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FOCAL POINT

★Examination of the musculoskeletal system is critical in evaluating recumbent cattle.

KEY FACTS

- Careful consideration of the signalment, history, and environment of recumbent animals may aid in establishing diagnostic differentials, p. *S*6.
- Muscles that are firm, swollen, and painful on palpation are suggestive of pressure myopathy resulting from prolonged recumbency, p. *S*7.
- Animals with a ruptured cranial cruciate ligament often have effusion of the femoropatellar joint and may display a positive cranial drawer sign or increased internal rotation of the tibia, p. *S*7.
- Abnormal position of the greater trochanter of the femur relative to the tuber coxae and tuber ischiadicum and crepitus on manipulation of the coxofemoral joint are suggestive of pelvic fracture, coxofemoral luxation, or proximal femoral fracture, p. *S*8.

Examination of the Musculoskeletal System in Recumbent Cattle

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ABSTRACT: The musculoskeletal system of recumbent cattle must be thoroughly evaluated before a final diagnosis or prognosis can be established. Collecting a detailed history can provide key information. The limbs must be palpated, inspected, and manipulated and the central and peripheral nervous systems assessed. Evaluation of the position of the greater trochanter of the femur relative to the tuber coxae and tuber ischiadicum is useful to assess traumatic injuries to the pelvis, coxofemoral joint, and proximal femur. Rectal examination is essential for complete evaluation of the pelvic bones. Palpation of the vertebrae in conjunction with assessment of spinal reflexes aids in detecting possible concurrent central or peripheral nervous system abnormalities.

Recumbent cattle can present a diagnostic challenge to veterinarians. A multitude of metabolic, infectious, toxic, degenerative, and traumatic disorders can result in recumbency. Cattle may be unable or unwilling to stand because of primary musculoskeletal disease or injury. In addition, primary diseases of other body systems (e.g., acute coliform mastitis) may debilitate an animal to the point of recumbency. In such cases, secondary musculoskeletal injury may result from prolonged recumbency or unsuccessful attempts to stand, and the clinical signs of the primary disease may be more apparent than are those of the secondary injury. A meticulous physical examination is often necessary to detect these secondary injuries.

Thoroughly evaluating the musculoskeletal system in recumbent cattle can be difficult, particularly if an affected animal is large or intractable or if the veterinarian is unassisted. However, detection of musculoskeletal disorders in recumbent cattle is critical for accuracy in diagnosis and prognosis. This article reviews the physical examination of the musculoskeletal system of recumbent cattle. Because normal musculoskeletal function requires a functional neurologic system, certain components of a neurologic examination are critical in evaluating recumbent cattle. Therefore, relevant aspects of a neurologic examination are also discussed.

SIGNALMENT AND HISTORY

The examination should begin with a determination of the affected animal's signalment (i.e., age, breed, gender, weight, production status, and intended use). Age, gender, and production status must be carefully considered when developing the differential diagnosis. A recumbent animal's age and size often influence the prognosis for musculoskeletal disorders. A clear understanding of the animal's intended use is necessary for cost-effective decision making and selection of appropriate medications.

A description of the nature of parturition and calf size should be obtained for recumbent puerperal heifers and cows. Dystocia or fetopelvic disproportion can traumatize the lumbar root of the sciatic and obturator nerves, resulting in calving paralysis (maternal obstetric paralysis).[1] The dietary and environmental history of a recumbent animal and its herdmates may reveal important diagnostic clues. Emaciation from severe protein and/or energy malnutrition may lead to intractable recumbency.[2] Pathologic fractures of the pelvis or vertebral column may result from primary or secondary dietary deficiencies of calcium, phosphorus, vitamin D, or copper.[3] Sudden increases in activity, such as turnout of animals onto pasture after a period of confinement, may precipitate clinical signs of myodegeneration caused by vitamin E and/or selenium deficiency.[4] Injuries related to fighting or mounting behavior may be seen when recent social interactions have occurred within the herd (e.g., mixing of groups of animals, introduction of new animals).

Veterinarians should carefully consider the recent medical and treatment history of recumbent animals to determine whether the recumbency is a progression or complication of a preexisting disease. Assessment of the treatment history and a complete physical examination are necessary to determine whether recumbency likely reflects inadequate treatment, misdiagnosis, relapse, or concurrent disease or injury. For example, inability to stand after treatment with calcium salts is a common complication of refractory periparturient hypocalcemia in dairy cows.[5] Administration of isoflupredone acetate to treat ketosis in dairy cattle has been associated with flaccid muscular weakness and recumbency caused by severe hypokalemia.[6] Cows and heifers in estrus, with cystic ovarian disease, or that have recently been given prostaglandin $F_{2\alpha}$ or hormones for superovulation may be injured when mounted. The location and technique used to administer any recent injections should be determined. The sciatic nerve may be damaged if irritating drugs are deposited between the greater trochanter and the tuber ischiadicum.[7]

Additional historical data to consider include the duration of recumbency, position of a recumbent animal (left versus right, sternal versus lateral), and any observed changes in an affected animal's position over time. Cattle that are recumbent for longer periods, particularly if they are on a hard surface and unable to change position, are prone to develop pressure damage on the down-side hindlimb muscles and nerves.[8] Cattle with a history of falling into or being found in sternal recumbency with both hindlimbs in abduction should be carefully evaluated for pelvic fracture, coxofemoral luxation, fracture of the greater trochanter of the femur, and pressure myopathy or rupture of the adductor muscles of the medial thigh.[8–10]

The site where a recumbent animal was initially located and the nature of the surface on which it was found should be considered. Ice, mud, smooth or wet concrete, and slopes that are steep or have loose soil may cause healthy cattle to slip and fall; ill or debilitated cattle that become recumbent on these surfaces are prone to injuries during attempts to rise.

PHYSICAL EXAMINATION

A thorough assessment of all organ systems should be performed according to one's own systematic approach to physical examination. It is prudent for veterinarians to consider the possibility of the paralytic form of rabies as a cause of recumbency and to take appropriate caution during handling. To begin, recumbent animals should be examined from a distance. The resting respiratory rate should be determined, and the animal and its immediate surroundings should be visually inspected. Animals injured while being mounted frequently have roughened, broken hairs over the rump and tailhead. Bullers (i.e., feedlot steers or bulls that are repeatedly mounted and ridden) may also have rub marks and mud over the flanks and ribs.[11]

A recumbent animal's attitude should also be assessed from a distance. Cattle that are recumbent because of primary musculoskeletal injuries are typically bright and alert. Profound depression in a recumbent animal is often indicative of severe systemic diseases of infectious, toxic, or metabolic origin; a thorough evaluation of the neurologic system is indicated in such cases. In addition, an animal's mental status, ability to eat and drink, and willingness to attempt to rise have significant influence on the outcome and are worthy of consideration when making a prognosis.

Hindlimbs and Pelvis

The examination of the musculoskeletal system of recumbent cattle begins at the distal aspect of the uppermost hindlimb with assessment of the digits. Severe, acute laminitis occasionally makes an affected animal unable or unwilling to rise.[12] Clinical signs suggestive of severe laminitis include elevated claw temperature, increased digital pulse strength, the presence of swelling or redness at the coronet, engorged superficial veins of the metatarsi, and an avoidance response to solar pressure applied with hoof testers.[13]

Because of a lack of thick overlying muscle, the bones distal to the stifle and proximal to the coronet can be readily assessed by inspection and palpation. Manipulation of the stifle, hock, fetlock, and digital joints into full flexion and extension should be performed. During manipulation, examiners should feel for crepitus in each joint and observe the animal's response to manipulation. The integrity of collateral ligamentous support can be assessed by palpating the medial and lateral aspects of these joints during abduction and adduction, respectively. Each joint should be palpated for effusion and heat. Arthrocentesis and radiography are ancillary tests that can help to better define joint disorders.

Rupture of the gastrocnemius muscle or tendon may occur when recumbent cattle struggle to rise. Rupture most commonly occurs at the junction of the muscle and tendon, approximately 8 to 12 cm proximal to the hock.[10] Hematoma formation around the muscle tear results in a warm, nonpainful swelling surrounding the gastrocnemius at the caudal aspect of the crus. The tendon of the gastrocnemius remains relaxed during hock flexion. If an animal attempts to bear weight on the affected limb, the hock remains flexed, the point of the hock drops, and the plantar aspect of the metatarsus may contact the ground.[10,14] Even if the condition is unilateral, affected animals, particularly if heavy, are often unable to rise more than a few inches off the ground.[14]

Stifle injuries may also occur in recumbent cattle that struggle unsuccessfully to rise.[14] Rupture of the cranial cruciate ligament results in marked effusion of the femoropatellar joint.[15] Increased craniocaudal movement of the tibia relative to the femur (a positive drawer sign) may be evident with cranial cruciate ligament injury[15] but may be difficult to elicit in recumbent cattle. Examiners can test the integrity of the cranial cruciate ligament by placing one hand on the tuber calcanei and the other on the tibial crest and rotating the tibia internally. If the cranial cruciate ligament is ruptured, increased laxity and crepitus may be evident when the tibia is rotated internally.[15] In heavily muscled bulls, an assistant may be needed to perform the manipulations while the examiner palpates the stifle.

Collateral ligament rupture of the stifle also results in significant effusion in the femoropatellar joint. In animals with medial collateral ligament rupture, increased medial laxity of the stifle (manifested as widening of the femorotibial joint) can be induced with the limb placed in abduction. Increased lateral laxity of the stifle during adduction of the limb is expected with rupture of the lateral collateral ligament.[15]

The hindlimb muscles should be palpated for swelling and pain. Firm swelling and pain in multiple muscle groups may be evident in recumbent animals affected with acute nutritional myodegeneration (white muscle disease).[4] Subcutaneous emphysema, which may accompany certain types of bacterial myositis, may produce crepitus during muscle palpation. To evaluate muscle tone, the limb musculature should be palpated and the hindlimb's resistance to flexion and extension assessed. Muscle tone in this limb should subsequently be compared to that of the opposite limb.

The muscles of the crus and caudal thigh are susceptible to pressure myopathy, which results from prolonged sternal recumbency with a hindlimb maintained beneath the animal.[8] In addition, the sciatic nerve may be damaged at the caudal aspect of the femoral neck by pressure to the down-side hindlimb.[8] Palpation and inspection of the cranial tibial, peroneus tertius, biceps femoris, semitendinosus, and semimembranosus muscles of the up-side hindlimb can give an examiner a basis of comparison for subsequent examination of these muscles in the down-side hindlimb. Muscles damaged by pressure may be visibly and/or palpably swollen, although the absence of swelling does not rule out pressure damage.[8] Swelling of the medial thigh muscles may be appreciated in animals with rupture of or pressure damage to the adductor muscles.[9,10] The quadriceps muscle group may be torn or ruptured in cattle that fall with the hindlimbs abducted or if the hindlimbs are forcefully extended.[1] Measurement of serum creatine phosphokinase and aspartate aminotransferase activity may aid in determining the severity of recent or ongoing muscle damage.

Recumbent cattle should be carefully evaluated for coxofemoral luxation and fractures of the pelvis and femur.[8,9,14] Examination of the femur and pelvic bones can be difficult because thick muscles cover all but a few points on these bones.[16] Examination of these structures can begin with evaluation of the spatial relationship of the tuber coxae and tuber ischiadicum of the pelvis and the greater trochanter of the femur. The spatial arrangement of these three points forms a triangle in normal animals,[16] with the greater trochanter located ventral to a line drawn from the tuber coxae to the tuber ischiadicum[17] (Figure 1). The spatial relationship of these three points should subsequently be evaluated for symmetry with the opposite side of the pelvis. This triangular spatial relationship may be disrupted in animals with fractures of the proximal femur or pelvis or coxofemoral luxation.

CORONET ■ GASTROCNEMIUS MUSCLE ■ CRANIAL CRUCIATE LIGAMENT ■ LIMB MUSCULATURE

Placing one hand on the greater trochanter, examiners should manipulate the hindlimb into full abduction and adduction and move the coxofemoral joint through its full range of flexion and extension (Figure 2). While moving the hindlimb, examiners may feel or hear coarse crepitus in animals with femoral or pelvic fractures or ligamentous stifle injury.[16] Crepitus may also be detected during hindlimb manipulation of cattle with coxofemoral luxation, but this finding may be inconsistent.[18] Crepitus originating in the stifle can be distinguished from that of the coxofemoral joint by attempting to isolate the movement of one joint while manipulating the other.[16] In addition, joint effusion and characteristic laxity on manipulation may be palpable with ligamentous stifle injuries. A stethoscope may be used for auscultation over various areas of the hindlimb; the audible strength of crepitus sounds may aid in localizing the source. Rectal examination is also necessary for accurate localization of skeletal injuries in the proximal hindlimb and pelvis.

Examiners should determine whether the greater trochanter undergoes normal motion during abduction and adduction of the limb and flexion and extension of the hip. If the greater trochanter rotates in congruity with the movements of the hindlimb, the femur is likely to be intact to the level of the greater trochanter (provided the limb is normal from the stifle distally). In contrast, if the greater trochanter does not move when the remainder of the hindlimb is manipulated, the femur may be fractured at or distal to the level of the greater trochanter.

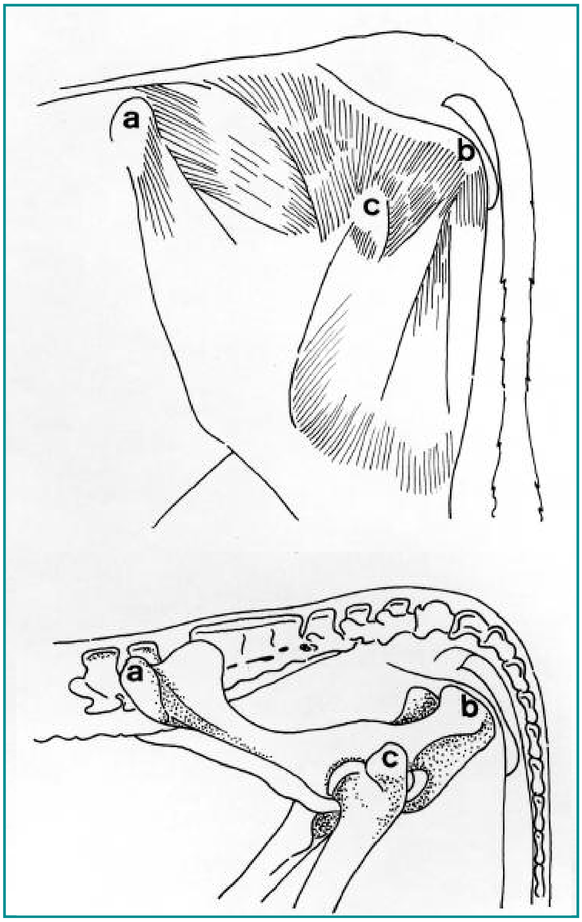

Figure 1—The spatial relationships between the tuber coxae *(a)*, the tuber ischiadicum *(b)*, and the greater trochanter *(c)* of cattle.

Figure 2—Manipulation of the hindlimb with one hand placed on the greater trochanter.

Excessive mobility of the greater trochanter during movement of the coxofemoral joint may be present in animals with coxofemoral luxation,[14,18] which is difficult to distinguish from a fracture of the proximal femur during physical examination.[18] Radiographs are often necessary to distinguish between these conditions, particularly if surgical repair is being considered.

The greater trochanter is displaced dorsally from its normal position in animals with craniodorsal or caudodorsal luxation of the coxofemoral joint,[6,18] resulting in disruption of the normal triangular relationship between the tuber coxae, tuber ischiadicum, and greater trochanter on the affected side (Figure 3). If such an animal is placed in lateral recumbency, the hindlimbs can be extended and their lengths compared; the affected limb may appear to be shorter than the normal side.[14] In most cases, cattle with unilateral craniodorsal luxations are able to stand,[18] although the demeanor of an affected animal and the presence of other injuries may influence this. If an affected animal is made to stand or is supported with hip lifters in the standing position, lateral rotation of the hindlimb may be evident.[16]

Cattle with caudoventral or cranioventral luxations of the coxofemoral joint are unlikely to be able to stand.[17] The greater trochanter is displaced ventrally; depending on the degree of medial displacement of the femur and the muscle cover present, palpation of the greater trochanter may be difficult.[14] The affected hindlimb can be placed into excessive abduction.[18]

After this examination has been completed, a recumbent animal is rolled into the opposite recumbency and the procedures are repeated for the opposite hindlimb. Rectal examination should be performed after external examination of the hindlimbs is completed. The symmetry of the internal surfaces of the pubis, ilium, sacrum, and ischium should be evaluated on each side. An assistant may perform hindlimb manipulation or may rock the animal's pelvis back and forth as the examiner feels for crepitus suggestive of pelvic fractures. A hematoma may be palpable in the soft tissue surrounding fractures of the sacrum, iliac shaft, or pubis. The femoral head may be palpable within the obturator foramen in animals with caudoventral luxation of the coxofemoral joint.[14] Cranioventral coxofemoral luxation may result in the femoral head being palpable cranial to the brim of the pelvis.[18] The rectal examination of recumbent cattle is completed by palpation of the reproductive tract, internal lymph nodes, and abdominal viscera.

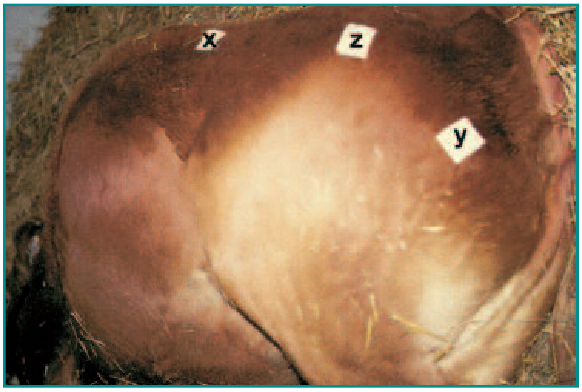

Figure 3—Disruption of the normal relationship between the tuber coxae *(x)*, tuber ischiadicum *(y)*, and greater trochanter *(z)* in a Limousin cow with dorsocranial luxation of the coxofemoral joint. The greater trochanter is located in an abnormal position (i.e., dorsal to a line drawn from the tuber coxae to the tuber ischiadicum).

Figure 4—To test the patellar response, the hindlimb should be supported in a partially flexed position. The examiner should strike the middle patellar tendon with a mallet, hoof testers, or a similar heavy instrument.

Vertebral Column

Vertebral fractures and subluxations in cattle occasionally result from trauma sustained during breeding activity, entrapment in a fence or head catch, or improper handling in squeeze chutes.[9] Palpation of the vertebral column can be difficult in well-muscled or overconditioned cattle. Beginning at the tailhead, examiners should palpate the spinous processes of the thoracolumbar vertebral column. Focal depression, elevation, or lateral deviation of the spinous processes may indicate fracture or subluxation.

The degree of impingement of the fractured or displaced bone on the spinal cord or spinal nerves influences the severity of associated neurologic deficits. Displaced fractures of the vertebral column located between the second thoracic and sacral vertebrae may result in hindlimb paresis or paralysis; affected cattle may acquire a "dog-sitting" posture during attempts to rise.[19] Displaced fractures in the cervical spine usually result in tetraparesis and/or tetraplegia; affected animals typically lie in lateral recumbency and are unable to right themselves into sternal recumbency.[9]

Because vertebral injuries commonly damage the spinal cord, spinal nerve roots, and/or peripheral nerves, examination of spinal reflexes is required for complete physical examination of the vertebral column. Evaluation of spinal reflexes assesses both spinal cord function and the integrity of the sensory and motor components of peripheral nerves, neuromuscular junctions, and muscles. Because the spinal reflexes of a down-side limb are difficult to accurately assess in recumbent cattle, animals should be moved into the opposite recumbency before reflexes are evaluated in that limb. Spinal reflexes, sensation, and muscle tone may be diminished in a limb that has been lain on for long periods.[19]

The hindlimb withdrawal (flexor) response should be evaluated by pinching the skin over the coronet with forceps, pliers, or hoof testers. The withdrawal response tests the integrity of the sensory and motor components of the sciatic nerve and the sixth lumbar and first and second sacral segments of the spinal cord. In adult cattle, these spinal cord segments are located within the vertebral canal of the fifth and sixth lumbar vertebrae.[20] Recognition of the stimulus by animals requires intact ascending sensory pathways to the cerebral cortex.

The patellar response tests the integrity of the femoral nerve, the response arc involving the fourth and fifth lumbar spinal cord segments, and the quadriceps muscle group (Figure 4). Injury to the femur, quadriceps muscles, and/or the femoral nerve can occur in calves that are "hip-locked" during dystocia and delivered with excessive traction.[1] Exaggerated patellar responses may be present in cattle with diffuse disease of the spinal cord white matter or with focal cord lesions cranial to the midlumbar region. In such animals, disruption of upper motor neuron control results in disinhibition of the patellar response. Exaggerated patellar responses are often difficult to appreciate in cattle.

Tail tone and sensation are controlled, respectively, by lower motor neurons and dorsal horn nerve cell bodies located in the caudal segments of the spinal cord.[21] In adult cattle, the caudal segments of the spinal cord are located within the vertebral canal of the first sacral vertebra.[20] Anal tone and sensation are controlled by the sacral segments of the spinal cord[21] located within the vertebral canal of the sixth lumbar vertebra.[20] In the perineal response, pinching of the perianal skin normally results in closure of the anus and flexion of the tail, which requires intact function of both the sacral and caudal components of the spinal cord.[21]

Skin sensation over the rump, lumbar region, and thorax can be tested by pinching the skin with forceps or poking the skin with the tip of a needle and observing for a behavioral response indicative of perception of the stimulus.[21] An intact skin sensation response begins with sensory nerves in the dermatome being stimulated; the impulses are then transmitted via the corresponding spinal nerve to the dorsal horn of the spinal gray matter, which relays the impulses via ascending spinal pathways to the cerebral cortex. Because the response of a stoic animal can be inconsistent, stimulation should be repeated several times before an area of reduced or absent response is deemed hypalgesic or analgesic, respectively.[21]

Stimulation of the skin over the thorax and cranial lumbar region elicits contraction of the cutaneous trunci muscle, which results in twitching of the skin of the trunk. The cutaneous trunci response requires transmission of the noxious stimulus to the corresponding spinal nerve and dorsal horn of the spinal cord via sensory nerves of the stimulated skin. The impulses are then transmitted via ascending pathways to motor nerves in the eighth cervical and first thoracic spinal cord segments. Relay of impulses via the lateral thoracic nerve results in contraction of the cutaneous trunci muscle.

Severe lesions of the thoracolumbar spinal cord can interrupt the ascending pathways involved in nociception and the cutaneous trunci response. In such cases, a transverse line can be detected over the trunk or lumbar region caudal to which the response to skin stimulation is reduced or absent; the spinal cord lesion is located one to two spinal cord segments cranial to that line.[19,21] It is important to note that the cutaneous trunci response may not be triggered in normal animals when the noxious skin stimulus is applied caudal to the midlumbar region.[21]

The flexor, or withdrawal, response of the forelimbs is performed in a manner similar to that described for the hindlimbs. Flexion of the fetlock, carpus, elbow, and shoulder normally occurs when the skin is pinched near the coronet. This response arc tests the integrity of sensory fibers in the radial, median, and ulnar nerves; motor fibers in the axillary, musculocutaneous, median, and ulnar nerves; and the neuromuscular junctions and muscles of the forelimb.[19] These sensory and lower motor nerves originate in the sixth cervical to second thoracic spinal cord segments. Perception of the stimulus by animals requires intact ascending pathways to the cerebral cortex.

To test the triceps response, examiners should strike the triceps tendon with a heavy plexor and observe for elbow extension. The sensory and motor components of the radial nerve and the seventh cervical and first and second thoracic spinal cord segments are involved in this response arc. The triceps response may be difficult to demonstrate in heavy cattle.[19]

Forelimbs

Intractable recumbency rarely results from primary musculoskeletal lesions of the forelimbs,[8] but examination of the forelimbs may reveal significant injuries that occurred because of recumbency. Cattle that remain in lateral recumbency for long periods may develop secondary compression damage to the brachial plexus and/or radial nerve of the down-side forelimb, particularly if the limb is trapped beneath an animal's thorax.[8] Abrasions or lacerations on the dorsum of the carpi are a common complication in cattle that struggle to rise on rough cement, and these injuries occasionally result in open wounds of the carpal joints.

SUMMARY

Disorders of the musculoskeletal system are both a cause and a potential complication of prolonged recumbency in cattle. Thorough examination of this system, along with testing of salient aspects of the neurologic system, allows veterinarians to make an accurate diagnosis or generate a list of reasonable diagnostic differentials. In addition, rational selection of ancillary tests, provision of effective treatment, and arrival at a realistic prognosis all depend on information obtained from the physical examination.

Regardless of the inciting cause of recumbency, measures should be taken to prevent injury caused by prolonged recumbency or attempts to stand. A deep bed of sand can be placed beneath the down-side hindlimb and around a recumbent animal to provide padding and a nonslip surface. Frequent turning of recumbent animals may also aid in preventing pressure damage to the muscles and nerves of down-side hindlimbs. Hobbles can be placed to limit excessive hindlimb abduction in weak or ataxic cattle. Hip lifters and flotation tanks may aid in helping recumbent cattle to stand.[8] The livestock welfare considerations involving management and disposition of persistently recumbent cattle have recently been reviewed.[22]

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ARTICLE #7 CE TEST

The article you have read qualifies for 1.5 contact hours of Continuing Education Credit from the Auburn University College of Veterinary Medicine. *Choose only the one best answer* to each of the following questions; then mark your answers on the test form inserted in *Compendium.*

1. Which of the following electrolyte disturbances should be the top consideration in a postparturient recumbent cow that was previously treated with isoflupredone and remains down after initial treatment with calcium?
   a. hyperphosphatemia
   b. hypophosphatemia
   c. hyperkalemia
   d. hypokalemia
   e. hypomagnesemia

2. Swollen muscles accompanied by subcutaneous emphysema is most suggestive of
   a. bacterial myositis.
   b. nutritional myodegeneration (white muscle disease).
   c. pressure myopathy.
   d. a fractured limb.
   e. torn muscles.

3. A ruptured gastrocnemius muscle in cattle
   a. causes noticeable lameness but rarely recumbency.
   b. causes the affected hindlimb to rotate outward.

(continues on page S24)

Musculoskeletal System (continued from page S13)

c. is a common complication of forced delivery of "hip-locked" calves.
d. causes the affected limb to be longer than the opposite hindlimb.
e. most commonly occurs at the junction of the muscle and tendon.

4. Rupture of the cranial cruciate ligament in cattle
   a. rarely results in effusion of the femoropatellar joint.
   b. results in increased lateral laxity of the femorotibial joint.
   c. results in increased laxity and possible crepitus when the tibia is rotated internally.
   d. results in increased medial laxity of the stifle.
   e. is often accompanied by osteochondrosis.

5. Fractures of the femoral neck in adult cattle
   a. are easily palpable despite the thick musculature covering the femur.
   b. are identified by the hock on the affected limb dropping toward the ground during weight bearing.
   c. rarely result in crepitus because of the thick musculature covering the femur.
   d. may not be easily distinguished from coxofemoral luxation during physical examination.
   e. are rarely unstable and result in minimal soft tissue swelling.

6. The greater trochanter of the femur
   a. is not a useful landmark in diagnosing coxofemoral luxation.
   b. normally lies on a straight line between the tuber coxae and tuber ischiadicum.
   c. normally lies dorsal to a line between the tuber coxae and tuber ischiadicum.
   d. normally lies ventral to a line between the tuber coxae and tuber ischiadicum.
   e. is an important pressure point that can damage the femoral nerve.

7. Which of the following statements regarding unilateral craniodorsal coxofemoral luxations is true?
   a. Affected animals are invariably unable to stand and remain recumbent.
   b. The greater trochanter of the femur is displaced below a line from the tuber coxae to the tuber ischiadicum.
   c. The affected limb appears shorter than the normal limb.
   d. The affected limb has increased medial rotation.
   e. The femoral head may be palpated rectally cranial to the pelvis.
8. The withdrawal (flexor) response in the pelvic limb tests the
   a. femoral nerve.
   b. sciatic nerve.
   c. tibial branch of the sciatic nerve only.
   d. peroneal branch of the sciatic nerve only.
   e. femoral and sciatic nerves.

9. A spinal injury in a cow that has assumed a dog-sitting posture while attempting to rise is most likely localized to the __________ region.
   a. cervical
   b. thoracic
   c. cervicothoracic
   d. lumbosacral
   e. thoracolumbar or lumbosacral

10. Radial nerve paralysis in recumbent cattle
    a. results in an exaggerated cutaneous trunci response.
    b. can be consistently tested in heavy animals by assessment of the triceps response.
    c. may occur in the down-side forelimb of cattle in lateral recumbency.
    d. is rare because the nerve is protected by the thick muscle of the proximal forelimb.
    e. results in an intact triceps response but absent cutaneous trunci response.