Review of Ultrasonographic Techniques to Evaluate the Equine Skull and Head Structures

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Ultrasonographic examination is a readily available, inexpensive diagnostic technique for investigating osseous and soft tissue abnormalities of the equine head, is complementary to radiography, and may elucidate bony abnormalities not initially apparent on skull radiographs. Ultrasound may provide enough information to preclude computed tomography examination or may validate recommendations for advanced imaging procedures. Authors’ addresses: Department of Surgical and Radiological Sciences (Vaughan and Whitcomb) and William R. Pritchard Veterinary Medical Teaching Hospital (Biscoe), School of Veterinary Medicine, University of California, One Shields Avenue, Davis, CA 95616; e-mail: mevaughan@ucdavis.edu. *Corresponding author. © 2011 AAEP.

1. Introduction

Abnormalities of the equine head can cause a myriad of clinical signs including anorexia, dysphagia, ptalism, localized soft tissue swelling, draining tracts, evidence of trauma, pain on manipulation of the head or cranial cervical region, blepharospasm, or exophthalmus, all of which have their own list of overlapping differential diagnoses. The anatomy of the equine head is complex, and radiographic interpretation is often complicated by summation and superimposition.1 Many of the soft tissue structures of the equine head, including the tongue; submandibular and retropharyngeal lymph nodes; the parotid, mandibular, and sublingual salivary glands and ducts, ocular structures; and the laryngeal and pharyngeal regions are difficult to characterize radiographically, and findings may be limited to localized soft tissue swelling.1,2 Endoscopy is used to diagnose abnormalities of the upper airway and guttural pouches but provides little information on other head or skull structures. Computed tomography (CT) is considered the gold standard to fully characterize osseous abnormalities of the equine head, but it has limited availability both in the field and referral setting.1,2 The use of MRI to evaluate extracranial head structures has also been described,3,4 but it has similar limitations to CT and requires lengthy anesthesia for image acquisition. Fortunately, many soft tissue structures of the equine head are superficially located and easily accessible for ultrasonographic examination. In our experience, ultrasonographic findings frequently provide complementary information to skull radiography and help to direct subsequent medical or surgical treatment. Numerous publications describe the use of ultrasound for examination of specific abnormalities or focused regions of the head.5–11 The purpose of this review is to provide practitioners with a concise yet complete guide to ultrasonographic examination of the equine head while summarizing findings from the Large Animal Ultrasound Service at University of California Davis over a 7-year period.
2. Ultrasonographic Technique

A thorough knowledge of the anatomy to be evaluated is integral to interpretation of any ultrasonographic examination. The skull and head region is no exception. Ultrasound examination of the head can be tailored to the specific region in question (i.e., localized swelling of the mandible) or may be performed broadly in search of a cause for more generalized clinical signs. Light sedation is often required because horses frequently object to repeated manipulation of the head. To maximize image quality, the region to be examined should be clipped and washed with warm water before the ultrasound gel is applied. Although not recommended in the head region, if alcohol saturation is used, care should be taken to protect the eyes from overspray or runoff.

Anatomic structures of the head can routinely be imaged with a high-frequency linear transducer (7 to 14 MHz), midrange frequency “microconvex” curvilinear transducer (4.0 to 8.0 MHz) or a rectal transducer at depths ranging from 3 to 8 cm, depending on the structure of interest. The microconvex transducer is often helpful to image regions that are severely swollen or when the penetration of the linear transducer is inadequate for visualizing deeper structures. Furthermore, the sector-shaped image generated by the curvilinear transducer offers a wider field of view regardless of scanning depth. A program (application or preset) should be selected that maximizes musculoskeletal image quality.

3. The Skull

The utility of ultrasound for the examination of bony abnormalities such as fracture, osteomyelitis, and neoplasia has been described. Ultrasound has been shown to identify bony pathology consistent with osteomyelitis as early as 1 to 2 days after the onset of symptoms, whereas radiography may take up to 2 weeks.

The skull is a common location on the overlying perios-
tum, and/or a thin hypoechoic to anechoic layer elevating, tearing, obliteration, or extrusion (Fig. 1). In cases of fracture, step defects can be detected in the otherwise smooth cortical surfaces. Overlying hematoma formation is an inconsistent finding.

4. Temporomandibular Joint

The temporomandibular joint (TMJ) is located between the base of the zygomatic process of the temporal bone and the condylar process of the mandible and contains a fibrocartilagenous disc or meniscus dividing the joint into dorsal and ventral recesses.

Reports of TMJ disease in horses primarily describe cases of septic arthritis or luxation, with a single case report describing neoplastic invasion of the joint. Soft tissue swelling overlying the TMJ and pain on manipulation or palpation may help localize clinical signs but are not always present. Horses with septic arthritis of the TMJ are often extremely painful and unwilling to masticate. Radiographic interpretation of the TMJ is challenging, and significant pathology may not be visible due to superimposition.

Ultrasonographic techniques for evaluation of the TMJ are well described in the literature. The TMJ is evaluated along all visible margins, from a rostral, lateral, and caudal window. Abnormalities of the superficial joint margins and intra-articular disc (meniscus) are readily visible with this technique. Roughening of the articular tubercle and the mandibular condyle has been described in cases of septic arthritis. Changes in the appearance of the intra-articular disc (meniscus) are also seen in cases of septic arthritis and include narrowing, tearing, obliteration, or extrusion (Fig. 2).

Thickened or proliferative synovium with or without excess synovial fluid is also a prominent feature of septic TMJ arthritis. In the author’s experience, ultrasound guidance is advantageous for needle placement for arthrocentesis and also for through-and-through lavage in the standing horse, especially in cases in which arthroscopy is not an option.

5. The Tongue and Oral Cavity

The inciting cause of nonspecific clinical signs such as anorexia, dysphagia, ptyalism, and halitosis can be difficult to identify on physical exam alone, especially when pain or lingual swelling precludes a

Fig. 1. Transverse ultrasound image of the mandible in a 14-year-old Thoroughbred gelding with osteomyelitis that presented for mandibular swelling associated with a draining tract. Elevation of the periosteum (arrowheads) is seen in close proximity to the draining tract (not seen in this image). This image was obtained with a 13-MHz linear transducer at a depth of 4 cm.
complete oral examination. Although dental abnormalities are often readily diagnosed via oral examination and skull radiography, radiographic abnormalities of the tongue or buccal mucosa are often limited to identification of radiopaque foreign bodies, gas accumulation suggestive of anaerobic infection, or soft tissue swelling of the intermandibular space.

The tongue is located between the mandibular rami and is examined ultrasonographically from the intermandibular space. Lingual abscesses associated with foreign bodies can be identified from this window in many cases. In addition, intraoral ultrasonographic examination can be performed in amenable horses with the aid of a full-mouth speculum and a rectal transducer placed directly on the tongue. Lingual foreign bodies are most commonly metallic (wires or needles) and demonstrate a linear or slightly curved hyperechoic appearance with variable shadowing. Anaerobic infections are common and produce hyperechoic gas echoes that can obscure visualization of foreign bodies in some cases. 

6. The Parotid, Mandibular, and Sublingual Salivary Glands

Abnormalities of the salivary glands most commonly involve the parotid gland and duct. It is the largest salivary gland of the horse and extends from the base of the ear to the ramus of the mandible, with its caudal border at the wing of the atlas. Several smaller ducts join at the rostral and ventral border of the gland to form the parotid duct. The duct then courses rostrad alongside the facial vein, crossing over the ramus of the mandible, entering the mouth at the level of the third upper cheek tooth.

The parotid gland is readily visualized ultrasonographically and can be examined in its entirety.
A sialolith has healed. Salivary duct laceration or duct obstruction via scar tissue once the located parotid duct can lead to salivary fistula formation or infection is not uncommon, in which case upstream dilation of the duct. Ascending anechoic structures that commonly cast shadows and are seen on ultrasonographic evaluation as small hyperchoic areas within the node to complete disruption of the node by the abscess.

7. The Submandibular and Retropharyngeal Lymph Nodes

The submandibular lymph nodes are located deep to the skin surface in the intermandibular space, just ventral to the tongue, and are commonly visualized during ultrasonographic examination of the region. Retropharyngeal lymph nodes reside lateral to the guttural pouch, ventral to the parotid salivary gland and dorsolateral to the pharynx, and are uncommonly visualized unless abnormal. Primary abnormalities of the submandibular and retropharyngeal lymph nodes include lymphadenitis, abscessation, and neoplasia. Reactive lymphadenitis causing enlargement of either group of lymph nodes is a frequent ultrasonographic finding, especially in horses with regional inflammation or infection. In our experience, squamous cell carcinoma is the most common neoplasia to affect submandibular or retropharyngeal lymph nodes. Affected lymph nodes are enlarged and may have an irregular surface and a heterogeneous appearance. Biopsy is important for definitive diagnosis.

Abscessation of submandibular and retropharyngeal lymph nodes can occur with upper respiratory infection and is commonly associated with Streptococcus equi subspecies equi infection (strangles). However, other organisms can cause similar clinical signs, and aspiration is warranted for culture and sensitivity in some cases. The ultrasonographic appearance of abscessed lymph nodes ranges from cavitated, hypoechoic, to anechoic areas within the node. 5 Reactive lymphadenitis causing enlargement of either group of lymph nodes is a frequent ultrasonographic finding, especially in horses with regional inflammation or infection. In our experience, squamous cell carcinoma is the most common neoplasia to affect submandibular or retropharyngeal lymph nodes. Affected lymph nodes are enlarged and may have an irregular surface and a heterogeneous appearance. Biopsy is important for definitive diagnosis.

8. The Eye

Ultrasonography provides an excellent noninvasive manner to image the globe and retrobulbar space. Ultrasound is especially useful when opacification of the anterior segment of the eye limits a complete ophthalmoscopic examination or when severe swelling of the eyelids prevents examination of the globe. Ultrasonographic examination provides excellent visualization of the cornea, anterior and posterior chambers, anterior and posterior reflections of the lens capsule, iris and ciliary body, corpora nigros, optic nerve and disc, and retrobulbar space. Cataracts are the most common ultrasonographic abnormality of the equine eye and are characterized by increased echogenicity of the lens and increased definition of the lens capsule. Lens luxation can also be seen in cataractous eyes (Fig. 5). Retinal detachments are seen as curved linear struc-

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Fig. 4. Ultrasound image of a markedly enlarged mandibular salivary gland (arrowheads) with anaerobic sialoadenitis in a 17-year-old Arabian gelding that presented for mandibular swelling and ptysalism. The structure visible at the edge of the upper right-hand corner of the image is the parotid salivary gland (PG). This image was obtained with an 8.5-MHz curvilinear transducer at a depth of 7 cm.
tures within the posterior chamber that arise from the optic disc, creating a “seagull” appearance.9–11,29 The retrobulbar space should be carefully evaluated in cases of exophthalmus for evidence of neoplasia, hemorrhage, and abscessation.9–11,29,30 Differentiation based solely on ultrasonographic findings can be challenging and may require ultrasound-guided sampling or advanced imaging such as CT or MRI. The retrobulbar space can be difficult to interpret, and the contralateral orbit should be examined for comparison in all cases.

9. Neoplasia

The head is a common site for neoplasia, and masses can be seen involving all structures described above.31 The majority of masses affecting the bony surface or soft tissue structures of the skull are amenable to ultrasonographic evaluation, and ultrasound-guided biopsy or aspiration is possible in many cases. Tumors affecting the equine head include melanoma, squamous cell carcinoma, lymphosarcoma, hemangiosarcoma, sarcomas, odontogenic tumors, and bony tumors such as osteoma, ossifying fibroma, fibrous dysplasia, and osteosarcoma.17,20,31–33 The ultrasonographic appearance of neoplastic masses varies greatly, depending on the location and tumor type. Masses can be variably echogenic and may demonstrate anechoic areas consistent with necrosis, hyperechoic areas consistent with dystrophic mineralization, or both.5 Definitive diagnosis requires histopathologic classification and cannot be made on the basis of ultrasonographic appearance alone. However, a presumptive diagnosis of melanoma is often made in gray horses with multiple masses in the retropharyngeal and/or parotid gland regions.

10. Results

Ninety-three horses underwent 118 ultrasound examinations of regions of the head performed by the Large Animal Ultrasound Service at the William R. Pritchard Veterinary Medical Teaching Hospital (VMTH) between January 2003 and December 2010. Abnormalities of the salivary glands and neoplasia were the most common diagnoses, seen in 19 horses each, followed by osteomyelitis (n=11), temporomandibular joint disease (n=10), abscesses and/or foreign bodies of the tongue (n=9), ocular abnormalities (n=9), primary submandibular or retropharyngeal lymph node abnormalities (n=8), and abscessation not involving the tongue or lymph nodes (n=6). Twelve horses were given miscellaneous diagnoses not categorized above, and some horses were diagnosed with more than one abnormality. Ultrasonographic findings yielded or corroborated the final diagnosis in 70 of 97 horses, with 25 ultrasound-guided biopsies and/or aspirates performed in 21 horses. CT examination was ultimately performed in 9 horses, primarily to fully characterize invasive neoplastic lesions and septic arthritis of the temporomandibular joint.

11. Summary

Ultrasonographic evaluation of the head has become an important part of the diagnostic workup at the VMTH for horses presenting with facial swelling, wounds, draining tracts, ptysalism, dysphagia, or facial trauma or as a complementary imaging modality to skull radiography. The number and variety of cases presenting over a 7-year period highlight the utility of the procedure and its wide acceptance at the VMTH. In many cases without radiographic abnormalities, positive ultrasound findings often provided enough information to formulate a treatment plan, whereas in other cases, owners were prompted to pursue further advanced imaging procedures.

The clinical anatomy of the equine head is complex, with numerous overlapping structures that can make interpretation of physical exam and radiographic findings difficult. The use of ultrasound is now widespread in equine practice, and most practitioners have access to a portable ultrasound machine equipped with at least a rectal transducer. The superficial nature of the soft tissues overlaying the equine skull make it an ideal structure for ultrasonographic evaluation, and ultrasonographic examination should be included in the diagnostic arsenal for abnormalities of the equine head.

References


