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Ultrasonographic Evaluation of the Equine Pelvis

Mary Beth Whitcomb, DVM

Author's address: Department of Surgical and Radiological Sciences, University of California, Davis, One Shields Avenue, Davis, CA; e-mail: mbwhitcomb@ucdavis.edu.

Introduction

The primary indication for pelvic ultrasound is to aid in the diagnosis of pelvic and proximal femoral fractures.[1-5] Ultrasound can provide a rapid diagnosis in the ambulatory and hospital setting and is less expensive than nuclear scintigraphy or radiography. At our hospital, pelvic radiography is infrequently performed as clinicians are reluctant to anesthetize horses to obtain ventrodorsal projections and risk further fracture displacement during anesthetic recovery. Standing lateral radiographic projections have been described,[6] but provide limited information in adult horses. Additionally, standing ventrodorsal views may not be possible with all radiography equipment.[7] Over the past 10 years, ultrasound has become the primary imaging modality in most horses suspicious for pelvic fracture at UC Davis. If ultrasound is negative in highly suspect cases, nuclear scintigraphy is then utilized to rule out nondisplaced or stress fractures.[8]

It is important to differentiate between horses with suspect pelvic fracture and horses with sacroiliac disease, as they rarely present similarly in the clinical setting. Horses with sacroiliac disease seldom show severe or acute onset lameness, whereas horses with pelvic fractures typically present with acute onset Grade 4-5/5 lameness (AAEP Lameness Scale). Evaluation of the sacroiliac region has received much attention in recent years as a cause of upper limb lameness and has often overshadowed pelvic disorders. The end result is that the pelvis is often the forgotten "middle child" of the upper hind limb, caught between a focus on the stifle, with which most veterinarians are comfortable, and a focus on the sacroiliac region. It is not uncommon for a horse with pelvic pathology to present with a previous diagnosis of a stifle or sacroiliac problem. It is the goal of this presentation to highlight the value of pelvic ultrasound in horses with upper limb lameness.

Pelvic fractures can occur in a wide range of ages, breeds and uses.[4,9,10] Fractures are often the result of trauma, such as a fall or becoming cast in a stall. In the initial injury phase, affected horses are often severely lame regardless of the fracture site. It is therefore difficult to predict fracture location based on the degree of lameness. Pelvic asymmetry and/or crepitus may be absent, and many horses are negative on rectal palpation. In horses with positive findings on rectal palpation, changes may be subtle and potentially overlooked. Gluteal atrophy, when present, is associated with chronic cases. The absence of these clinical signs should not decrease the suspicion for fracture.

The distribution of fracture sites can be affected by the type and use of horses in the practice area. In practices with a large Thoroughbred racehorse population, ilial wing fractures are most frequently identified.[2,9] In contrast, the coxofemoral joint, specifically acetabular rim fractures,

is the most common site of fracture at our hospital, followed closely by fractures of the tuber coxae, tuber ischii and ilial wing. Fractures of the ilial body, pubis and ischium are seen in progressively decreasing numbers. Sacral and femoral fractures, including 3rd trochanter fractures, have also been seen during pelvic ultrasonography.

Ultrasonographic Technique and Findings

Ultrasound of the pelvis can be performed with alcohol saturation; however, clipping is often necessary in large or overweight horses or in horses with a thick hair coat. A complete exam should be performed in all cases suspicious for fracture, including the deep structures of the pelvis (ilial wing, ilial body and coxofemoral joint) and the superficial structures of the pelvis (tuber sacrale, tuber coxae, tuber ischii and third trochanter of the femur) (Fig. 1). A rectal exam should also be performed to evaluate the ischium and pubis, regardless of findings on rectal palpation.

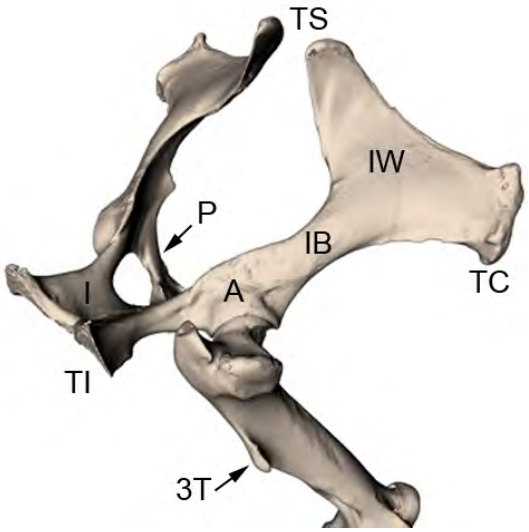

Fig. 1. Anatomic regions of the pelvis and femur to be evaluated with ultrasound. IW=ilial wing, IB=ilial body, A=acetabulum, TS=tuber sacrale, TC=tuber coxae, TI=tuber ischii, P=pubis, I=ischium, 3T=3rd trochanter.

Deep Structures of the Pelvis

Evaluation of the deep structures of the pelvis (ilial wing, ilial body, coxofemoral joint) requires a low frequency curvilinear transducer with a scanning depth of 10-25 cm. These structures are located beyond the imaging window of a tendon, rectal or microconvex transducer in adult horses, although imaging is possible with these transducers in neonates. The ilial wing is best evaluated longitudinally, beginning at the tuber sacrale and scanning in a direct line to the tuber coxae. The normal ilial wing demonstrates a smooth concave bony surface (Fig. 2). Care should be taken not to mistake edge artifacts from overlying fascial layers for fracture. These shadows often create a gap in the bony surface of the ilial wing. Ilial wing fractures are often easy to recognize as step defects in the normally smooth bony surface (Fig. 3), but may be overlooked or undetectable if nondisplaced or if a stress fracture is present. Ilial wing stress fractures in

Thoroughbred racehorses typically extend from the caudal border of the ilial wing and require careful evaluation using multiple sweeps across the ilial wing for their detection.

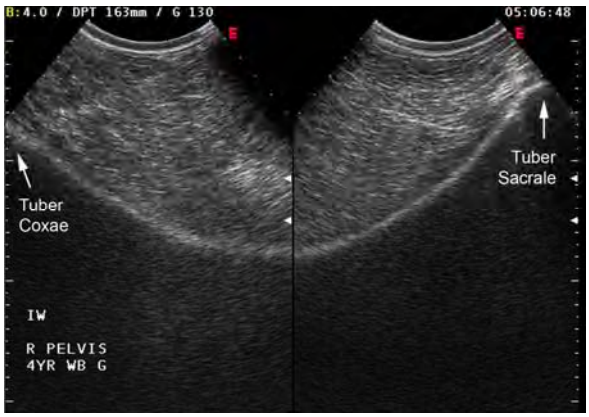

Fig. 2. Composite longitudinal image of the normal ilial wing showing a smooth concave bony surface from the tuber sacrale to the tuber coxae.

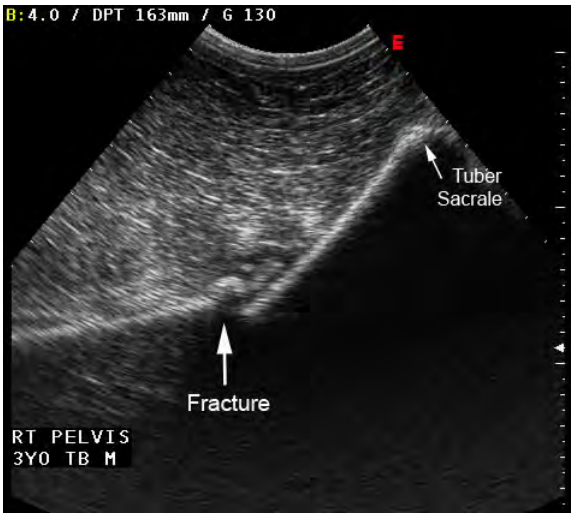

Fig. 3. Fracture of the ilial wing in a Thoroughbred racehorse.

The ilial body is next evaluated longitudinally from the tuber coxae to the coxofemoral joint region. The ilial body is located at an increased depth compared to the ilial wing and demonstrates a smooth surface that slopes towards the coxofemoral joint (Fig. 4). Ilial body fractures are relatively uncommon and create an appearance similar to that described for ilial wing fractures. Outcome is variable in affected horses, with some returning to athletic use and others requiring euthanasia.

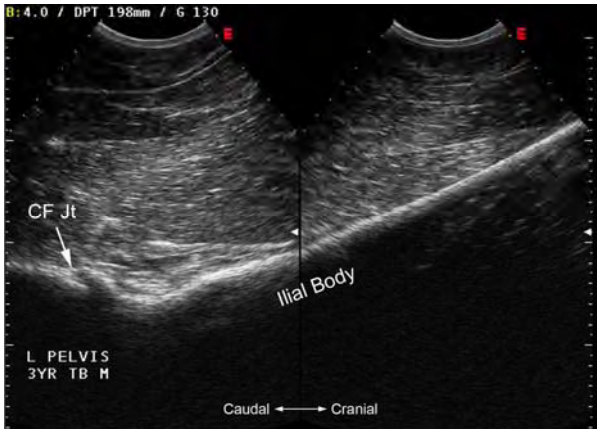

Fig. 4. Longitudinal image of the normal ilial body. CF=coxofemoral joint.

The coxofemoral joint is a simple ball and socket joint. However, it is the most difficult pelvic structure to evaluate, requiring the most skill for image acquisition and interpretation.[11] Transverse images of the joint are obtained by sliding the transducer caudally from a longitudinal image of the ilial body until the articulation of the acetabular rim and femoral head is visualized (Fig. 5). The acetabular rim and femoral head should be tightly articulated with only a slight

incongruity visible at the joint level (Fig. 6). Joint effusion is typically not visible in normal horses. From the cranial view of the joint, the craniodorsal and dorsal surfaces are evaluated by sliding the transducer slightly dorsally and caudally while simultaneously rotating the transducer in a clockwise direction when scanning the right CF joint (counter-clockwise when scanning the left). The transducer should be directed ventrally to visualize the dorsal joint surfaces and avoid interference by the greater trochanter of the femur. The most common abnormalities include fragmentation of the acetabular rim which appears as step defects at the level of the joint (Fig. 7). Complete fractures through the acetabulum are less common, but can be more challenging to recognize. Although evidence of fracture is usually apparent in these cases, accurate configuration of complete fractures may be difficult to assess sonographically.

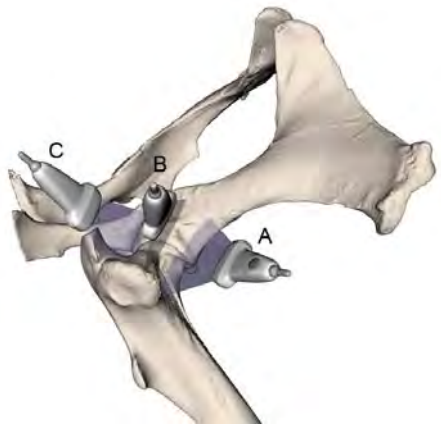

Fig. 5. Transducer positioning to obtain transverse views of the cranial (A), craniodorsal (B) and dorsal (C) surfaces of the coxofemoral joint.

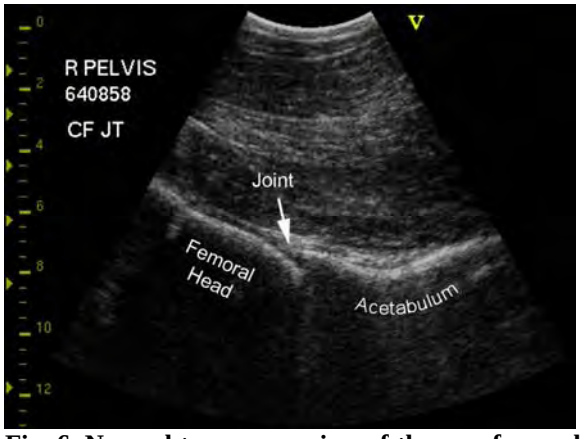

Fig. 6. Normal transverse view of the coxofemoral joint.

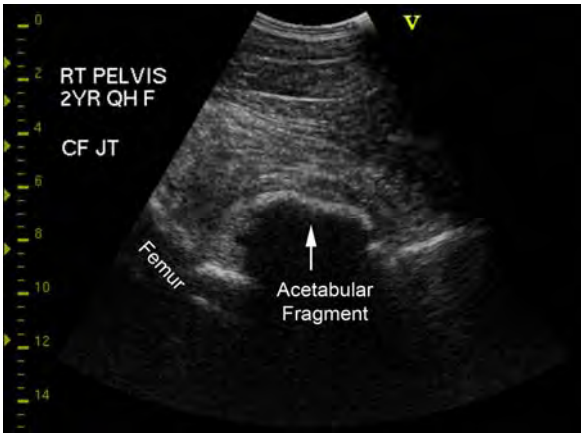

Fig. 7. Large acetabular rim fracture (arrow) in a 2-year-old Quarter Horse filly with acute onset lameness.

Coxofemoral subluxation and luxation due to complete or partial disruption of the round ligaments may also be diagnosed with ultrasound.[12] Horses with subluxation can show a relatively normal configuration of the joint (femoral head located within the acetabulum) when the affected limb is resting in partial weight bearing; however, upon weight bearing, the femoral

head will be seen to displace dorsally (Fig. 8). In cases of luxation, the femoral head remains displaced regardless of weight bearing status. Acetabular fractures and severe joint effusion typically accompany these injuries.

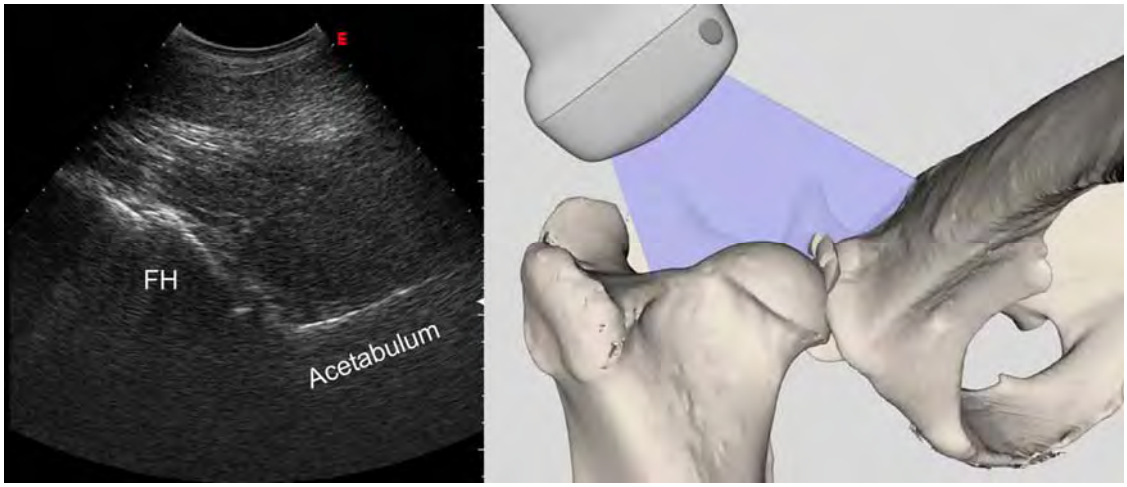

Fig. 8. Craniodorsal displacement of the femoral head (FH) relative to the acetabulum in a horse with subluxation.

Transcutaneous evaluation of the sacrum can also be performed during pelvic ultrasound to evaluate for sacral fracture. Examination of the lateral surfaces of the sacrum requires a low frequency curvilinear transducer with a scanning depth of 8-15 cm. The right and left lateral surfaces of the sacrum are evaluated individually by sliding the transducer caudally to the right and left of midline, respectively, from a longitudinal image of the ilial wing and tuber sacrale. The normal sacrum will show a smooth sloping surface. Image quality of the sacrum is highly variable, with some horses producing nondiagnostic images. Step defects consistent with sacral fracture can be identified in affected horses. Suspicious findings should be confirmed on transrectal examination. Radiography may also be useful to confirm ultrasound findings. Sacral fractures are unusual and only represent 2% of fractures identified during pelvic ultrasound at UCD.

Superficial Structures of the Pelvis

Evaluation of the superficial structures of the pelvis (tuber sacrale, tuber coxae, tuber ischii) can be performed with a tendon or rectal format transducer at a scanning depth of 4-10 cm. The tuberosities are evaluated by placing the transducer directly on their bony prominences. Tuberosities should demonstrate smooth bony surfaces (Fig. 9a), although some roughening of the tuber coxae may be seen. Comparison to the contralateral limb can be beneficial in suspect cases of fracture and in skeletally immature horses where ossification of cartilage caps may create the appearance of a fracture. Musculature ventral to the tuber coxae and tuber ischii should be evaluated for fracture fragments that typically displace ventrally due to tension from these muscle attachments (Figs. 9b and 9c). Visible muscle tearing with hemorrhage usually accompany these fractures, and affected horses often show external evidence of swelling that should heighten clinical suspicion for tuber coxae or tuber ischii fracture, depending on the site of swelling.

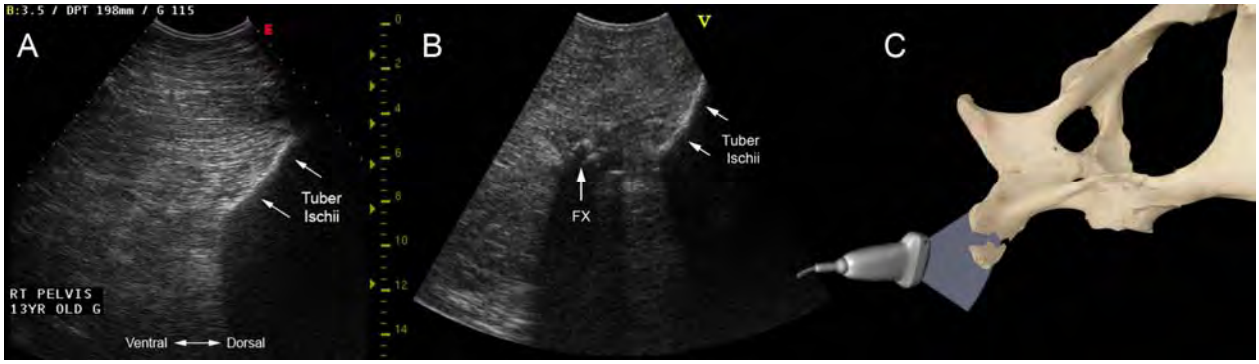

Fig. 9. (A) Normal tuber ischii and ventral musculature. (B) Ventrally displaced fracture fragment of the tuber ischii. (C) Transducer position to visualize tuber ischii fracture fragment.

Although not part of the pelvis, the third trochanter of the femur should also be evaluated as part of a pelvic exam. It is rare for a horse to show localizing clinical signs specific to the third trochanter, and many fractures would likely be missed if this region was omitted from the ultrasound exam. The third trochanter is not readily palpable, but can be visualized ultrasonographically at the proximal third-middle third junction of the femur along its caudolateral aspect (Fig. 10a). Fracture fragments are often readily identifiable but comparison to the contralateral limb is advisable to confirm the diagnosis (Figs. 10b and 10c).

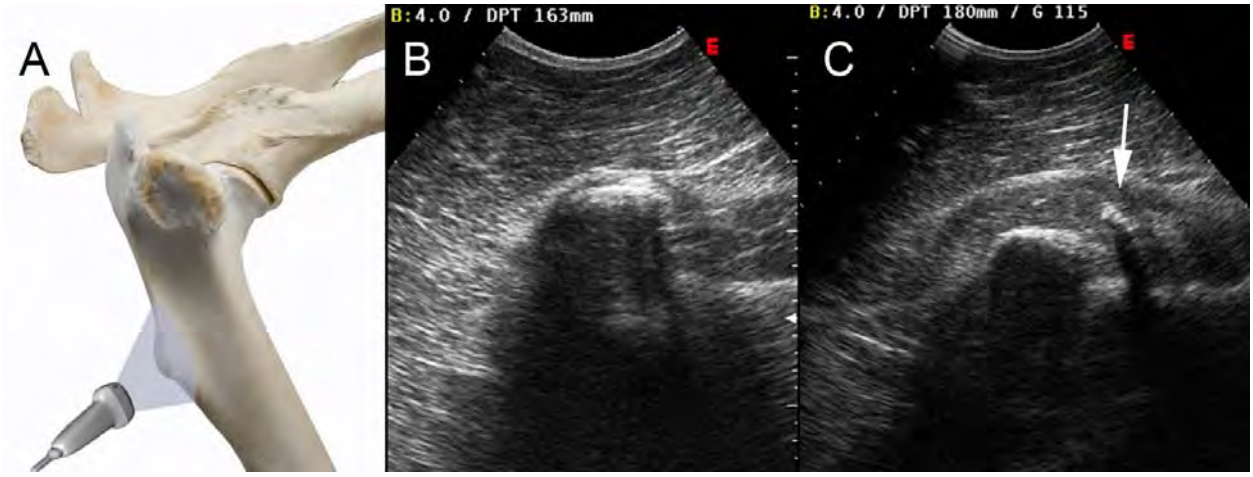

Fig. 10. (A) Transducer position to evaluate the third trochanter of the femur. (B) Normal longitudinal view of the third trochanter. (C) Fracture of the third trochanter (arrow).

Transrectal Ultrasound of the Pelvis and Sacroiliac Region

Transrectal ultrasound should be performed in all horses wherever possible, regardless of rectal palpation findings. As stated above, palpable swelling or callus is frequently absent in many horses with pelvic fracture.[4] In addition, the pubis and ischial body can only be evaluated per rectum. A standard rectal transducer is adequate. A microconvex transducer can also be used because its small size allows it to be readily manipulated in the rectum. The ischium is visualized by directing the transducer ventrally immediately upon entry into the rectum (Figs. 11a and 11b).

Its smooth bony surface will be seen within 2-3 cm of the rectal lining. As the transducer is advanced further into the rectum, it passes over the obturator foramen until the bony surface of the pubis is seen at approximately mid-forearm's length. The pubis should have a smooth surface that slopes away from the transducer towards midline. The midline symphysis of the ischium and pubis will appear as a gap in the bony surface and should not be mistaken for fracture. Step defects are otherwise consistent with fracture. Hematoma or callus formation (Fig. 11c) may be found in association with fractures. In questionable cases, comparison to the contralateral side can be performed. The axial surface of the acetabulum should also be evaluated by sweeping laterally from an image of the pubis.

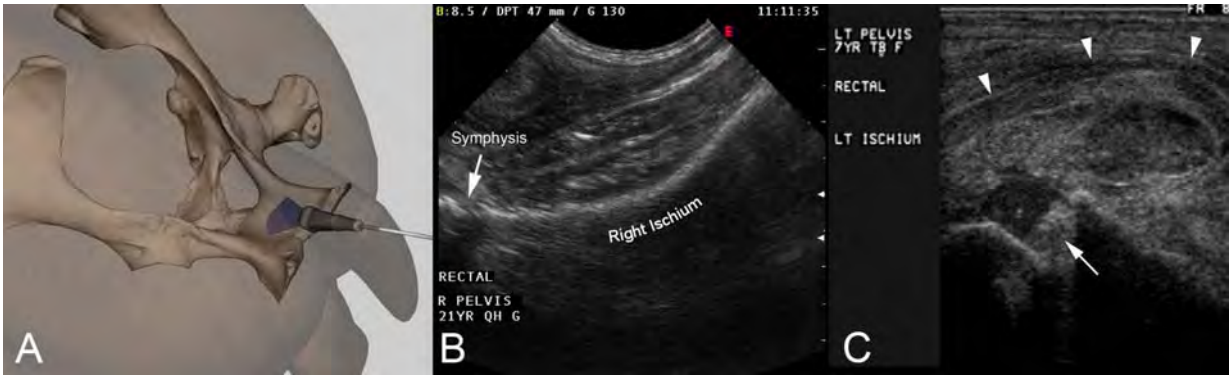

Fig. 11. (A) Transrectal ultrasound of the ischium using a microconvex transducer. (B) Normal transrectal image of the right ischium. (C) Ischial fracture (arrow) with small overlying hematoma.

Evaluation of the sacroiliac joints can also be performed during transrectal examination of the pelvis.[13] The exam is begun by first locating the lumbosacral disc space (L6-S1) at approximately mid-forearm to elbow's length with the transducer positioned dorsally along midline. This produces a transverse image of the lumbosacral disc. The bony surfaces of the vertebral body of L6 and sacrum should be smooth, and the disc should be homogeneous. Pinpoint hyperechoic specks, areas of increased echogenicity and mild irregularity of bony surfaces are not uncommon in mature and geriatric horses.[14] Such findings should be interpreted with care. The right and left sacroiliac joints are identified separately by sliding the transducer slightly caudally from the lumbosacral junction onto the cranial aspect of the sacrum. Once the concave first sacral foramen is identified (either right or left), the transducer is slid abaxially until the sacroiliac joint is identified. The normal joint should demonstrate smooth bony surfaces. Proliferative change is consistent with osteoarthritis.

Transrectal evaluation of the ventral aspect of the sacrum can be used to detect sacral fractures. Visible step defects and bony fragmentation are consistent with fracture; however, care should be taken not to misinterpret neural foramina as fractures. The right and left nerve roots of S1 and S2 can also be visualized in this region. Ultrasonographically detectable abnormalities of the nerve roots are not common.

Management of Pelvic Fractures

The majority of horses with pelvic fractures are treated with confinement. Options include a tie stall, a tie line in a stall or loose in a stall. Each has its own drawbacks. Regardless of

confinement type, many horses will eventually lay down and can become cast, especially in a narrow tie stall. Such horses are at risk for further injury and fracture displacement when struggling to rise. The use of a tie line can also restrict a horse's ability to rise after lying down. For these reasons, the majority of horses diagnosed with pelvic fractures at UCD are allowed to roam freely in their stall without the use of a tie line.

Recheck ultrasound examination is recommended in horses with fractures of the ilial wing, ilial body, ischium and pubis, generally at 3-6 months post diagnosis. Fractures at these locations generally show ultrasonographic evidence of healing, and in some cases, the fracture line may become indistinguishable. In contrast, ultrasonographic re-evaluation of the coxofemoral joint is generally unrewarding, as acetabular rim fractures usually remain displaced. Ultrasound may be useful later in the recuperative period to guide injections into the joint for therapeutic purposes. Ultrasound recheck exams are generally not useful for tuber coxae and tuber ischii fractures either due to persistent fracture displacement. Repeat ultrasound is often required in horses with open tuber coxae fractures due to the development of osteomyelitis and draining tracts. In such cases, ultrasound is useful to localize the source of persistent drainage and to guide removal of fragment(s). Nuclear scintigraphy is valuable for recheck purposes in racehorses with ilial wing stress fractures. With other fractures, increased radiopharmaceutical uptake often remains apparent for prolonged periods during the recovery process.

Ultrasonographic localization of the fracture will help to guide owners regarding prognosis for various purposes, including breeding, athletic use, etc. In general, prognosis is good for return to function in horses with ilial wing and tuber coxae fractures. Prognosis for fractures of the coxofemoral joint is difficult to predict in the early stages, but many horses with acetabular rim fractures can become quite comfortable and pasture sound. Some owners have even reported back that horses diagnosed with acetabular rim fractures are occasionally ridden. Outcome can be variable with other fracture sites. The author has seen horses with ischial fractures develop uncontrollable pain, presumably due to nerve entrapment, while other similarly affected horses go on to heal completely.

Many horses with severe lameness in the acute phase of injury will show gradual improvement in their degree of lameness. It can be tempting to base the decision for euthanasia on the initial severity of lameness. Euthanasia should be considered if the degree of pain or lameness becomes unmanageable. In our experience, this is most often seen in horses with a complete fracture through the acetabulum but may also be seen in horses with proximal femoral diaphyseal fractures. Sacral fracture should also be considered, as they can produce severe pain and neurologic signs.

Summary

With practice and the availability of proper ultrasound equipment, many pelvic fractures can be identified ultrasonographically; however, false negative examinations are possible, especially in horses with nondisplaced fractures where bony incongruity will not be visible. In cases where clinical suspicion for fracture remains high, nuclear scintigraphy is indicated. Radiography may also be performed, but the potential for displacement or worsening of the patient's clinical condition should be considered in the decision making process.

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