How to Perform Ultrasound Evaluation of the Jugular Vein

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1. Introduction
Disorders of the jugular vein are relatively common and potentially serious problems for the equine practitioner, with thrombophlebitis being the most common. Early recognition, proper assessment, and appropriate treatment are required to avoid serious consequences such as complete thrombotic occlusion of the vein or sequelae to sepsis within the vein, which could include hematogenous extension to other locations of the body.

Jugular thrombophlebitis is a common complication in sick horses with hypercoagulable states. It has also been observed to occur in horses receiving repeated injections (such as might occur with certain athletic disciplines), with errant intravenous injections in horses that are difficult to handle or with injections given by an unskilled individual, and with intravenous injection of potentially irritant substances. Traditional evaluation of changes in the jugular vein have included clinical evaluation by digital palpation and determining whether it can be distended by distal occlusion, indicating the presence of normal blood flow. Ultrasound is a valuable tool for assessing pain and swelling along the jugular vein—in early detection and extent of jugular thrombosis—as well as for determining the likelihood of septic thrombophlebitis. Ultrasound evaluation of the jugular vein is an easily applied technique that is often underutilized in clinical practice. It can provide immediate visual imaging and definition of the anatomic location of swellings or alterations along the jugular vein and can guide clinical decision-making. This presentation should provide the practitioner with the knowledge of the technique for ultrasound imaging of the jugular vein as well as a brief review of ultrasound changes associated with jugular vein thrombosis and thrombophlebitis.

2. Materials and Methods
Technique for Ultrasound Imaging of the Jugular Vein
The approach to ultrasound imaging of the jugular vein involves selection of an appropriate ultrasound probe, patient preparation, and occlusion of the vein distally to allow for maximal distension of the lumen, if any blood flow is present. Higher-frequency ultrasound probes (7.5 mHz or higher, preferably 12 mHz) are necessary to allow for fine detail imaging of the jugular vein and other adjacent superficial anatomic structures within the neck. Smaller contact footprint probes or microconvex probes may fit against the jugular groove most eas-
ily, but commonly available linear rectal probes can also be used. Scanning of the jugular vein may involve simply wetting the skin and hair on the neck with isopropyl (or similar) alcohol in horses with a thin hair coat. In those patients with thicker hair coats, or those in which best clarity and detail of image is desired, clipping the hair along the jugular groove from the mandible to the thoracic inlet might be necessary. Application of ultrasound contact gel may facilitate best contact of the probe with the skin along the jugular groove. The examination is performed by occluding the jugular vein with pressure.

Fig. 1. Ultrasound image of a normal, distended jugular vein shows a thin wall and relatively echolucent blood within the lumen. Adjacent anatomic structures include the carotid artery, esophagus, and trachea.

Fig. 2. Ultrasound image of a normal, occluded jugular vein with swirling echogenicity of the static blood within the lumen.
by the thumb near the thoracic inlet to achieve maximal distension of the vein (if there is venous flow) to allow for better definition of the contents of the lumen of the vein. This can be done with the opposite hand of the sonographer, or an assistant might perform this task. The jugular vein should be scanned along the entire extent of the vein in both directions—along the visible branches of the jugular vein proximally just behind the mandible, distally to the thoracic inlet. The examiner may

Fig. 3. Irregular echogenic appearance of the central aspect of the sternocephalicus muscle (arrow) and perivenous connective tissues from an aberrant attempted jugular vein injection in a fractious horse. Clinically, this appeared as swelling and pain along the jugular groove and required ultrasound examination to differentiate the location from a true jugular vein injury.

Fig. 4. Partial luminal thrombus in the jugular vein after intravenous catheterization. The tunica muscularis (arrowhead) and intimal layers (arrow) are thickened by reactive inflammatory response.
eventually focus on the region of interest—a site of swelling adjacent to an intravenous catheter site or a region of swelling from prior intravenous injection. The author finds it most useful to initially evaluate the vein in a transverse (cross-sectional) plane and then follow with a longitudinal plane, which is useful to demonstrate linear anatomic relationships, such as linear extent of a thrombus along the course of the vein.

Fig. 5. Longitudinal ultrasound image of an acute thrombosis of the jugular vein associated with intravenous catheterization. Arrowheads denote the more mature component of the thrombus, with the more recent fibrin deposition denoted by the arrow. For anatomic orientation: proximal is to the right, distal to the left in this image.

Fig. 6. Chronic thrombosed jugular vein. The venous lumen is obliterated by organized fibrous connective tissue with a somewhat laminar appearance.
of the jugular vein. It may also be useful to scan
the contralateral jugular vein for comparison with
more normal architecture within that individual
horse.

Anatomic Considerations
Ultrasonography will allow anatomic definition of
the location of clinically apparent swellings along
the course of the jugular vein and their relationship

Fig. 7. Multifocal echogenic regions and gas echoes within the luminal thrombus, suggestive of suppurative exudate, from an
anaerobic infection septic thrombophlebitis.

Fig. 8. Color flow Doppler ultrasound image of septic jugular thrombophlebitis with laminar echogenic material (arrow), consistent
with suppurative exudate.
to the structures caudal to the mandible (parotid salivary gland, branches of the carotid artery) and from the underlying main carotid artery, esophagus, and trachea along the course of the neck.

3. Results
Normal jugular veins appear to be collapsed, with thin echolucent regions of blood flow without some distal occlusion to interrupt blood flow and allow for maximal distension of the vein lumen. Normal distended jugular veins will appear as rounded tubes of echoluent fluid (blood) within the lumen and thin, echogenic walls with distinct margins of the endothelial surface (Fig. 1). The blood column within a normal vein that has been occluded will, on some occasions, begin to swirl and provide a variably echogenic laminar appearance (Fig. 2).

In the author’s practice, swelling or pain around the intravenous catheter insertion site are considered indications for ultrasound imaging of the jugular vein. In addition, distension of the vein or its proximal branches with or without unilateral facial edema or trauma to the neck region might also be indications for scanning the jugular vein.

Common problems that can be identified with ultrasound imaging of the jugular vein include detection of perivascular inflammation, localized or extensive thrombophlebitis, differentiation of septic thrombophlebitis from thrombosis alone, and early detection of catheter-associated thrombosis.

Perivascular inflammation (Fig. 3)—associated with intravenous injection or catheter placement—can result in swelling and thickening of the perivascular tissues, whereas the lumen of the jugular vein remains unaffected. This finding would usually indicate that topical local therapy—anti-inflammatory and/or topical antimicrobial agents—might be sufficient in resolving the thickening. Occasionally, an aberrant injection of material into the adjacent perivascular tissues or surrounding musculature might occur, and this can be demonstrated and monitored with the use of ultrasound.

Varying degrees of thrombosis within the jugular vein lumen (Fig. 4) can be identified, from focal/regional involvement to more progressive thrombosis with complete luminal obstruction that can extend along the entire course of the jugular vein within the neck. A thrombus will appear as a variably echogenic, variably shaped solid material within the lumen of the vein. Often, the thrombus will appear to be attached to the endothelial surface of the vein at a site of catheter entry or as a sheath along an indwelling intravenous catheter or attached to a site of previous injection or catheterization. The margins may appear irregular and indistinct (“fuzzy”), as with recent or active thrombus formation, or smooth with thrombi of longer duration in which blood flow has formed the margins.

Occasionally, a jugular thrombus of longer duration will have a cone shape to its distal margins. Longitudinal images (Fig. 5) are useful for determining the linear involvement along the course of the jugular vein. Acute thrombosis can undergo repair by fibrinolysis to varying degrees of recanalization, or it can evolve to organization into chronic fibrous resolution with complete obstruction of the vein lumen (Fig. 6).

Thrombosis can occur with repeated intravascular injections, iatrogenic trauma on attempting to inject the jugular vein of a fractious horse, or after injection by an unskilled individual. Thrombosis has also been reported to occur as a sequel to other sites of infection, unrelated to venipuncture or catheterization. Once thrombosis of the jugular vein has been identified, ultrasound imaging can be useful in monitoring the clinical progression or resolution of the lesion.

In addition to detection of thrombosis, ultrasound is also useful for detecting changes consistent with septic thrombophlebitis as well as determining the location and extent of inflammatory exudate within the vein. Septic thrombophlebitis is usually observed as varying regions of densely echogenic material within the thrombus (Figs. 7 and 8). Finding this echogenic focus can allow for ultrasound-guided aspiration to obtain a sample of the exudate for bacterial culture and sensitivity and possibly drainage of the exudate.

4. Discussion
Ultrasound imaging is a useful tool for evaluation of a variety of changes along the jugular vein. It can aid in differentiation of the anatomic location of swellings in the jugular groove—whether the change is within the jugular vein or from involvement of the perivascular tissues. Commonly differentiated changes include perivascular inflammation, jugular thrombosis over the spectrum of acute-to-chronic and focal-to-extensive involvement of the vein, and detection of changes consistent with septic exudate within the thrombus or in the perivascular tissues. Early detection and intervention for thrombosis, whether from injections or associated with intravenous catheter placement, can improve clinical outcomes and may help to reduce costs of medical management. Ultrasound imaging is vital in the detection of sites of sepsis within the venous thrombus. The technique for ultrasound imaging of the jugular vein is relatively easy and involves the use of readily available ultrasound equipment in most equine practices.

References