

Challenges in small animal parturition—Timing elective and emergency cesarian sections

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Abstract

Given the societal emphasis placed on the deliberate breeding of purebred animals, the practitioner today is faced with issues relative to successful parturition in these animals. Today, the serious hobby breeder expects to use planned breeding management to result in a high conception and pregnancy rate and survival rates of offspring that may exceed published parameters. These clients may elect to schedule cesarean section to maximize puppy survival and assure that they have access to quality veterinary care. Using a combination of hormone assays, temperature changes in the dam and carefully timed and documented breeding management, a cesarean section can be planned. Emergency cesarean sections will still be required for the bitch that experiences dystocia or a medical condition that warrants intervention. Timed cesarean section results in a favorable medical outcome for the dam and litter and a better financial outcome for the owner.

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1. Emotional considerations

Coincident with the intensity of the human-animal bond and the passion with which breeders (owners) make decisions to commit to specific dog breeds or a specific animal comes the necessity for options in the production of the next generation of dogs. For most committed dog breeders, what begins as a hobby with a single pet animal becomes an avocation as their education and areas of competition explode. Literally the changes made in their lives are dramatic, as every uncommitted minute and dollar becomes devoted to the “dog sport”. Consequently, these breeders expect and require the best possible outcome for each litter—a live, healthy re-breedable bitch and a litter of viable puppies.

2. Financial considerations

The average purchase price of a well bred, registered puppy in the Midwest today is well over \$1200; prices on both coasts are substantially higher. Puppies of certain breeds and puppies of potential conformation show quality often sell for two to three times that amount. Stud services vary tremendously in cost with ranges from \$500 to >\$2500. Many of these stud service fees will be augmented by the costs of chilled or frozen semen (or both). The success or failure of a breeding program is greatly influenced by the expertise of the veterinarian. The dog of a lifetime may be in any one of these litters. In these breedings, ancillary costs such as veterinary fees, semen collection and extension, shipping fees, and tank rentals are borne by the bitch owner.

The American Kennel Club requires semen collection/extension and insemination with chilled semen be performed by a licensed veterinarian. Visit the American Kennel Club's website (www.AKC.org) to

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download forms for registration of a litter from chilled semen. It is important that any veterinarian whose clients register their dogs with the American Kennel Club familiarize themselves with the requirements for registration of litters with AI; failure to properly comply could jeopardize registration privileges. This author advises all breeders carefully consider the financial, personal and ethical commitment needed to appropriately breed dogs; I suggest that the client be prepared to sustain a loss of at least \$2000.

3. Rationale

As veterinary care has advanced, so has the request for assisted reproductive technology. These technologies include semen preservation, ovulation timing, estrus induction and management of parturition. In human medicine, there has been an increase in demand for delivery by cesarean section over vaginal delivery. The health balance is in favor of the baby delivered by planned cesarean section over vaginal delivery [1]. Using maternal morbidity and mortality statistics, the argument for a planned cesarean section stands. In several studies, pregnant women preferred cesarean section over vaginal delivery [2,3]. Many obstetricians and gynecologists prefer vaginal delivery, but agree that the mother has the right to request cesarean delivery. When considering elective cesarean section, the clinician must take into account the improved anesthetic techniques and the decrease in morbidity and mortality after cesarean section and the patient's autonomy. In humans, most studies comparing elective cesarean section and vaginal delivery finds them equally safe [1–4]. The same is not true for cesarean associated with trial labor. Cesarean section during labor in humans does result in high risk to the mother and the fetus [5]. Does that mean that this author wholesale recommends cesarean section over vaginal delivery? NO!! It does mean that as clinicians we should be prepared to counsel, treat and respect a client's right to elect a cesarean section for their bitch.

In 2006, the American Kennel Club registered 413,957 litters of puppies. More than 130,000 of these litters were of breeds with a high incidence of dystocia [6]. These breeds include Bulldogs, Pugs, Boston Terriers, French Bulldogs, Boxers, Shih Tzu, Yorkshire Terriers, and Labrador Retrievers. These statistics do not include the many unregistered litters or litters registered with other registries such as the United Kennel Club (UKC) or the Field Dog Stud Book (FDSB). Cesarean sections should not be considered a last resort.

4. Elective cesarean sections

4.1. Selection criteria

The selection of a bitch for planned cesarean section may include any of the following criteria: nulliparous bitch ≥ 6 years of age, litter size of two or less, litter size of eight or more, brachycephalic breed, a bitch with a previous history of dystocia, owner lives in an area with limited access to after-hours care, or a bitch with a familial history of dystocia. The final decision on a planned cesarean section involves cooperation and discussion between the bitch owner and the clinician. The bitch owner may choose a cesarean section to maximize puppy survivability in a particularly precious breeding.

Late-term radiography is the best modality for accurate assessment of litter size. Radiography may also reveal an emphysematous fetus or fetal skeletal or skull collapse, consistent with fetal death [8]. In the event that breeding dates are suspect, radiography can be used to approximate fetal maturity. The pelvic bones are apparent by Day 57; the caudal vertebrae, fibula, calcaneous, and paws are observed later [7,9]. Ultrasonography also allows assessment of fetal maturity based on published data [10,11].

In an ideal situation, the clinician will know the date of the LH surge as a result of progesterone concentrations measured during the breeding management process. Planned cesareans can be safely performed after Day 63 after the LH surge [12]. With the ability to measure progesterone concentrations in the clinic, cesarean sections can be scheduled when the progesterone concentrations reaches ≤ 2 ng/mL. Progesterone is a thermogenic hormone; decreased progesterone concentrations are followed by decreased rectal temperature [12,13]. Clients may be instructed to measure and record rectal temperatures two or three times daily and to request the cesarean when the rectal temperature is 37.2 °C (99.0 °F) or lower.

Concurrent with radiography or progesterone determination in late-term pregnancy, it is prudent to perform a complete blood count. Although bitches typically have a decrease in hematocrit during pregnancy due to increased plasma volume [12,13], an occasional bitch will have a more dramatic decrease to below 30 and some bitches may exhibit platelet dysfunction. If there is any question regarding timing the cesarean section, a Welch Allyn sigmoid illumination system with a disposable 24 cm speculum can be use to visualize the cervix; this is better than an endoscope for visualization of the vagina and cervix.

4.2. Surgical technique

Once cervical dilation is apparent or if fetal membranes are visualized, the cesarean section can be performed. It is prudent to place a cephalic catheter and institute fluid therapy with appropriate fluids prior to induction of anesthesia. This author routinely uses lactated ringers with 5% dextrose. Dexamethasone is given iv to improve lung surfactant production in the puppies and to assist with overall anesthetic stability of the bitch [12,14].

The bitch should be prepped for surgery prior to induction in order to decrease the duration of anesthesia. A variety of induction regimens have been utilized. The bitch should be premedicated with either glycopyrolate (0.011 mg/kg im or sq) or atropine (0.04 mg/kg im or sq). Induction agents reported to be associated with a positive outcome include propofol, diazepam, oxymorphone, hydromorphone [15–18]. In the author's hospital, hydromorphone (0.05 mg/kg) is the induction agent of choice. Induction agents reported to result in fetal depression include ketamine, thiopental, and other barbiturates [15]. The use of line blocks may decrease the overall anesthetic requirement. Inhalant anesthetics are used for maintenance of anesthesia following mask pre-oxygenation prior to intubations. Appropriate inhalants that may be used include isoflurane, sevoflurane, desflurane, and halothane [15–18]. General anesthesia is preferred over local anesthesia to prevent movement of the bitch and regional vasodilatation.

The cesarean section is performed in a routine manner. A midline incision is used to exteriorize the uterus. A single uterine body incision is made to facilitate delivery of each puppy and its placenta. Puppies are 'milked' towards the single incision, although on some occasions it will be necessary to make an additional incision in the uterine horns. The uterus is carefully inspected and palpated to ensure that all puppies and placentae have been delivered. Any unusual uterine debris observed should be cultured and uterine biopsies obtained at this time if deemed necessary. The uterine incision is closed in two layers with a Cushing suture pattern. Oxytocin is administered intramurally to promote uterine involution and reduce hemorrhage. This author lavages the abdomen with warm saline and infuses the abdomen with ampicillin prior to closure. The abdomen is closed in layers in a routine fashion. Excessive uterine hemorrhage may necessitate the use of ergonovine. The author uses a human product, Methergine[®] (Novartis), packaged in 1 mL vials containing 0.2 mg of ergonovine; a typical dose is 10–30 µg/kg im.

The puppies are resuscitated, dried well and placed in an incubator, providing warmth and humidity. If the puppies are not vigorous, they are given supplemental oxygen and respiratory stimulants such as doxapram and/or the Jen Chung acupuncture site is used [16]. For the latter, the clinician inserts a 25 gauge needle into the nasal philtrum at the base of the nares, presses, and twists briefly. Doxapram is minimally effective if used without oxygen supplementation. Any reversible induction agents used in the bitch may also be reversed in the neonate.

5. Dystocia

Dystocia is difficulty in delivering fetuses through the vagina. Dystocia may involve failure to initiate labor, failure of progression during labor, situations compromising the dam, and fetal compromises [13,16]. Dystocia can be caused by dam factors, litter or fetus factors, or a combination of both. Fetal factors predisposing to dystocia include singleton litters with one large puppy, anasarctic fetuses (commonly in brachycephalic breeds), hydrocephalus, fetal monsters, and abnormal presentation of the fetus. Transverse presentation can occur and account for a substantial percentage of dystocias of fetal origin [19]. With transverse presentation, the bitch may stop uterine contractions. Also, two puppies can enter the uterine body simultaneously, resulting in a "traffic jam". Posterior presentation with rear limbs presented first is normal in the dog and cat, however, a true breech in which the hips are flexed under the puppy presenting the hips first is not normal [16]. Many cases of dystocia are associated with fetal malposition [19].

Maternal factors contributing to dystocia include obstruction from healed pelvic fractures, vaginal tumors or vaginal strictures, improper maternal environment, and nervousness [13,16]. The whelping bitch should not be bothered by visitors. Primary uterine inertia is a failure of the uterus to contract or to contract in an unorganized fashion [13,16]; this can have a familial basis and will result in fetal loss due to placental separation if intervention does not occur. Primary uterine inertia may occur with small litter size, large litter size, hypocalcemia, and uterine torsion. Primary uterine inertia may also be associated with low serum oxytocin concentrations in bitches with normal serum calcium concentrations [20].

Secondary uterine inertia generally occurs from uterine exhaustion. In this condition the uterus fails to respond to oxytocin administration and the Ferguson reflex (straining when pressure is applied per vagina to the pelvic canal) is absent. The exhaustion may be due

to large litter size or due to prolonged effort to deliver a large fetus. Hypocalcemia may also contribute to secondary uterine inertia [13,16,20].

5.1. *Diagnosis of dystocia*

The following criteria may be used to reach a diagnosis of dystocia [13,16,19]: (1) prolonged gestation when ovulation date is known; (2) the pregnant bitch is 72 days post-breeding; (3) the bitch strains for 1 h continuously before the delivery of any puppy; (4) a green or black vaginal discharge is seen prior to delivery of the first puppy; (5) the bitch rests ≥ 3 h between puppies; (6) the bitch delivers still-born puppies; and (7) the dam appears to be ill or distressed.

5.2. *Treatment protocol*

A complete physical examination should be performed to assess temperature, pulse, respiration, hydration status and capillary refill time to assess maternal compromise. Check the bitch's sclera; scleral injection reflects stress. The chest should be carefully auscultated. Examine the abdomen and perform a vaginal examination to identify the presence of a puppy in the vagina. Ensure that the bitch is pregnant! An abdominal radiograph should be done to confirm the number of remaining puppies. The bitch should have a complete blood count and serum chemistries (including glucose and calcium) performed. If the bitch is fatigued or there is fetal distress, proceed with a caesarean section. Puppy deaths increase rapidly with prolonged Stage II labor from 5.8% in labors of 1–4.5 h to 13.7% in bitches treated 5–24 h after onset of Stage II labor [19].

5.3. *Neonatal support*

Ultrasonography should be used to assess fetal stress and viability. The normal heart rate of the fetus is ≥ 200 beats/min. A fetal heart rate < 180 beats/min is a sign of fetal distress, whereas a fetal heart rate < 160 beats/min warrants emergency intervention. In one study, rapid intervention reduced fetal mortality from 9 to 3% [9]. In cases of dystocia, proceed promptly with surgical intervention [10,15,17]. The combination of rapid diagnosis and rapid surgical intervention result in the best outcome for the bitch and the litter. Caesarean section performed in private practice has been associated with much higher puppy viability than when performed at a teaching institution [15].

Once the diagnosis of dystocia has been made, support the bitch with intravenous fluids, prepare her for

surgery, and proceed rapidly to perform the caesarean. Support staff trained in resuscitation of the neonate should be available so that each puppy receives one-on-one care. Neonatal survival is dependent on rapid intervention and trained assistants. Resuscitation equipment includes a warming box or incubator, bulb syringes or other airway suction devices, hemostats, scissors, suture material, supplemental oxygen, and supportive drugs [16]. The puppy's head should be cleared of fetal membranes. The puppy should be stimulated with towels and may be swung gently, provided the head and neck are carefully supported. A suction apparatus may be needed to clear the airway. Respiratory stimulants (e.g. dopram) may be administered in an oxygen-rich environment (incubator or face mask). Cardiac compression may be used, but must be accompanied by respiratory support.

6. **Summary**

Properly timed cesarean section is an appropriate therapeutic modality to be used in small animal reproduction. The use of planned cesarean sections will result in favorable outcomes for the bitch and her litter. Additionally, the breeder will minimize financial outlay by avoiding emergency clinic visits and will maximize the opportunity to produce the next great dog.

7. **Case studies**

7.1. *Planned cesarean section*

7.1.1. *Case 1*

A 3.5-year-old female Afghan hound was presented for an elective cesarean section. She was surgically inseminated on 7 July 2005 with frozen-thawed semen; her serum progesterone concentration at breeding was 17.6 ng/mL. She presented on 6 September 2005 with a rectal temperature of 37.2 °C and dripping milk. A cesarean was performed and two live, large puppies (553 and 468 g, respectively) were delivered.

7.1.2. *Case 2*

A 2.5-year-old Nova Scotia Duck Tolling Retriever was presented on 1 October 2004 for a pre-breeding examination. The physical examination was unremarkable, except for a wide vaginal band running vertically within the vagina. Her vaginal smear was 90% cornified and her progesterone was 0.35 ng/mL. The owner was advised that the vaginal band could interfere with whelping. The bitch was artificially inseminated in North Dakota on 12 and 13 October 2004. Pregnancy

radiograph on 8 December revealed nine puppies. The vaginal stricture was present and not relaxed. A cesarean section was planned, based on temperature drop. On 12 December, she was presented with a rectal temperature of 36.9 °C and no signs of labor. Cesarean section was performed, yielding nine healthy puppies.

One 21 January 2006 this same bitch was presented for a determination of serum progesterone concentration. The client had elected to use frozen semen. Serum progesterone concentrations were <0.20, 1.5, 7.3, and 20.2 ng/mL on 21, 26, 27, and 30 January, respectively. She was surgically inseminated on 30 January. Ultrasound on 1 March revealed at least six puppies; radiography on 24 March 2006 revealed eight puppies. A cesarean was performed, based on a temperature decrease to 37.1 °C and 64 days from the LH peak (based on progesterone concentrations). Eight live puppies were delivered.

On 5 September 2006, the bitch was again presented for timing of breeding with chilled semen. Progesterone concentrations were 0.43, 1.3, and 5.1 ng/mL on 5, 9, and 11 September 2006. The bitch was inseminated transcervically on 13 September (progesterone, 14.9 ng/mL) and vaginally inseminated on 14 September (progesterone, 17.2 ng/mL). Ultrasound on 10 October revealed at least three puppies; radiographs on 7 November 2006 revealed five puppies. At cesarean section on 15 November (based on temperature decrease and 66 days after the LH peak), five live puppies were delivered.

7.1.3. Case 3

A 4-year-old Pug bitch, pregnant with her third litter, was presented. She was bred 16, 19 and 21 March 2006 (progesterone concentrations were not measured). On 12 May, pregnancy radiograph revealed five puppies. The client always requests cesarean sections based on temperature drop. On 16 May, the bitch presented with a history of a temperature drop to 37.0 °C at 04:00. On presentation at 09:00, the bitch was bright, alert, active with minimal milk present. Vaginoscopy revealed a closed cervix. Body temperature was 37.6 °C in our office. Progesterone was 2.8 ng/mL. Cesarean section next day (17:00) resulted in five live puppies and a healthy bitch.

7.2. Emergency cesarean sections

7.2.1. Case 4

A 3.5-year-old Labrador Retriever, was bred by intravaginal AI on 20 August 2005 (progesterone concentration, 11.2 ng/mL) and by transcervical AI on 25 August (progesterone, 21.4 ng/mL). On 23 September

2005, based on ultrasonography, litter size was estimated to be at least six puppies (six puppies were confirmed by radiographs on 13 October). On 18 October, she was presented as her temperature was 37.3 °C. The cervix appeared closed on vaginoscopy and progesterone was 1.0 ng/mL; a cesarean section was recommended but declined by the owner. Approximately 24 h later, the bitch was brought back to the clinic, distressed and in Stage I labor. The client agreed to a cesarean section. The bitch had one puppy in one horn and five puppies in the other horn with the heavy, gravid horn entrapping the other horn, resulting in uterine torsion. The bitch and six puppies all had normal recoveries.

7.2.2. Case 5

A 2.5-year-old Samoyed bitch, bred on 5, 6, and 7 October 2002 with no timing or veterinary assistance was presented on 3 December. Radiology revealed eight or nine puppies. A signed form was returned to Whelp Wise[®], indicating my desire for communication any time of day or night. The client called at 13:00 and reported that the bitch was “not right”. There had been no temperature drop. Whelp Wise[®] had advised the client that there was no labor and everything was fine. On presentation, the bitch had injected sclera and tacky mucous membranes with a yellow vaginal discharge. Vaginoscopy revealed an open cervix with fetal membranes visible. Ultrasound revealed live puppies, but two puppies with heart rates <160 beats/min. A cesarean section was performed at which time a right horn uterine torsion was diagnosed. The bitch and nine live puppies made an uneventful recovery.

7.2.3. Case 6

A 6-year-old Afghan bitch presented for ovulation timing and breeding with fresh semen. Progesterone values were as 1.2, 0.9, 6.4, and 25.8 ng/mL on 1, 3, 7, and 9 July 2003. Vaginal insemination with excellent quality, motile semen was performed on 9 July. On 22 July, the client called to report a 3-day duration of a green vaginal discharge which became reddish today. Physical examination was unremarkable except for a mucopurulent vaginal discharge. Vaginal cytology indicated diestrus, with greatly increased PMN's. Vaginal culture (guarded swab) yielded no growth. The bitch was placed on prophylactic amoxicillin. Pregnancy ultrasound on 4 August revealed multiple (4+) fetal vesicles; six puppies were detected radiographically on 30 August. The client requested a cesarean section based on temperature decrease. On 1 September, the bitch was suddenly “off” and had a temperature of 36.7 °C, was in shock, with injected

sclera, a slow capillary refill time, thready pulse and tachycardia. The abdomen was painful on palpation. Vaginoscopy revealed a partial cervical dilatation. On ultrasonography, the fetal heart rates were >200 beats/min. After discussion with the owners, it was decided to treat the bitch for shock and surgically explore the abdomen. The clients were warned that this was a premature litter and there was a substantial risk of fetal loss. A midline incision was made. The dam had substantial subcutaneous edema. The right uterine horn had a 180° torsion at the ovary and an additional twist midway between the ovary and uterine body. There was a single puppy in the uterine body. The entire right horn had excessive fluid present. A single uterine body incision was made.

A very premature live female puppy was delivered. She was hairless on her muzzle and distal extremities. Once she was delivered, the uterine torsion was reduced and the uterus and abdomen were closed in a routine manner. The remaining five puppies were NOT delivered. The bitch and puppy were sent home. The puppy was given 0.8 mL of the bitch's serum IP as an antibody source. Daily follow up ultrasounds indicated fetal growth, activity and normal heart rates. On 6 September 2003 ultrasound showed fetal bradycardia so another cesarean section was performed. Five live puppies were delivered normally. These puppies were also a little small but had normal hair coats.

Post note: The single puppy bitch delivered 5-day before her littermates and two of her male siblings are now AKC champions.

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