

How to perform neurological examination in a neonatal foal



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Abstract

Neurological examination on a neonatal foal is performed concurrently with the physical examination. First step in examination is observation. Neurological examination consists of evaluation of behavior, state of consciousness, cranial nerve function, posture (head, neck, trunk, limbs, and tail) and postural reactions (limbs), segmental (spinal) reflexes, palpation, and gait evaluation. To assess most segmental reflexes, the foal must be in lateral recumbency and relaxed. Key points include safety, observation and palpation, knowing normal, including development of important milestones, and (if possible) conducting serial examinations over time.

Keywords: Foal, neonate, neurology, neurodevelopment, reflexes

Introduction

Neonatal foals, as prey animals, in order to survive, must develop major milestones relatively quickly after birth.¹ This evolutionary adaptation provides specific neurologic development, maturation, and function. For an equine clinician, it is essential to become familiar with normal neurologic status during neonatal period.¹ A complete clinical history of mare and foal should be obtained, including pregnancy and periparturient events. A thorough physical examination of the foal is important to determine the overall health status.¹ Common neonatal disorders manifest with similar clinical signs to foals with neurologic disease and might include weakness, reduced muscle tone, recumbency, reduced or absent suckle reflex, and dysphagia.¹ Therefore, ruling out common neonatal disorders is paramount to direct proper therapy and supportive care.

Alertness, response to environment, and movement are different in utero, during birth, and in extrauterine life. In the birth canal, foals appear in a drowsy/sleepy state, become minimally responsive, and movement is depressed. However, as precocious species, neonatal foals must rapidly transition to extrauterine life.¹ Neonatal foals are able to stand and nurse in a relatively short interval after birth compared to predator species. Foals are fully visual and have auditory function comparable to adult horse.¹ Nervous system continues to mature after birth. For example, although cerebellar layers in neonatal foals are already distinct histologically at birth, cell differentiation and migration into various layers continue after birth.¹ Cerebellar development and myelination in various parts of nervous system might explain the 'bouncy' gait in neonatal foals.¹

Neurologic examination in a neonatal foal is performed concurrently with general physical examination. Neurological ex-

amination consists of assessing behavior, state of consciousness, cranial nerves, posture and postural reactions, segmental (spinal) reflexes, palpation, and gait evaluation.¹⁻³ Key points include observation and palpation, knowing normal, tailoring the examination to the individual (safety, domestication, and cooperation), and, if possible, the importance of conducting serial examinations over time.¹ Furthermore, it is critical to recognize autonomic nervous system (parasympathetic, sympathetic, and intrinsic enteric) as integral part of the nervous system.¹

Neurologic examination in neonatal foals

Neurologic status of the normal neonatal foal goes through a transition from in utero to extrauterine life. The APGAR score was adopted from human medicine to assess neonates in the postfoaling period and consists of evaluating the following variables:

1. Heart rate (normal: regular, 60 beats per minute [abnormal if undetectable, irregular or < 60 bpm])
2. Respiratory rate (normal: regular, 60 breaths per minute [abnormal if undetectable, irregular or < 60 bpm])
3. Mucous membranes (normal: pink)
4. Muscle tone (normal: strong enough to remain in sternal recumbency)
5. Responsiveness
 - a. Nasal stimulation (expected response: strong grimace, sneeze)
 - b. Ear tickle (expected response: head shake)
 - c. Back scratch (expected response: attempts to stand)

This evaluation is performed shortly after birth and repeated within 15 minutes postfoaling to determine if veterinary intervention is needed. Important postbirth milestones include, time to sternal recumbency 1 - 2 minutes, alert and responsive to external (tactile, visual, and auditory) stimuli within 5 minutes, suckle reflex within first 20 minutes, vocalizing in response to dam's nickering within 30 minutes, time to stand within 60 minutes (> 2 hours is considered abnormal), and time to nurse 2 hours (> 3 hours is abnormal). Neurologic examination must cover all areas cited for adult horses.

Determine mentation, observe behavior and posture as history is recorded and foal is examined. States of consciousness include bright alert and responsive, obtunded, stuporous, and comatose (Figure 1).¹⁻³

1. Obtunded: Quiet, a neurologic status and NOT due to systemic disease (response is lethargy). In this state, the foal remains responsive to stimuli (visual, tactile, and sound) and reacts to environment. There could be de-

grees of obtundation (e.g., mild, moderate, and severe) on which the stimuli might have to be stronger for a response; however, the key to recognize this state is the ability to ALWAYS respond to nonpainful stimuli. In this state, foals could be standing or recumbent. Foals with moderate and certainly with severe obtundation are recumbent.

2. Stuporous: Severely altered mental status, unresponsive to minimal to moderate stimuli. Profound painful stimulus (pinching skin or foot with hemostats) generates a response from the foal ('waking up'); however, the response dissipates (goes back to stuporous) as soon as stimulus stops. In this state, foals are always recumbent.
3. Comatose: The foal is unresponsive to any kind of stimuli including profound painful stimuli. Profound stimuli might result in reflexive movement but NOT voluntary movement and the foal will be unresponsive. Needless to say, foals in this state are ALWAYS recumbent.

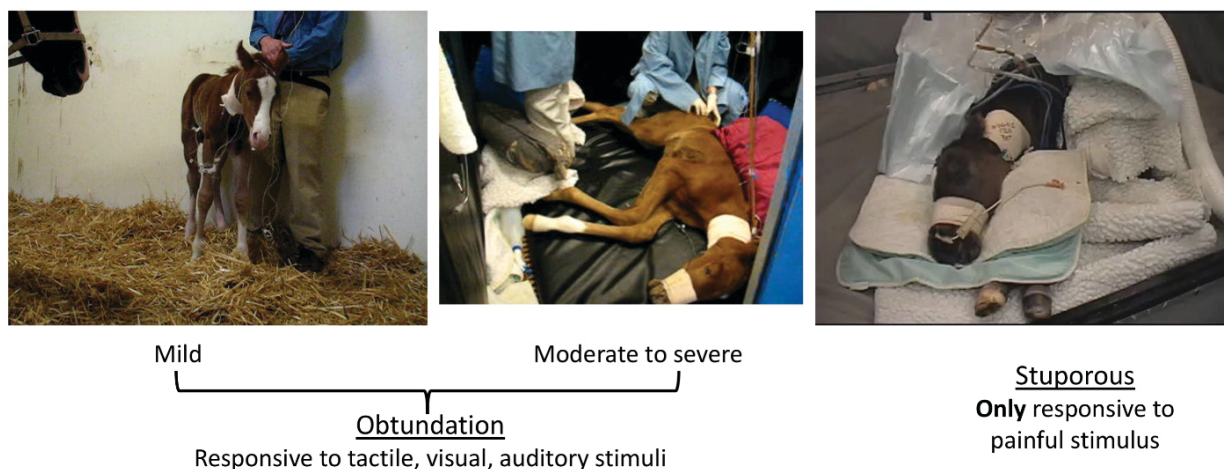


Figure 1. States of consciousness in neonatal foals, mild (left) and moderate to severe (middle) obtundation; note foal with mild obtundation is standing and appearing 'sleepy'. Foal with a more severe degree of obtundation is recumbent and responsive to non-painful stimuli. Stuporous foal (right) is recumbent and requires painful stimuli to respond transiently.

Normal neonatal foal is bright alert, curious and responds to environment, bonds with mare, draws closer to mare, seeks udder, nurses, and sleeps. It is important to note that neonatal

foals have their entire sleeping in recumbency, different to older foals (> 2 months of age) and certainly adults. Sleeping while standing in neonatal foals is abnormal (Figure 2).



Figure 2. Sleep in neonatal foals. Left: normal sleep, right: abnormal sleep characterized by sleeping while standing.

Cranial nerve deficits might be apparent during the initial observation before approaching the patient. Cranial nerves are evaluated in order (from I to XII) or they can be evaluated by their functional regions.¹⁻³ Author prefers functional regions starting with sense of smell (subjective); all eye functions (menace, palpebral fissure size, palpebral reflex, corneal reflex, dazzle reflex, pupillary light reflex, adaptation to light and darkness, eye globe position and retraction, physiologic nystagmus, and tear production), jaw/facial motor, sensation, and symmetry, and nursing (suction, tongue tone and movement, and gag reflex).¹⁻³ Do not alter your method of evaluation and always be consistent to avoid overlooking abnormalities. Menace response is a learned response (i.e., not a reflex) that develops within 7 - 10 days in neonatal foals. Foals are completely visual and brainstem reflexes are present at birth (e.g., pupillary light reflex, corneal reflex, and palpebral reflex). Dazzle reflex is a subcortical reflex and is evaluated using a bright light close to the eye. Normal reflex consists of fast sharp blink that is present since birth. Also, auditory function is present at birth and comparable to adults based on brainstem auditory evoked response (brainstem auditory evoked responses or hearing test).¹ Neonatal foals have physiologic nystagmus at birth. This is the normal conjugate eye movement (both eyes moving in the same direction) when the head is moved from side to side. Absence of physiological nystagmus indicates bilateral vestibular disease.

Head posture in neonatal foals has a 'flexed' appearance at the atlanto-occipital joint compared to adults and their stance is wide-based that becomes narrower within days. Head posture also changes as foal matures. Observation of posture during urination and defecation is also important. Palpation is essential to detect areas of apparent pain, local temperature, muscle tone and symmetry, joint extension and flexion, and tail tone among others. Tactile stimuli result in brisk exaggerated responses and reactions in normal foals compared to older animals. Segmental (spinal) reflexes that can be evaluated in foals include cervicofacial, cutaneous trunci, biceps, triceps, patellar, gastrocnemius, flexor (withdrawal), anal, and perianal. The cross-extensor reflex may or may not be present in the neonatal period. If present, it is not considered abnormal and will subside within a few days. Extensor thrust reflex can also be observed in normal neonatal foals.¹ As a reminder, in order to assess most segmental reflexes (e.g., biceps, triceps patellar, gastrocnemius, and flexor), the foal has to be in lateral recumbency and relaxed. Increased muscle tone will result in difficulty assessing and interpreting these segmental reflexes.¹

Neonatal foals have a hypermetric gait that becomes less 'bouncy' within a few days. Effects of systemic disease, orthopedic disease, congenital anomalies, motor deficits (from initiation of movement by the forebrain all the way to the nerves, neuromuscular junction, and muscle as the executors), and weakness can result in recumbency.¹ Cutaneous sensation is evaluated to investigate presence or absence of sensory function. Nociception (conscious perception of pain) is only evaluated, if voluntary motor function is absent or difficult to interpret.

Neuroanatomical localization

Main divisions of the nervous system are brain, spinal cord, and peripheral.¹⁻³ Brain has 3 functional anatomical areas:

cerebrothalamus, brainstem, and cerebellum. Note that although thalamus is anatomically part of brainstem, functionally it forms part of forebrain (cerebrothalamus). Spinal cord consists of spinal cord segments: C1 - C5/6, C6 - T2, T3 - L3, L4 - S2, S-caudal.¹⁻³ Peripheral system consists of nerve rootlets, roots, ganglia, nerve, and neuromuscular junction.

Neuromuscular system

Neuromuscular system has central (lower motor neurons [LMN]) and peripheral (nerve rootlets, roots, ganglia [sensory], nerves, and neuromuscular junction) components.¹ Neuromuscular disorders can be diffuse or can involve only a single nerve. Diffuse neuromuscular disease induces generalized weakness, difficulty supporting weight, base-narrow stance, paresis or paralysis, muscle fasciculations, and tendency to become recumbent. Segmental reflexes can be decreased or absent in neuromuscular disease. The most common diffuse neuromuscular disease of foals is botulism. Focal LMN disease or neuropathy leads to specific signs pertaining to the region affected (e.g., specific gait deficits and focal muscle atrophy).

Conflict of interest

None to declare.

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