Equine Behavior

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The Characteristics of Equine Sleep

☐ Horse owners frequently ask the following questions concerning sleep:

- Can horses sleep on their feet?
- How long do horses sleep?
- When do they sleep?
- Do they dream?

Practitioners should be concerned about certain aspects of sleep. For instance, horses that are cross-tied to prevent them from disturbing a wound, may be badly sleep-deprived if the treatment is continued for many days.

Sleep can be identified behaviorally as a period of immobility in which the horse is relatively unresponsive to external stimuli, but sleep can better be defined on a neurophysiological basis. To study the neurophysiological basis of sleep, electrodes are positioned over the frontal epidural, occipital and parietal regions of the cortex in order to record cortical brain waves.[1] The electroencephalographic characteristics of wakefulness in the horse are low voltage (10-30 μV) fast activity (25-40 c/sec) desynchronized waves termed LVFA. During wakefulness an electrode implanted in the dorsal hippocampus shows an irregular theta rhythm with periods of small irregular activity. During periods of alert wakefulness (i.e. when another horse was seen or an unaccustomed sound heard) the hippocampal activity was characterized by regular synchronized high amplitude waves (150-200 μv) of a low frequency (3-6 c/sec). As the horse becomes drowsy, spindles begin to appear in the frontal lead of the electrocorticogram (ECoG), that is, high amplitude, slow waves fade in and out.

At the hippocampal level, large (250μV) slow (1 c/sec) waves progressively replace the irregular theta waves. As the horse falls asleep, cortical spindle activity alternates with high voltage slow activity waves (200 μV, 1-4 c/sec) (HVSA).

Sleep is divided electrophysiologically into Slow Wave Sleep (SWS) and Paradoxical (PS) or Rapid Eye Movement (REM) sleep. During SWS the HVSA synchronized waves

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predominate in the cortex and slow waves of high amplitude are also recorded from the hippocampus. The electromyogram (EMG) during SWS indicates that there is still some muscle tone and activity. The electrooculogram (EOG) measures the change in the electric field generated by the movement of the eye. During SWS the EOG indicates that there is very little eye movement, and the lids may be partly open. In contrast, during PS there are eye movements (hence the term REM) behind closed lids, but muscle tone is lost. The ECoG features of PS are low voltage fast activity. Both the electrical activity of the cortex and of the hippocampus resemble that of wakefulness, yet the horse is least responsive to external stimuli during PS. Paradoxical sleep is sometimes termed the sleep of the body because of the general muscular relaxation while slow wave sleep is known as the sleep of the mind.

Dreaming

Human PS is associated with dreaming. There is no way of determining whether horses dream during PS, much less determining the subject of their possible dreams. In addition to the burst of rapid eye movement, twitching of the ears, contractions of the limbs and occasionally whinneys, tachycardia and polypnea are observed during PS indicating that the horse may indeed be dreaming. The polygraphic characteristics of equine sleep are shown in Figure 1.

Sleep in horses has several unique characteristics:

- ► As far as we know adult horses sleep only at night, although they may drowse during the day. Ruminants sleep mostly at night, but do not appear to be strictly limited to night sleeping.
- ► The sleep cycle of horses is very short. The usual cycle consists of 5 minutes of SWS, 5 minutes of PS and another 5 minutes of SWS. The horse will then awaken and remain awake for about 45 minutes before another sleep cycle begins.
- ► The total sleep time is very short, aver-

aging about 3 hours per night. This represents even less sleep time than that of ruminants. Pigs, dogs and cats sleep for many more hours than horses.

► Although the total sleep time is short, the length of PS sleep bouts (and the ratio of SWS to PS) is longest in the horse. Figure 2 is a schematic representation of sleep patterns in horses. Of course, sleep cycles would not be as regular in an individual animal.

Sleeping Posture

Horses stand many hours during the day and even at night 80% of their time is spent standing. The stay apparatus allows horses to rest, drowse and even engage in SWS, but horses must be recumbent (usually lateral recumbency) in order to engage in PS. The movements of a horse in lying down and standing up are very consistent, in fact they are almost stereotyped. Horses usually are in sternal recumbency during SWS, sometimes with their muzzle resting on the ground. When in lateral recumbency, the upper foreleg is always cranial to the under leg. The postures of the horse as it lies, sleeps and arises are shown in Figure 3. The clinical significance of the sleeping posture of the horse is that an animal forced to stand will be sleep deprived. For that reason sleep deprivation accompanies transportation when the horse must stand all night in a trailer or airplane. Horses that must be suspended in slings for many days will also be sleep deprived. A horse that has been tied so that it cannot lie down may show abnormal behavior as a result. The effects of PS deprivation have not been systematically made in horses, but in other species, including humans and laboratory animals, sleep deprivation leads to hyperirritability, learning deficits and even hallucinations. Horses deprived of PS will show a rebound or an increase in PS after deprivation which further indicates the importance of PS. Sleep time is short in horses, but apparently essential, nonetheless. In the days when many horses were kept in straight stalls, tied short so that they could not lie

down, they must have suffered chronic sleep deprivation. It may be possible for a horse to adapt to such conditions and exhibit PS while standing, but this has not been demonstrated in the laboratory.

Factors Affecting Sleep

Many factors affect sleep in horses. When deprived of visual and auditory stimuli, horses exhibit more SWS and a large increase in PS after the period of perceptual deprivation. When their diet was changed from one of hay (high roughage) to one of oats (high concentrate), ponies slept more and were awake less. Fasting also increases sleep time. The environment is probably most important in influencing sleep patterns. Horses assume recumbency only in a familiar environment; therefore when put out on pasture it may be a day or two before a horse first lies down. This hesitancy to lie down in a strange place has obvious survival value for a prey animal such as the horse. Because horses are herd animals their behavior often shows social facilitation; that is, if one horse who is familiar with the environment lies down, the others will too. The dominant animal is usually the first to lie down.[3]

The anatomical and biochemical basis of sleep has been studied mostly in rodents and cats, although goats were used to demonstrate the humoral basis of sleep. The cerebrospinal fluid of sleep-deprived ani-

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mals induced sleep when infused into other animals.[2] Several neurotransmitters have been implicated in sleep. Both norepinephrine and acetylcholine appear to be involved in PS sleep as well as in wakefulness. Anatomically, the reticular activating system is necessary for wakefulness. Transection of the brain stem just behind the origin of the oculomotor nerves abolishes wakefulness in cats. Apparently neuronal impulses travel to the reticular activating system as well as to the sensory cortex. If the external stimuli are strong enough, the reticular activating system will be stimulated to send impulses to higher CNS areas and the ECoG will shift from the pattern of sleep to that of wakefulness. Lesions of the brain stem can abolish PS sleep.

Purpose of Sleep

The final question to be answered is "Why do horses (or other animals) sleep?" Many behaviors have an obvious function. Sexual behavior functions in reproduction, ingestive behavior in nutrition of the organism, etc. Sleep is a behavior that occurs in all mammals, and it occupies a major portion of the 24 hours of such species as the pig and dog. It is easily recognized by the most casual observer, nevertheless the function of sleep remains obscure. There are several hypothetical functions of sleep:

- ☐ sleep serves the function of maintaining immobility at times when immobility is an optimum survival strategy.
- ☐ sleep is a restorative process.

The first hypothesis is supported by the finding that exposed prey animals sleep less than predators, but that burrowing prey animals sleep more. PS is correlated with overall danger to the species so that PS is disadvantageous to those animals subjected to heavy predation because the animals are minimally responsive at that time. SWS is negatively correlated with body size. The smaller the animal and the higher its metabolic rate, the more it sleeps. SWS is a mechanism for enforcing rest and conserving energy. Large herbivorous animals like the

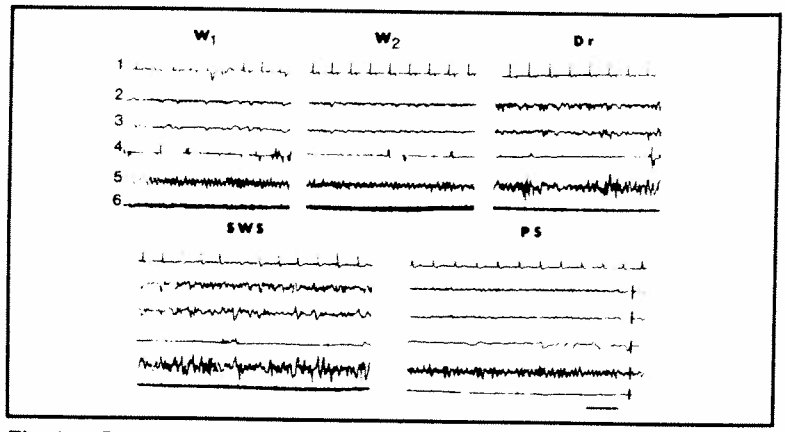

Fig. 1 — Polygraphic characteristics of alert wakefulness (W_1), quiet wakefulness (food intake: W_2), drowsiness (Dr), slow wave sleep (SWS) and paradoxical sleep (PS). 1: EKG; 2: Occipital EEG; 3: Frontal EEG; 4: EOG; 5: Hippocampus; 6: EMG. Calibration 1 sec, 100 μV. (Reprinted with permission from Dallaire and Ruckebush 1974.)

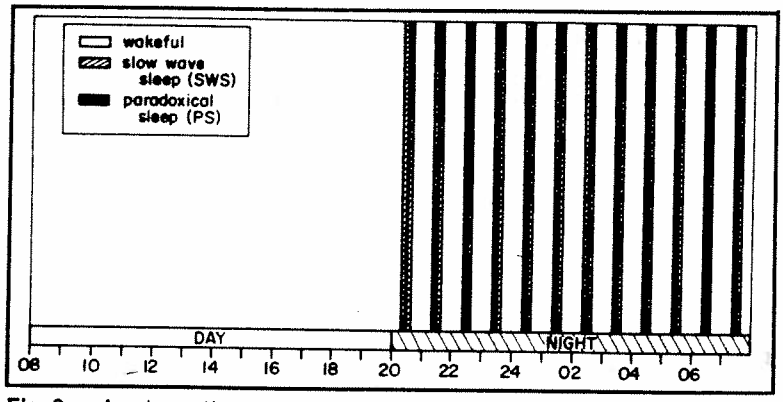

Fig. 2 — A schematic representation of sleep and wakefulness patterns in the horse. Horses are awake almost all of the time during the day. At night they sleep, but only for a few minutes at a time. PS or REM sleep is preceded and followed by SWS sleep. The horse is awake and on its feet for part of each hour, even at night. The cycles would not be as regular in real life as those depicted here.

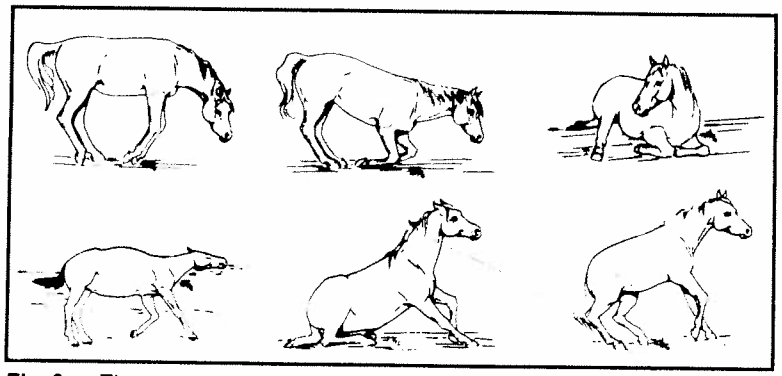

Fig. 3 — The postures of the horse when lying down, sleeping and arising. Top: The horse lies down by flexing its forelegs first. When lying in sternal recumbency the lateral aspect of the leg on one side (in this case the left side) is flat on the ground. The horse does not lie symmetrically on its sternum as a cat does. The horse is usually in sternal recumbency during SWS. Bottom: The horse lies in lateral recumbency during PS. The upper foreleg lies anterior to the lower one. When getting up the forequarters are raised before the hindquarters.

horse need not conserve energy, but rather must devote time to consuming a large quantity of calorically dilute food; therefore they do not sleep many hours. More time is available for sleep when horses are consuming concentrates.

The evidence that sleep is restorative is based on the fact that there is increased cell division and increased output of growth hormone during sleep. Young animals sleep more, perhaps for this reason. The sleep time of the foal decreases from nearly half the daylight hours at birth to the adult level by 7 months.

Conclusion

In summary, horses sleep 3 hours of each 24 hours, mostly at night, but they sleep for only brief periods. They sleep when recumbent, maintaining sternal recumbency during SWS and lateral recumbency during PS. Two hours a day are spent drowsing and this increases in warm weather. Sleep in horses is affected by changes of diet and by environmental disturbances. Whether or not horses dream, their sleep is important for normal growth and behavior. ■

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