It’s time, past time, or is it? Managed whelping and cesarean section in the dog

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The most common reasons for estimation of gestational age or determination of fetal readiness for birth are the presentation of a bitch for timed cesarean section or presumed dystocia. Timed cesarean section may be desirable in bitches with known compromised pregnancy, such as evidence of puppy loss, presence of an obstructive vaginal mass or trauma. Alternately, they may be based on risk factors for dystocia, such as breed history of dystocia, pregnancy with one or two pups, history of failure to whelp in previous litters and breed predisposition to dystocia. Techniques for estimation of gestational age and determination of fetal maturity have been described for all stages of gestation with varying degrees of accuracy and can be used singly or in combination for management of routine and high-risk pregnancy.

The easiest methods to estimate whelping dates involve breeding management. However, breeding dates provided by owners are notoriously unreliable. Parturition may occur anywhere from 57 to 72 days after a single observed breeding. On the contrary, the easiest and most accurate way to predict whelping is to diagnose or estimate the time of luteinizing hormone (LH) surge. Eighty-seven percent of bitches whelp 64-66 days following the LH surge, which can be diagnosed by repeated LH assay (every 12 hours, due to the short duration of the peak). The luteinizing hormone peak may also be estimated by observing serum progesterone levels that achieve 2-3 ng/ml and continue to rise thereafter, or by combining progesterone and LH assays. Shortly after this period, vaginal cytology may be used to diagnose the onset of diestrus, occurring approximately 51-60 days before whelping (80% on day 57).

Ultrasonographic determination of gestational age to predict whelping has been investigated extensively and several equations exist to calculate gestational age. However, results have been conflicting. In the author’s experience, ultrasonographic estimation of gestational age in early or mid-gestation is not accurate enough to predict whelping or time a cesarean section in high-risk animals. A recent publication by Gropetti and co-workers suggests that this is likely due to the need for breed-specific parameters rather than ultrasonographic capability. Nevertheless, ultrasonographic examination around day 30 after the LH surge is a reliable means of diagnosing pregnancy, evaluating gestational health or confirming gestational progression. A few parameters used by the author for approximate estimation of gestational age are listed below:

- The fetal heartbeat is visible at approximately 22-26 days.
- Limbuds, fetal movement and a fluid filled stomach may be seen on day 29, 30 and 33.
- Fetal length exceeds chorionic width at approximately day 42.

Likewise, determination of gestational age based on radiographic films has been described. Radiographic interpretation of gestational age has not been considered sufficiently accurate for management of high-risk animals. However, no recent studies have been performed comparing digital radiography to conventional film and no study has evaluated advanced radiologic techniques, such as magnetic resonance imaging. Parameters used by the author for approximate estimation of gestation age are listed below:

- The scapula, humerus and femur are first detectable 17 days (15-18) prepartum.
- The pelvis and 13 pairs of ribs are visible 11 days (9-13) prepartum.
- Teeth are visible 4 days (3-8) prepartum.

Thus, regarding prediction of whelping date, factors determined during breeding management are vital for accurate assessment and no single factor assessed during pregnancy approaches the accuracy of a known date of LH peak or rise in progesterone. However, in many instances, this information is unknown. Further, in our experience, data from breeding management or early pregnancy are insufficient in cases of high-risk pregnancy that should not be allowed to whelp naturally, as well as those cases when surgery is necessary and the aim is to perform a cesarean section at the earliest possible time. It becomes
expedient to determine fetal maturation and stress in order to affect a positive treatment outcome. Unfortunately, no single parameter is available that could determine the attainment of fetal maturity or term gestation other than the onset of labor or identification of fetal distress. Consequently, in most instances, a variety of modalities are recommended to form a “consensus opinion” of gestational age and fetal maturity prior to progressing with obstetric management.

As with early pregnancy, characteristic hormonal changes can be observed late in pregnancy, correlating with fetal maturation. Concannon and coworkers measured maternal progesterone and cortisol during late pregnancy and found that progesterone dropped from 2.6-7.8 ng/mL (average 4.5±0.6) at approximately five days prepartum to 1.9+/−0.36 ng/mL and 0.55+/−0.07 ng/mL at 24-16 and 12-8 hours prepartum, respectively. In that same group of bitches, serum cortisol levels during the last 4 days of gestation ranged from 11-43 ng/mL (average 22.9 +/-1.2). In six of seven bitches, a distinct increase in cortisol occurred 8-24 hours prior to parturition reaching 42-87 ng/mL. The rapid drop in progesterone is correlated with a temporary drop in maternal body temperature by one degree Fahrenheit, which was detected in approximately 85% of cases. This indirect measure of “maturity” is frequently used by owners, but has insufficient sensitivity and specificity for use in a hospital setting. However, in practices that have easy access to automated endocrine assays, serial measurement of progesterone is the most definitive measure of fetal and maternal readiness for birth. In the author’s practice, one to three progesterone assays are typically performed prior to timed cesarean section in order to determine fetal readiness for birth. It should be noted, however, that a single progesterone level above 2ng/mL does not have good negative predictive value (i.e., whelping can ensue on the same day even when serum progesterone concentrations are between 2 and 5 ng/mL).

Morphometric parameters, such as renal development and gastrointestinal motility, have been described as measures of fetal maturity in the past, but not gained wide traction among veterinary ultrasonographers. Gradual changes in the renal architecture may suggest fetal maturity in late gestation and gastrointestinal development and then detection of peristalsis correlate with approximately 62-64 days of gestation. Recently, Gil and coworkers described ultrasonographic interpretation of fetal gastrointestinal characteristics based on differentiation into four phases: phase I (19-24 days prepartum) – one uniform echogenic area in the region of the bowel; phase II (14-19 days prepartum) – visualization of some bowel wall segments; phase III (8-15 days prepartum) – bowel wall segments had clearly defined intestinal wall and intraluminal content; phase IV (1-6 days prepartum) – identification of complete intestinal wall, visual distinction between the mucosal surface and intestinal wall, peristalsis in all segments of the bowel. These data provide support for the use of morphometric evaluation of fetal structures in estimating fetal age and maturity. However, the authors cautioned against using gastrointestinal appearance alone to determine fetal maturity and noted that parturition occurred naturally one to four days after this was first noted.

Alterations in fetal heart rate have long been associated with impending parturition and fetal stress. Normal fetal heart rates during late pregnancy are typically 220-240 beats per minute (bpm), while fetuses that are experiencing space-constraint or metabolic stress have decreased heart rates around 180 bpm and fetuses experiencing severe distress due to hypoxia have heart rates less than 140-180 bpm. Gil and coworkers also correlated “oscillation” (increased variability, with elevated and decreased heart rates between 180 and 240 bpm sequentially in a two to four minute period) with onset of labor. Cardiotocography, or correlation of fetal heart-rate patterns with maternal contractions is a widely used, but controversial monitoring technique in human obstetrics. In addition, Gil and coworkers recently described the use of Doppler ultrasound canine umbilical arteries to predict delivery time and fetal distress. The results of this study suggested that the resistive index, an indirect measure of peripheral resistance, decreased significantly in the immediate prepartum period, with values measured at less than 0.7. In contrast, they found that animals taken to cesarean section had an initial decline and then significant elevation in resistive index and suggested that this modality may be useful in identifying fetal distress.

When factored together, the plethora of diagnostic potentials gives a high degree of security regarding timed cesarean section in high-risk animals and puppy vigor and survival should be excellent.
after cesarean section. The most complicated situations are those that require estimation of gestational age without breeding management and those that necessitate surgery prior to the “ideal” window based on breeding management. Nevertheless, serial evaluation and use of multiple diagnostic approaches provides adequate information for management of these animals.

References