horse as a flight animal and the duration of the standing up process which delays escape. Accordingly the majority of Light Sleep also occurs while standing (> 50 %). Lying down for Light Sleep is possible, but not necessary.

Regarding the effects of physical exercise on sleep, no influence of intense late-evening exercise on the sleep behavior of trained horses could be shown. On average horses slept the same after rest and exercise. This could be founded by the fact that all investigated horses were fit and trained individuals for whom the intense late-evening training was nothing unusual.

The results of this work suggest, that a certain level of stability as well as inter- and especially intraindividual repeatability of equine sleep behavior exists under relatively standardized conditions similar to humans. But, in addition to that, even different "sleep-types" seem to exist, which could lead to different demands on stabling and handling horses. To support these assumptions, further electroencephalographic studies must be carried out on a great number of comparable animals. From this, a better understanding of horse welfare and optimal athletic training may be deduced.