Parturition management: 15,000 whelpings later
An outcome based analysis*

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The art of parturition management has been documented in breeder and veterinary literature for over 100 years. Until the mid 1990’s a system did not exist to gather and analyze objective data on parturition, specifically looking at fetal and maternal outcomes. Presented here is retrospective data, collected from an international perspective, on over 15,000 whelpings that have been collected in a “real world” scenario of breeder’s homes, veterinary offices and service dog organizations.

The WhelpWise™ service has been providing whelping support for breeders, veterinarians and service dog facilities since 1997. Since its inception, a detailed database has been maintained on patients, numbering around 20,098 since the start of business. All patients have not been included in this database as some only spent a short time on service. Our monitored database has included parity, prior dystocias, diet history, progesterone/LH timing for breeding, radiographic counts, and specific parturition events. The most scrutinized of our data analysis is parturition management; including dose and frequency of medications and their tocometric response, and the resulting maternal/fetal outcomes (live vs. deceased births and cesarean section rate).

WhelpWise™ is offered as an in-home support service for dedicated breeders. The service always works in conjunction with the client’s veterinarian; guided by specific veterinary orders provided by the veterinarian. The service monitors both uterine contractions, and fetal heart rates using obstetrical equipment specifically designed for use in the home setting. Data collected by the owner are transferred to a staffed 24 hour monitoring center. The WhelpWise™ staff functions under veterinary orders for patient management including veterinary notification of patient status, medication instructions and outcome notification. Using objective data as the base for intervention, the antiquated days of behavioral interpretations in obstetrical management are gone. Assessments and interventions can now be made on truly objective data. Clients that utilize the service are interested in bettering maternal and fetal outcomes and being proactive in the management of whelping issues. A significant benefit offered by the service is the ability to safely manage inertia through labor augmentation protocols developed specifically for canines, and designed for safe use in the home setting.

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What have we learned?
Temperature drop prior to parturition

As described in a prior study, maternal core temperature change occurs in only 33% of bitches in a predictable manner, contrary to descriptions in a multitude of veterinary resources. These time-honored studies, conducted in a controlled kennel situation, describe a change in basilar temperature, with parturition occurring eight hours after the nadir of the decline. A more recent 100 bitch, home-based, multi-breed study was conducted utilizing the uterine monitor to document the onset of labor (defined as an organized pattern of uterine contractions, not related to the presence of subjective clinical signs), showed that 35% of the time there was no temperature change of more than 1 °F. If a detectable temperature change was noted, delivery of the fetuses averaged 37-48 hours after the change rather than 12-24 hours.

Length of labor

Labor, as defined for this retrospective review, is the presence of an organized pattern of uterine contractions. Our definition of “labor” is not related to behavioral signs of parturition, temperature

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change or the presence of vaginal discharge. A uterine contraction pattern, i.e. “labor” is sustained until delivery of the fetuses is complete, and throughout early uterine involution. We have found that labor patterns will vary with breed, litter size, and abdominal mass of the bitch. Uterine contractions are detected by applying an external uterine sensor. This sensor detects changes in intrauterine pressure using a tocodynamometer specifically designed for early gestation human pregnancies. “Contractions” are traced on a linear axis, graphing changes in intrauterine pressure. As the myometrium contracts, the pressure inside the uterus will increase and as the myometrium relaxes, the pressure decreases. Uterine activity graphs are documented as time in minutes on the X-axis, and strength of the contraction shown as an increase in pressure in millimeters of mercury on the Y-axis (figure 1). It is important to note that the bitches are always monitored in lateral recumbency. This position eliminates uterine contractions caused by physical activity. These contractions, related to physical activity, are called “Braxton-Hicks” contractions in human medicine.

Figure 1. Uterine contraction. During normal gestation it is expected that uterine contractions are present in a frequency of 1-3 per hour beginning about 56 days post LH surge.

Figure 2. Labor. Presence of an organized pattern of uterine contractions. Contractions are marked with a “C” and vertical line. Note the consistency in spacing and strength.

Once first stage labor is established, our data strongly indicate that deliveries will begin on an average of nine hours from the presence of an organized pattern of labor (figure 3). The range for delivery times averaged nine to 14 hours, with a significant increase in fetal mortality and cesarean section rates when labor is extended beyond 14-16 hours. This information supports earlier studies, and reflects labor management, as the incidence of inertia is increased when first stage labor surpasses the 14-hour mark. So clear was the difference in fetal outcomes related to prolonged labor that augmentation protocols were established early in the development of the service, based on the human model of parturition management.5
Human labor management strongly documents that parturition should follow a specific progression once active labor has been established. This predictable progression of parturition has been called “Friedman’s curve” after the physician who documented that poor fetal outcomes were the result of an ineffective labor, pioneering the concept of human labor management to improve fetal outcomes.

Figure 3. Length of labor before first delivery.

Inertia

For the purpose of this review the term “inertia” will be used to describe failure to maintain an adequate contraction pattern. Inertia may be the inability to move into second stage labor, or once second stage has occurred, the lack of contractility to continue to deliver pups. We have noted that there is a very strong predisposition among breeds for “style” of uterine contraction patterns. These intra-breed patterns are also additionally affected by litter size and weight of the bitch.

Primary uterine inertia has been extremely rare (less than 0.1%). In almost every patient with acceptable timing, we have noted an attempt by the bitch to establish first stage labor. This attempt at labor is frequently asymptomatic and is not associated with a change in temperature. It is not uncommon for maiden bitches to establish a short episode (three to four hours) of mild contractions that are in a disorganized pattern that will subside and return within 12-24 hours and subsequently move into an active labor pattern. If this attempt to establish labor re-occurs more than twice without progression to active labor we have found that there is a strong correlation with dystocia commonly caused by an over-distended uterus from polyhydramnios, fetal malposition, or exceptionally large pups. Using the human model for medical management of labor, fetal outcome data consistently show that lack of progression (cervical effacement, cervical dilation and fetal head engagement) with an active labor pattern requires medical intervention, as low Apgar scores are frequently associated with prolonged labor.

Early studies evaluating whelping outcomes documented an increase in fetal loss correlated with lengthy labor. Early intervention and labor management drastically reduced fetal demise from 33% to around 6%. In one study, a prolonged first stage was associated with increased fetal death. Also noted was an increased incidence of fading puppy syndrome, 19% compared to 1% in the labor-managed group.

Secondary inertia, or the inability to progress from either stage one labor to stage two, or stage two to stage three appears to be the primary cause for fetal mortality and morbidity in our patient population. Early detection and proactive management of inertia is a priority. Whelping management protocols have been modified over the past 11 years of data collection, fine-tuning the “art” of whelping management. This fine-tuning has further decreased our fetal mortality rate to around 4% for home breeder management, and to less than 1.5% for educated whelping kennels such as service dog organizations. Our average cesarean section rate is 16% (6 % for abnormal uterine contraction patterns.
and 10% for fetal distress). When inertia is detected early we expect that 80% of our patients will respond favorably to medical management protocols, titrating small doses of either oxytocin, injectable calcium, or both, returning the bitch to her “normal” labor pattern without causing uterine hyper-stimulation or uterine tetany.

Evaluating a bitch subjectively is very difficult. As demonstrated with the uterine monitor session below (figure 4), there was absolutely no inherent contraction strength in the labor pattern, but the veterinarian evaluating the case felt that the observed “contractions were strong”. What the veterinarian was evaluating was the abdominal expulsive efforts of the bitch, as she was indeed pushing very hard. However, if the contraction strength were increased by labor augmentation, the bitch would require less physical effort to deliver the pups.

Injectable calcium

Injectable calcium has been documented as a uterotonic since 1947. The myometrium is dependent on adequate calcium levels to contract effectively, and creates its own calcium consumptive state. It is this author’s opinion that frequently calcium levels can be within an acceptable range based on traditional laboratory values. But a bitch may experience calcium-based inertia, as her calcium levels may still be within the normal range, but the decrease impacts the contractility of the uterus. Inadequate calcium levels are also suspect in bitches that establish a pattern of labor and then stop contracting. Questioning the ability of the parathyroid gland to rapidly respond to a declining calcium level because of fetal consumption, or active labor, we have seen that calcium supplementation, both oral and injectable, frequently results in an effective contraction pattern (figures 5 and 6). We have objectively noted that administration of calcium will increase the strength of contractions rather than the frequency of contractions. A study of serum calcium levels conducted at the Guiding Eyes, also has documented that low ionized calcium had direct impact on stillbirths.
Dosage range for injectable calcium has been 0.5 to 1 cc of 10% calcium gluconate administered subcutaneously. Dosage amounts are titrated to the contraction pattern; with the volume of medication calculated per 10 pounds of gestational body weight (weight at time of delivery). Adverse effects have not been noted unless a higher concentration of calcium has been used (23%). Injection sites following administration of 23% calcium have been very painful for the animal and tissue sloughs have been rarely reported. No cardiac problems have been experienced with the subcutaneous administration of the 10% solution because of gradual absorption. There have been no reports of accidental IV infusion.

In our patient population, oral calcium supplements have been successful for proactive prevention of a calcium-based inertia for exceptionally large litters, which appear to be somewhat predisposed to calcium imbalances. Beginning oral supplementation of 500-750 mg two to three days prior to parturition or as early first stage labor is established does seem to be beneficial, without noted complications of antepartum eclampsia. Presence of adequate vitamin D levels in the diet has also been significant for the prevention of calcium-based inertia. The amount of vitamin D in the diet is frequently markedly decreased to completely absent when owners feed the raw diet. Whelping complications related to this imbalance are frequently not medically manageable, and surgical intervention is required for delivery. We have not seen an improvement in contraction patterns with the oral calcium gel products, and have had several dogs using these products experience gastrointestinal bleeding after their use. Questions unanswered: Is there a role for “intelligent” calcium supplementation two to three days prior to a whelp? Would this supplementation improve labor patterns, decreasing inertia? Should supplementation be based on litter size or diet of the dam, making sure that adequate levels of vitamin D are also present in the diet?
Oxytocin

Oxytocin has been the most frequently used drug for labor augmentation. Dosing prior to the use of the uterine monitor was arbitrary, usually based on animal weight, not uterine contraction patterns. Administering oxytocin in excessive amounts can actually be a detriment to both labor progression and fetal well-being, as a hyper-stimulated uterus does not contract effectively and constriction of the myometrium impedes blood flow to the fetus. The relaxation phase between each contraction is important to allow blood to circulate to the fetus. Excessive doses of oxytocin can cause uterine rupture. According to our database, effectiveness of oxytocin is related to length of labor, with best response noted after first stage labor has been present for at least eight hours, but not more than 16 hours. Administering oxytocin before eight hours of active labor (documented contraction pattern, not clinical signs or temperature change) or after 16 hours of labor frequently has minimal effect on the contraction pattern.

From our perspective oxytocin dosing should always be titrated to the existing uterine contraction pattern, without regard for body weight of the bitch. Our general protocol begins with 0.5 unit of oxytocin, administered either subcutaneously or intramuscularly, depending on the desired rate of response and duration of action. Oxytocin is only administered after eight hours of first stage labor and documented inertia. Expected result with oxytocin is increased frequency of uterine contractions. Because of the short half-life of oxytocin, the dose is usually repeated every 45-60 minutes. If the desired response of increased uterine contractility is not achieved with the first dose, doses are increased until an adequate pattern of contractions is achieved. After administering three doses of oxytocin, incrementally increasing each dose, critical evaluation is made of the success of the augmentation. Failure to improve the inertia indicates that resolution will not be successful utilizing a medical approach and surgical intervention is frequently necessary.

With the presence of close-coupled contractions, delivery should occur within one hour. Frequently when this type of contraction pattern is noted the presenting fetal part may be palpated during a vaginal examination (figure 7).

![Figure 7. Contraction pattern with fetal/pelvic engagement. Note of interest, the bitch was sleeping during this session, showing once again that subjective clinical signs are not adequate markers of labor progression. Medication would be contraindicated with this uterine contraction pattern, and the first pup was delivered 15 minutes after the end of the session.](image)

**High risk pregnancy management**

**Premature labor**

The presence of organized uterine contractions in the canine was first documented in 1989 by van der Weyden et al, by surgically implanting electrodes in the canine myometrium. van der Weyden’s observation of the presence of one to three contractions per hour seven days before the onset of an active labor pattern has been duplicated in our patient population. We consider the occurrence of one to three contractions per hour a normal “baseline” uterine contraction pattern after 53 days following the LH
Uterine contractions occurring before day 53, especially with the presence of irritability (contractions that are less than a minute in length) are associated with a high incidence of premature delivery and/or premature placental separation. About 33% of our patients are at high-risk for premature labor, and are monitored because of a problematic history or acute premature labor. Documented conditions associated with increased premature contractions in our patient population include uterine infections, both acute pyometra and low-grade metritis; hypolutealism; and uterine contractions associated with no known cause. Regardless of the cause, premature labor has been controllable in most patients. Keys to successful management have been the early documentation of uterine contraction patterns, early intervention, and medication titration to maintain uterine quiescence.

Of particular concern for premature labor management is the presence of a pattern of irritability within the uterine contractions. Irritability is defined as uterine contractions that are less than one minute in duration (figure 8). Once a pattern of contractility is established the pattern frequently will escalate into an active labor pattern within 48 hours if not treated. Clients using the WhelpWise™ service have a high motivation for success; in most cases they have already lost litters. Our “failure” rate, or “what happens if you don’t treat the contractions” has occurred from clients that are non-compliant with treatment protocols. Clients that have not treated aggressively have gone on to lose a significant amount of pups in the litter, or lose the entire litter. Compliant clients have had overall very successful outcomes. It is also very important to note that rarely are there clinical signs associated with premature labor, nor is premature labor associated with a decline in maternal temperature. Frequently the presence of uterooverdin is the first sign of a problem with the pregnancy. In the era of dog over-population, one must ask the question, “Why do you want to breed this bitch with all her whelping problems?” The answer in many cases is because this is the last animal from a specific lineage, frequently bred as an older bitch, or

Figure 8. Uterine irritability at 27 days post LH surge, prior history of losing litter around 40-45 days of gestation. Irritability is defined as uterine contractions that are less than 1 minute in duration.
painstaking selective breeding has eliminated many adult health issues in a line, but has not been selective for good whelpers.

Medications for premature labor management

**Antibiotics.** As documented in both human and veterinary medicine, infection plays a significant role in preterm labor because of prostaglandin F2alpha release with resulting leutolysis. The presence of infection can be difficult to ascertain and frequently high-risk bitches, especially those with a prior history of infectious loss, are prophylactically placed on antibiotic therapy.

**Tocolytics.** Terbutaline is one of the most frequently used drugs in the treatment of human preterm labor. Terbutaline is in the class of drugs called beta-mimetics. These beta2-adrenergic receptor agonists are sympathomimetic, causing smooth muscle relaxation by decreasing free intracellular calcium ions. Controversy exists in human medicine about the long-term effectiveness of terbutaline; some of this controversy is related to the b-site saturation causing the drug to become ineffective. Titrating doses, beginning with the smallest effective dose, proactively monitoring uterine activity, and increasing the doses in very small amounts to control uterine contractility has proven effective in human medicine. The author believes that the primary reason for our success with terbutaline is that we do not begin with an arbitrary dose, but rather titrate the dose to control uterine contraction patterns of concern and increase the dose as needed. Most owners of high-risk patients do not want to take the chance of any fetal loss, and will elect to perform a cesarean section. Of those that do choose to free whelp, the incidence of fetal distress or severe inertia is high (70%), so clients are informed before the parturition date of the potential risks of a free-whelp.

**Hypolutealism**

Progesterone decline during gestation leading to active labor has been well accepted in veterinary research. What is unclear from our database is the correlation of an “acceptable” level of progesterone with a specific point in gestation, factoring in the litter size and prior history of litter loss or breed pre-disposition for hypolutealism. Data from our high-risk patients strongly suggests that a progesterone level “greater than 2 ng/ml will maintain a pregnancy” appears valid only in the last 2-3 days of gestation. Documented progesterone levels within our patient population range greatly, and are strongly influenced by the breed of dog and the number of whelps in the litter. In our high-risk patients proactive uterine and progesterone monitoring have given early evidence that the existing progesterone level, regardless of laboratory value, is not adequate to promote a healthy uterine environment. For patients experiencing preterm labor that is hypoluteal based, frequency of measurement of progesterone levels or adding supplemental progesterone and subsequent dose changes have been based on the presence or absence of uterine contractions. Cooperative management with the clients’ veterinarians, evaluation of uterine contractility, actual progesterone levels and fetal well-being have provided an effective team approach.

In patients experiencing hypolutealism, we have seen the best response and long term stability when using injectable progesterone (50 mg/ml) in a carrier such as sesame, apricot, or cottonseed oil. The oil-based medication is absorbed slowly and maintains a more constant progesterone level. The efficacy of this type of therapy can also be documented through laboratory testing. Doses have ranged from 1-3 mg/kg, given QOD to every fourth day, with dosing schedules determined by both laboratory values and uterine monitor results. Using the uterine monitor provides an early warning that uterine quiescence is not being achieved with the current dose plan, allowing the veterinarian to evaluate serum levels and adjust doses if necessary. Weaning from progesterone as term gestation approaches, using the uterine monitor to adjust doses and maintain a contraction-free uterus also allows a safe reduction of the medication and promotes a normal transition into lactation and maternal skills.

Oral progestins (altrenogest, Regumate®, Intervet-Schering-Plough Animal Health, Millsboro, DE; and progesterone, Prometrium®, Solvay Pharmaceuticals, Marietta, GA) have not shown significant impact in the control of uterine contractions in our patient population. While they appear somewhat effective in some patients, the majority have not demonstrated a stable uterine environment. Questions
unanswered about the use of oral progesterone supplements and their lack of impact on uterine contractility would be the effect of the canine gastric pH and canine metabolic rate on the absorption and metabolism of the oral medications.

In extremely difficult cases of premature labor combinations of progesterone, terbutaline and antibiotics have been employed. Management of these exceptionally high-risk patients relies on day-to-day observation, documentation, and modification of treatments to achieve the goal of term gestation. Unfortunately, because of the multifaceted nature of high-risk pregnancy management, no specific “cookbook” management technique exists.

**Neonatal resuscitation**

The most commonly observed cause of neonatal death in our patient population is hypoxia related to absent or poor placental perfusion during labor, a torn or ruptured umbilicus during delivery, or suppression of respiration from either metabolic acidosis or anesthetics. The hypoxic-metabolic-acidotic state creates a vicious cycle of further respiratory depression. Breaking this cycle can be difficult.

Establishing respiratory effort is of paramount importance. Because of size and skill limitations, intubation and mechanical ventilation are frequently impossible, especially in the home setting. Supplemental oxygen is helpful, but only if there is respiratory effort. Over-riding the central nervous system’s inability to initiate respirations can be accomplished in two ways.

**Doxapram hydrochloride**

Reports in the human literature indicate that doxapram hydrochloride (Dopram-V®, Fort Dodge Animal Health, Ft. Dodge, IA) is effective in stimulation of the respiratory center in severely premature infants, however it has received criticism in recent studies. In these studies doxapram was administered to maintain respirations until the neurologic respiratory center reached maturity in infants born between 25-27 weeks of gestation (40 weeks for full term). Side effects noted from the use of the drug were developmental delays. When evaluating the ineffectiveness of the drug it would be important to look at all aspects of prematurity, not just the possibility that doxapram caused developmental delay. Factors not evaluated by the studies were the deleterious effects of long-term mechanical ventilation which may have more untoward effects than did doxapram. In the veterinary literature there are mixed reviews on the effectiveness of doxapram, but it has been our experience that it is very useful in stimulating respirations in apenic pups, especially in the home setting.

For severe respiratory depression we have found the best success with administering doxapram IM in the caudal thigh muscle, as this is usually the largest muscle mass in a pup. Injecting the drug sublingually can cause extreme pain in the surviving neonate and prevent effective nursing. For mild respiratory depression, oral administration is mildly effective, but suctioning of mucus frequently removes the drug. Doxapram doses are titrated to the level of distress (presence of any respiratory effort, and neonatal heart rate). We typically suggest the IM dose of 0.01cc, watching for the usual doxapram “flush”, a profound redness of the mucous membranes. This flush is a positive indication that the drug is circulating in the system and respiratory effort should soon follow. If the flush is not noted, repeated injections are administered until the flush is observed. Additionally cardiac rate is assessed and cardio-pulmonary resuscitation is performed if the pup does not become stable.

**Accordion squeeze**

The accordion squeeze is an easy method for novice owners to create negative and positive chest pressure in the puppy. These pressures help to stimulate cardiac activity and will actually draw air into the puppy. The “squeeze” is done by firmly grasping the head and shoulders of the pup in one hand, the pelvis and rear legs in the other. The pup is compressed and then retracted, keeping the head substantially lower than the pelvis. This position will also help drain fluids from the pup. The “squeeze” is alternated with suctioning, doxapram and cardio-pulmonary resuscitation for very distressed pups.
**Anesthetic depression**

Naloxone hydrochloride

Naloxone hydrochloride (Narcan®, Endo Pharmaceuticals, Inc., Chadds Ford, PA) is used to reverse respiratory depression caused by opioids and has no effect on other causes. The dose is 0.1 mg/kg and can be given IV, IM or SQ.

**Diazepam**

The use of diazepam (Valium®, Roche Pharmaceuticals, Nutley, NJ) in obstetrics is very controversial, as the medication does cross the placenta, and will concentrate in the fetal tissues. Because of the immaturity of the liver, the pup is unable to metabolize the drug and can die from the severe respiratory depression. The only drug that will reverse the effects of diazepam is flumazenil.

**Supportive methods**

DeLee mucus trap

The DeLee mucus trap is very effective at removing mucus from the posterior nasal cavity, aspirated fluids and gastric contents. Frequently in distressed pups a large amount of fluid exists in the stomach, preventing effective expansion of the lungs and chest cavity. Removal of this fluid by the specially designed suction tube both increases lung capacity and stimulates the gag and respiratory reflexes. It is especially useful for removing aspirated fluid and decreases the incidence of meconium aspiration pneumonia.

Warmth, glucose, and fluids

Once respirations and stable heart rate are established supportive care is of utmost importance. Recovering from a difficult delivery frequently leaves minimal glucose stores for the pup to convert to energy, and if placental function has been decreased, they may be born hypoglycemic and dehydrated. We have found that stressed neonates recover faster if they receive a dextrose or glucose supplement. Dextrose and/or fluids can be given either by tube feeding, or fluids only by subcutaneous infusion. Warmed half-strength formula seems to be the most effective first feeding in a stressed neonate and should be given to the pup at the rate of 0.5 to 1 cc per ounce of body weight initially, and every two hours thereafter, slowly increasing to full strength as the pup is able to digest the formula and the dehydration is resolved. Half-strength formula is especially important for premature pups as their ability to digest protein appears to be decreased. As soon as the pup can transition to nursing on the dam, tube feeding may be eliminated. If nursing is not possible, formula should be fed at the rate of 1cc/ounce of the pup’s body weight, administered every two hours.

**Whelping success**

Successful management of all aspects of medicine is dependent upon objective information on which to base decisions. Management of diabetic patients requires the measurement of blood glucose parameters to determine how to dose insulin, orthopedic problems require radiographs or magnetic resonance imaging to assist the veterinarian with the diagnosis. Maternal and fetal management is no different. The best whelping outcomes will be achieved when decisions are based on objective data, and whelping issues are detected early, with interventions based on objective rather than subjective data.

**References**
