

Ultrasound evaluation of the equine pregnancy and identification of “high risk” conditions

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Introduction

Multiple routine and emergency circumstances in equine practice may require an in-depth evaluation of the pregnancy. Ultrasonography (US) offers safe and continuous viewing of fetal life in the mare, from completion of fetal organogenesis (day 40) to term. The combination of transrectal and transabdominal scanning techniques provides extensive investigation of fetal growth and development and monitoring of the fetal environment. Doppler ultrasonography represents an additional tool to assess fetal viability, by characterizing blood flow through maternal, fetal and placental circulations. Clinical applications of Doppler blood flow velocimetry to the pregnant mare are currently being investigated, showing great promise as a novel diagnostic instruments in the evaluation of fetal health.

Sonographic Profile of the Equine Fetus

The “sonographic” profile of the equine fetoplacental unit requires the establishment of a minimum database to ensure adequate fetal growth and development and demonstrate appropriate levels of activity and responsiveness, within an adequate environment.

Fetal Growth and Development

Several parameters can be measured to estimate fetal size. Orbital diameters/eye volume, aortic diameter, bi-parietal diameter and to a lesser extent fetal chest and femur length have all been reported as useful indicators of fetal growth. The aortic diameter correlates to fetal size more efficiently than any other anatomical structure and measurement should be taken in systole, on a longitudinal scan of the dorsal left hemithorax, in close proximity to the spinal cord of the fetus.

Fetal activity and Responsive Patterns

Fetal activity and tone reflect central nervous system (CNS) function and development, with decreased activity and declining muscular strength resulting from depressed CNS function. Activity is required to ensure satisfactory muscular development and skeletal joint function, allowing for successful postnatal adaptation. Dormant (inactive) phases are observed at all stages of pregnancy, but are more common and prolonged in late gestation, where they can last up to 60 minutes or longer on occasion. Lack of fetal movements and sudden bouts of excessive activity followed by abrupt cessation have both been associated with a negative outcome. Rhythmical breathing movements may be observed in all fetuses in advanced gestation (from 7 months), when the diaphragm is visualised. Nevertheless, fetal breathing is intermittent in nature and cannot be consistently evaluated.

Fetal Heart Rate (FHR)

FHR and FHR reactivity represent the most sensitive indicators of fetal well-being. Cardiac frequency, obtained by M-mode echocardiography and automatically estimated by the cardiac calculation software, declines as gestation progresses and increases during activity, with accelerations of 25 to 40 beats per minute (bpm) of approximately 30 seconds duration. Sustained tachycardia or a large range of FHRs may indicate fetal distress, but could be brought on by painful maternal systemic

problems or excitement. Sustained bradycardia or inappropriate FHR for gestational age, or lack of heart rate reactivity suggests CNS depression, usually attributable to hypoxia and may indicate impending fetal demise. Fetal cardiac rhythm is usually regular, and cardiac arrhythmias are commonly associated with a negative outcome. Cardiac activity may also be estimated by assessment of peripheral pulses, particularly by the fetal carotid pulse, easily accessible by US per rectum in the fetus in anterior presentation.

Adequate environment

Evaluation of fetal environment includes assessment of fetal orientation, volume and quality of fetal fluids, combined thickness and contiguity of the utero-placental unit, cervical relaxation and, of course, should confirm the presence of a single fetus.

Fetal orientation: presentation

Abnormal presentation causes dystocia and early detection may prevent a serious perinatal crisis, by implementation of specific strategies at delivery. Under normal circumstances, fetal mobility gradually declines as gestation advances and after nine months rotation along the short axis, allowing changes in presentation, is restricted by fetal body size and the encasing of the fetal hindlimbs within the gravid uterine horn. Detection of an abnormal presentation after nine months gestation should raise concern and be investigated as term approaches to formulate an appropriate plan of action.

Volume and quality of fetal fluids

The equine pregnancy includes an allantoic and an amniotic compartment. The distribution of allantoic fluid is directly related to fetal dynamics and uterine tone, with no preferential area of maximal fluid depth detectable. Amniotic fluid tends to collect more frequently around the cranio-ventral half of the fetus. Minimal and maximal allantoic and amniotic fluid depth values are reported in the literature. Pathological increases in fetal fluids have been reported (hydramnion and hydroallantois). Markedly reduced volumes of amniotic fluid (olygohydroallantois) may be observed in mares suffering from severe systemic illness. An association of the condition with a poor fetal outcome has been reported. Objective assessment of fetal fluid depth requires extensive scanning of the mare's abdomen and is best carried out during phases of fetal quiescence.

Combined thickness and continuity of the utero-placental unit

The literature reports reference values for the combined measurement of the utero-placental unit at different stages of gestation. Both uterus and placenta should present with similar echo-texture up until term, when diffuse sono-lucency of the allantoic layers of the placenta may be observed. Adequate utero-placental contact should also be maintained throughout gestation. An average combined thickness of the utero-placental unit of 1.26 ± 0.33 cm has been reported in mares with normal term pregnancies. Measurements should be taken avoiding areas of compression of utero-placental thickness by the fetus, using the ventral uterine vasculature as landmark.

Cervical Parameters

Recent data on cervical size and echotexture in the pregnant mare suggest a high degree of cervical tone maintained up to nine months gestation, followed by progressive cervical relaxation until delivery. A high degree of correlation between cervical size and sonographic appearance was also demonstrated.

Doppler Ultrasonography

Doppler ultrasonography represents an additional diagnostic instrument to characterize blood flow in the pregnant mare and provides an insight on fetal (umbilical and carotid

arteries), maternal (uterine arteries), and placental circulations (intraplacental vessels). In addition, two distinctive color Doppler signal patterns differentiate male from female fetal gonads, offering an auxiliary tool in the diagnosis of fetal gender.

Doppler ultrasonography has become an important clinical instrument for the assessment of placental performance in healthy and high risk human pregnancies, but applications to the equine pregnancies are still limited, due to the lack of reference values. In normal pregnancies, haemodynamic changes in the uterine arteries progress from a high resistance/low flow pattern during the first half of gestation to a low resistance/high flow system in the second half. Doppler velocimetry indices of the umbilical vasculature and carotid artery are currently being investigated, in order to establish fetal hemodynamic patterns, throughout gestation. Signs of circulatory derangement indicating fetal hypoxia and intra-uterine-growth-restriction (IUGR) could then be identified, as routinely done in the US evaluation of the human pregnancy.