How to Assess Equine Fetal Viability by Transrectal Ultrasound Evaluation of Fetal Peripheral Pulses

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The most significant ultrasound parameters indicating viability of the equine fetus include fetal heart rate and fetal activity. Abnormal patterns in fetal heart rate reactivity represent the most sensitive indicator of fetal compromise. In advanced to late gestation, the fetal cardiac area becomes quite inaccessible to an ultrasound examination per rectum. Peripheral arterial pulses may be used instead to evaluate changes in fetal heart rate. Fetal external carotid pulse is easily accessible by ultrasound examination per rectum in advanced gestation and may provide a useful diagnostic tool for the clinician in practice. Authors' addresses: XY Equine Veterinary Services, Select Breeders Service Ireland, Hodgestown, Donadea, Naas, Co. Kildare, Ireland (Bucca, Carli); and The Irish Equine Centre, Johnstown, Naas, Co. Kildare, Ireland (Fogarty); e-mail: stefbucca@hotmail.com (Bucca).

1. Introduction

Equine clinicians are often asked to advise on the state of health of the equine pregnancy in late gestation. Feto-placental environment can be successfully explored using ultrasounds, with a combined per rectum and transabdominal approach. Equine fetal monitoring techniques, mostly adapted from human perinatology, rely heavily on ultrasonography. Transabdominal[1–6] and transrectal[7] techniques have been developed in recent years.

Indications for equine fetal monitoring techniques in late gestation include premature mammary development and lactation, vaginal discharge, prolonged gestation, sudden increases in abdominal volume, systemic maternal disease, and history of previous problems in late gestation.

Fetal heart rate (FHR) reactivity represents the most significant parameter to assess fetal viability, as shown by Reef et al.[4,5] Abnormal patterns in FHR reactivity are a clear indication of fetal compromise.[1–4] As gestation progresses and fetal size increases, the fetal cardiac area becomes gradually inaccessible to a transrectal ultrasound approach, when light and heavy breed horse fetuses are examined. Under those circumstances, assessment of arterial peripheral pulses may provide a more accessible means of estimating fetal cardiac activity.

Because most equine fetuses will lie in utero in anterior presentation, from 9 mo to term,[6,8–10] vascular structures of the head and proximal neck provide an easily accessible source of arterial pulses in advanced gestation. In anterior presentation, the equine fetal carotid artery is readily visualized, by

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ultrasound per rectum, in the proximal neck, within the jugular groove, and over the external compartment of the guttural pouches.

Lack of facilities, need for specific ultrasound equipment, expertise, and time make assessment of feto-placental well being by a transabdominal route a difficult task for the clinician in the field. An easy and repeatable method of assessing relevant equine fetal parameters would allow the clinician to carry out a preliminary investigation in the field and refer cases in need of further investigation and management to suitable facilities.

The aims of this study are to show that (1) a peripheral artery may be easily and consistently detected by ultrasound, per rectum, in the equine fetus in advanced gestation, (2) repeatable pulse tracings may be obtained, combining two-dimensional real time and M-mode ultrasonography, and (3) a direct correlation exists between FHR and peripheral pulse frequency.

2. Materials and Methods

Forty-six pregnant, Standardbred mares, of variable age and body weight were examined by ultrasound, on a monthly basis, from day 180 of gestation to term. The study was conducted on a commercial Standardbred farm, located in the north of Italy. Each examination involved both transrectal and transabdominal ultrasonography, using a B-mode, real-time, portable, ultrasound unit. Transrectal imaging was obtained with a real-time unit,[a] equipped with a 7.5-MHz linear rectal transducer, and transabdominal ultrasonography was performed using a sector scanner,[b] with a choice of 2.5-, 3.5-, 5.0-, and 7.5-MHz sector transducers.

The mares were restrained in a purpose-built stocks, with both sides open, to allow ease of access to both sides of the mares ventral abdomen. Sedation was avoided, if possible, because this leads to suppression of fetal activity and heart rate reactivity. Transabdominal and transrectal examinations were performed simultaneously by two operators, and recordings of FHR and fetal carotid pulse (FCP) were obtained.

Fetal Heart Rate

Transabdominal imaging of the fetal cardiac area was obtained by liberal application of alcohol and ultrasound coupling gel on the mares ventral abdomen. Multiple assessment of FHR and rhythm were made as described by Reef et al.[4,5] Several FHR recordings, both at rest and after activity, were obtained using M-mode echocardiography. To do this, the fetal cardiac activity was identified, using two-dimensional B-mode ultrasonography and then an M-mode echocardiogram obtained by placing the M-mode cursor through the moving fetal cardiac structures. FHR was calculated using an in-built cardiac calculation package.

Fetal Carotid Pulse

Transrectal ultrasound assessment of the gravid uterus was performed using a standard technique. The carotid pulse could only be evaluated with the fetus in anterior presentation, when the head and proximal neck were readily visualized. Fetal activity would interfere with proper positioning of the ultrasound probe over the carotid artery. Because of the narrow acoustic window offered by a transrectal ultrasound exam, carotid pulse recordings lasted a short time. Imaging of the fetal guttural pouches was achieved by placing the ultrasound transducer over the proximal neck and moving it toward the mandible. The anechoic appearance of the fluid filled guttural pouches provides a good background to visualize the cross-sectional external carotid wall, as it courses over the lateral wall of the pouch's lateral compartment (Figs. 1 and 2). Relevant anatomical landmarks, for scanning planes orientation, include the following: fetal skull, temporomandibular joint, wing of atlas, orbit, auricular pinna, glottis, and trachea (Fig. 3). Pulsatile activity of the carotid artery can be detected in the upper jugular groove, but most distinctively over the guttural pouches. Once the external carotid was imaged, the M-mode cursor was placed perpendicularly over its wall, and a tracing was taken. The ultrasound unit cardiac software package was used to

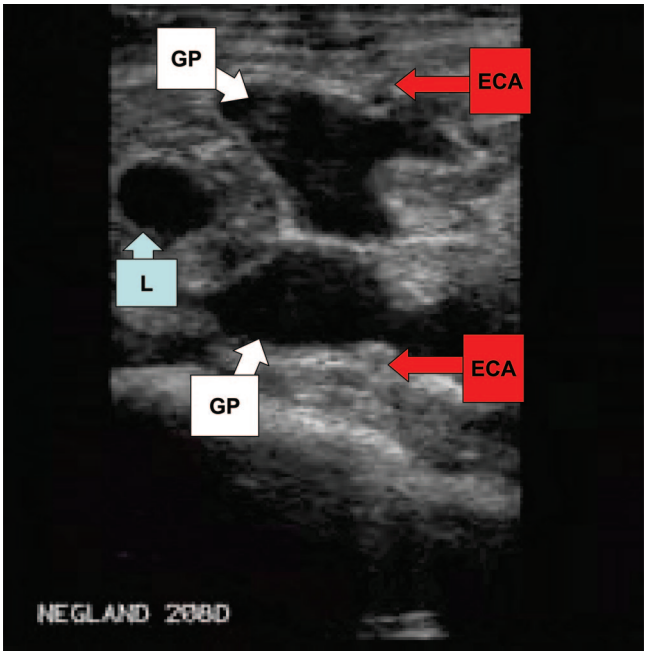

Fig. 1. Sonogram of the guttural pouch area of a 208 days old equine foetus in anterior presentation. The head was flexed at poll. The sonogram was taken transrectally, with a linear 7.5MHz rectal transducer. Scanning plane is as depicted by the black line in figure 2. Left of sonogram is mare's caudal and right is cranial. GP: guttural pouch; ECA: external carotid artery; L: larynx.

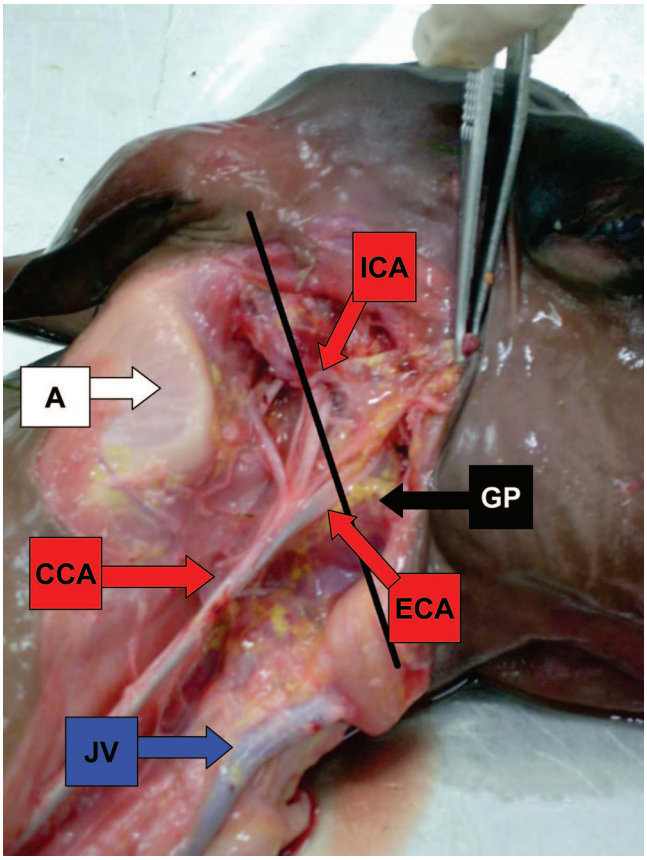

Fig. 2. This image depicts a dissected 7 months old, equine, foetal head/upper cervical region. The black line indicates the scanning plane illustrated in figure 1. The jugular vein (JV), has been reflected ventrally from the jugular groove. A: wing of atlas; CCA: common carotid artery; ECA: external carotid artery; ICA: internal carotid artery; GP: guttural pouch, lateral compartment, which has been distended with fluid.

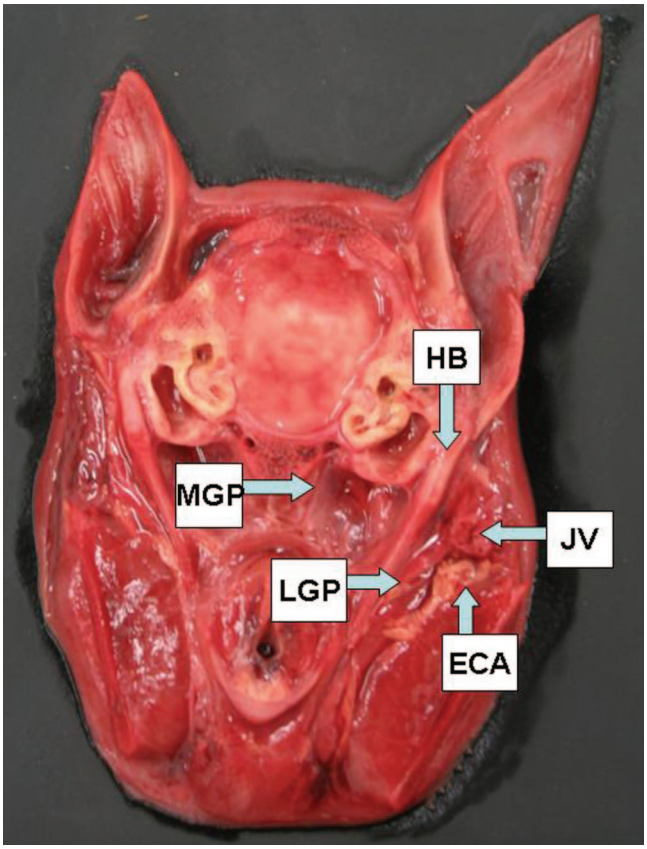

Fig. 3. Wet specimen of a 6 month old equine fetal head. Plane of section is as depicted by the black line shown in figure 2. HB: hyoid bone; MGP: medial compartment of guttural pouch; LGP: lateral compartment of guttural pouch; ECA: external carotid artery; JV: jugular vein.

calculate the pulse frequency out of the registered M-mode tracing.

Simultaneous FHR and FCP Recordings

The operator recording FHR would first locate the fetal cardiac area from a transabdominal approach and assess fetal presentation, position, and activity. When the fetus appeared in anterior presentation and in a quiescent phase, a second operator would evacuate the mare's rectum and insert a linear transrectal 7.5-MHz probe to locate the fetal head and external carotid artery, as described. As a carotid artery tracing was obtained, the first operator would simultaneously record a fetal cardiac M-mode tracing transabdominally. An average of five tracings were evaluated on each examination. Calculations were obtained from each tracing, and the resulting mean was recorded, as shown in Table 1.

3. Results

For the purpose of this study, the gestational age of the fetus was defined as follows: month 7 (G7), 180–210 days; month 8 (G8), 210–240 days; month 9 (G9), 240–270 days; month 10 (G10), 270–300 days; month 11 (G11), 300–330 days; month 12 (G12), 330–360 days; month 13 (G13), 360–390 days. Data are summarized in Table 1. Recordings for G12 could not be collected when mares foaled before 330 days of gestation.

In this study, the carotid pulse was easily and consistently assessed in all fetuses in anterior presentation, from day 180 of gestation to term. Before that stage of gestation, fetal size and activity hampered proper visualization of the carotid artery.

Several pulse tracings were obtained on each scanning session. Simultaneous recordings of FHR activity and FCP showed a direct correlation, as reported in Table 1.

In this study, FCP recordings could only be obtained at rest. Great care was taken not to confuse real pulsatile activity of the external carotid with guttural pouch wall motion, caused by episodes of oro-lingual movements and fetal swallowing. Best ultrasound imaging of the external carotid artery was obtained on a cross-sectional view, cutting through the back of the skull or just caudal to it,

Table 1. Mean Fetal Heart Rate (FHR) and Fetal Carotid Pulse (FCP) Recordings at Different Stages of Gestation

	G7		G8		G9		G10		G11		G12	
Fetus ID	FHR	FCP	FHR	FCP	FHR	FCP	FHR	FCP	FHR	FCP	FHR	FCP
Mean	107.5	107.0	101.4	101.1	92.3	92.4	84.0	84.0	73.1	73.1	68.2	68.3
±STD	6.9	7.0	7.3	6.7	7.6	7.8	8.2	8.3	6.4	6.4	6.2	6.5

* n/a: not applicable, as parturition had occurred.

showing portions of the caudal brainstem, the guttural pouches, and the glottis/proximal trachea ventrally. On this scan, the internal carotid was inconsistently imaged on the medial septum of the guttural pouches.

4. Discussion

The most significant equine fetal parameters, indicating fetal viability, as shown by Reef et al.,[4,5] include FHR and fetal activity, detected by ultrasonography.

In late gestation, fetal activity can be estimated by transrectal palpation of fetal parts in motion. However, this is not an accurate assessment of fetal well being. Also, dormant (inactive) phases are observed in fetuses of all ages and more commonly in late gestation. Such phases usually last <10 min,[3] but can persist up to 30–60 min or longer, on occasion. It is for these reasons that FHR remains the most reliable means of evaluating fetal viability. In the healthy equine fetus, basal FHR declines[1,3,6] as gestation advances and varies in relation to activity. Abnormal FHR patterns have been well documented in distressed equine fetuses and include persistent tachycardia,[3,4] bradycardia,[1,2,4] and cardiac arrhythmias.

Peripheral pulses, where detectable, would offer a good means of estimating fetal cardiac activity in advanced gestation, when fetal size hampers ultrasound access to the cardiac area from a transrectal approach. Measurements of pulse frequency may be obtained, combining two-dimensional real-time and M-mode ultrasonography.

Most equine fetuses lie in utero in anterior presentation, from 9 mo to term.[6,8–10] Vascular structures of the head and proximal neck will therefore provide an easily accessible source of arterial pulses by ultrasonography per rectum.

In conclusion, an FCP can be consistently detected by transrectal ultrasound examination of fetuses in anterior presentation, with a gestation >180 days, when the guttural pouch area can be visualized. Calculation of FCP can be easily obtained, using the ultrasound machine software on an M-mode tracing of the external carotid artery. Finally, a positive correlation between FHR and FCP was shown. FCP evaluation may therefore be used as a reliable tool for FHR assessment and fetal viability. The technique requires standard reproductive ultrasound equipment and may provide a useful instrument for a field evaluation of fetal well being.

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[b]Opus Plus, Ausonics, Lane Cove, NSW 2066, Australia.