

Surgical management of canine and feline dystocia

A.M. Traas*

Department of Clinical Studies, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA 19104, USA

Abstract

If medical management of dystocia has failed or is inadvisable, a Cesarean section is indicated. The necessity of surgery is primarily based on the condition of the dam, progression of labor, and fetal heart rate. Timely intervention is crucial for optimal fetal and maternal survival. Surgical technique may vary, based on the needs of each individual case. There are many options for each portion of the surgery, including the choice of anesthetic protocol, abdominal approach, uterine incision location, and post-surgical pain management. Indications for surgery and some of the options for each step of the procedure are presented. Episiotomy is rarely used to treat dystocia and therefore, it is discussed only briefly.

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1. Introduction

Surgical intervention is required in approximately 60–80% of dystocia cases in the bitch and queen [1]. Cesarean section is common in small animal practice, especially practices devoted to reproduction or emergency and critical care. In one study, 58% of Cesarean sections were performed on an emergency basis [2]. Timely and appropriate interventions for dystocia, either medical or surgical, are crucial for both maternal and fetal survival. Determination if surgery is necessary is based primarily on the condition of the dam, progression of labor, and fetal heart rate. The surgical technique may vary, based on the needs of each individual case. There are options for each portion of the surgery, including the choice of anesthetic protocol,

abdominal approach, uterine incision location, and post-surgical pain management. In determining the appropriate interventions, veterinarians rely on the literature. Unfortunately, many current standards of care lack supporting evidence in the form of randomized, controlled prospective clinical trials. Therefore, we often rely on retrospective studies, our experiences as practitioners, inference based on studies in humans, and common sense. This article attempts to present traditional methods, as well as alternatives, for Cesarean section. A less common surgical intervention for dystocia is the episiotomy; it is rarely performed, and therefore will be discussed only briefly.

2. Indications

The foremost indication for Cesarean section is a reduction in fetal heart rate, indicating fetal stress. A fetal heart rate <150 beats/min is considered an emergency and a Cesarean section should be performed as soon as possible. A rate of 150–170 indicates moderate to severe fetal stress, whereas rate >180

* Correspondence address: Matthew J Ryan Veterinary Hospital, University of Pennsylvania; Room 181e Old Vet Quad, 3800 Spruce Street, Philadelphia, PA 19104-6010, USA. Tel.: +1 215 573 7751; fax: +1 215 746 1970.

E-mail address: atraas@vet.upenn.edu.

should be considered normal. It is noteworthy that a brief reduction in heart rate (usually determined with ultrasonography) may occur due to passage of a uterine contraction over a fetus. Therefore, any fetus with a low heart rate should be monitored for 30–60 s, or reassessed 1–2 min later, to ensure that the low heart rate is caused by fetal distress, rather than a uterine contraction.

Other indications for Cesarean section include maternal abnormalities of the birth canal (e.g. vaginal hyperplasia/edema complex, vaginal neoplasia, vaginal strictures or septums, pelvic fractures, etc.), obstructive dystocia that cannot be manually corrected rapidly, inadequate or no response to medical management (i.e. oxytocin and calcium), primary or secondary uterine inertia, or suspicion of uterine rupture or torsion. In a survey of Boxer dogs, the most common indications for Cesarean section were fetal malpresentation (26%) and primary uterine inertia (60%) [3].

In this author's experience, when there was doubt regarding the need for a Cesarean section, choosing surgery usually resulted in the best outcome for both dam and neonates. In that regard, prolonged dystocia (>4.5–6 h) increased the incidence of puppies that were dead at birth [4–7].

3. Preparation

The female should be stabilized as much as possible prior to surgery, by treating shock, dehydration, electrolyte imbalances, and any other biochemical or hematological abnormalities.

Owners should be counseled about the risks to both dam and neonates if surgery is performed, or not performed. In addition, owners should be asked about their plans to re-breed the bitch or queen. If additional offspring are not desired, ovariohysterectomy at the time of surgery may be offered, if the dam is in appropriate condition for a slightly longer surgery. It should be mentioned that there are additional risks associated with ovariohysterectomy at this time, including increased risk of hemorrhage and severity of hypovolemia (due to the removal of the uterus and associated fluids). Ovariohysterectomy during Cesarean section should not decrease milk production, provided that fluid intake and pain are managed appropriately.

Owners are occasionally reluctant to consent to a Cesarean section, due to fears that once their dog or cat has had the procedure, that it will be more likely to need one again. However, in most animals that subsequently need another Cesarean section, it is due to the underlying condition (uterine inertia, vaginal stricture,

etc.) and not the previous surgery. Therefore, if the owners are planning to re-breed their female, the cause of dystocia should be determined, and if it is likely to recur, they should be advised.

In this author's experience, with proper uterine closure, dogs in dystocia that were obstructed due to fetal malpositions or malformations, had vaginal deliveries with subsequent pregnancies. Many of these dogs were bred surgically at the next estrus, and the uterine suture lines were no longer evident at that time. Additionally, in dogs that needed more than one Cesarean section (for any reason), the uterine incision(s) were no longer visible in most dogs at surgery, even when bred at the next estrus.

4. Anesthetic protocols

The most important components of the anesthetic protocol are time (interval to induction and from induction to delivery of all neonates), maintenance of uterine blood flow, and the ability to reverse anesthetic effects in the neonate. If neonates are exposed to anesthetic agents for only a short interval, many of the negative effects can be reversed. However, prolonged induction and delayed delivery increased fetal hypoxia and depression [8]. Post-operative ability of the dam to care for her puppies is also very important. In that regard, sedation following surgery may inhibit this ability (for up to 24 h) due to dysphoria, disorientation, clumsiness, and decreased maternal behaviors.

It should be noted that many bitches and queens will have eaten prior to anesthesia, increasing the risk of aspiration. In addition, bitches or queens who have already delivered vaginally may have consumed fetal membranes. Therefore, care should be taken to place a cuffed endotracheal tube in these patients as quickly as possible after induction, to limit the risk of aspiration.

4.1. Medications

This paper cannot cover all considerations for every possible drug. No anesthetic protocol is ideal for both the dam and the neonates. Furthermore, alpha-2 agonists (xylazine, medetomidine), ketamine, thiobarbiturates (thiopental and thiamylal), and methoxyflurane should be avoided [9–10].

Opioids are excellent pain medications in the dam. Although they have some depressive effects on the fetuses, they are easily reversed in neonates. Opioids with a prolonged duration of action should be avoided prior to delivery, as they may outlast the reversal effects of naloxone. Therefore, short-acting opioids are best

used initially, whereas longer-acting opioids may be used for post-surgical pain. An excellent review of these drugs in lactation was done by Karol Mathews in 2005 [11].

Propofol is a good choice as an initial induction agent [12]; the short duration of effect after a bolus is due primarily to rapid redistribution out of the central nervous system. Therefore, neonatal puppies are able to awake from propofol, despite their limited hepatic and renal clearance. However, propofol does cross the placental barrier and is found in the umbilical vein of human neonates at approximately 13% of the concentration in maternal blood [13]. Repeated injections to prolong anesthesia should be avoided, due to the inability of neonates to adequately metabolize and clear that amount of the drug.

Gas anesthetics pass the placental barrier easily and may have a persistent respiratory depressive effect on the fetus [14]. As respiration is the primary method of clearance for isoflurane and sevoflurane, apneic neonates will have difficulty eliminating these drugs. If inhalant anesthetics are used prior to delivery, it is recommended that puppies and kittens are exposed to anesthetic agents *in utero* for minimum intervals [15]. If inhalants are necessary, apneic neonates should receive effective cardiopulmonary resuscitation to facilitate clearance of these compounds.

4.2. Local blocks

Local anesthetics may be infused into the area surrounding the incision site, to supplement general anesthesia, and as post-surgical pain control. This procedure can be performed as the bitch or queen is being prepared for surgery, so that the total time to delivery is not increased. For example, lidocaine pre-surgically and bupivacaine post-surgically will reduce the dose and number of other anesthetic and analgesic drugs. However, care should be taken not to exceed the toxic doses of these drugs.

4.3. Epidurals

Puppy survival is optimized when the bitch or queen nurtures the neonates rapidly after birth. Long-acting local anesthetic epidurals that prevent post-surgical movement of the hind legs are not recommended; the female may become distressed by her inability to move, potentially delaying her ability to care for the neonates [12]. Furthermore, epidurals can cause systemic vasodilation, reducing blood pressure and delivery of blood to the placenta. Protocols involving primarily epidurals have the advantage of requiring no systemic

drugs, but also have several disadvantages, including the inability to intubate and ventilate the bitch, resulting in decreased oxygenation of the fetuses during surgery and difficulties with bitch anxiety, which may necessitate sedation prior to delivery of the fetuses. Opioid epidurals that do not prevent normal movement of the hind legs prior to general anesthesia are a better choice if the fetuses are not bradycardic, and the temperament of the dam allows them to be performed in the awake, unsedated animal. In addition, an opioid epidural may be given after surgery for post-operative analgesia, especially if the fetuses were not stable enough to allow for a pre-surgical procedure.

4.4. Anesthetic protocol used by the author

An intravenous catheter is placed (if not already present) and crystalloid fluids are given to maintain blood pressure and uterine perfusion during anesthesia and surgery. The dam is clipped, pre-scrubbed, and preoxygenated while awake. An opioid epidural is performed, if it can be done in the awake animal with stable puppies or kittens. Hydromorphone or fentanyl, with atropine premedication is given just prior to propofol induction, with or without one additional bolus of propofol to maintain anesthesia. The dam is intubated and given oxygen only, followed by inhalant anesthetic once the puppies are out. Once the abdomen is closed, a local block is done with bupivacaine. This protocol is dependant on a rapid surgical procedure up to the point of delivery of the last neonate.

5. Procedure

5.1. Abdominal approach

A ventral midline or flank approach may be performed. In a standard ventral midline approach for a Cesarean section, the incision should extend from just cranial to the umbilicus to just cranial to the pubic bone. This incision should be extended as needed. A large incision is helpful for exteriorization of the uterine horns. Care should be taken to remain on the midline, so as to not incise the mammary glands. Any large vessels incised during abdominal entry, particularly mammary vessels that cross the midline, are ligated as needed. In addition, the linea alba will likely be very thin, due to stretching of the abdominal musculature and fascia; therefore, caution should be exercised to avoid premature entry of the abdomen.

If a flank incision is preferred, the female is placed in lateral recumbency and an incision is made on either

side of the body, approximately 3–5 cm behind the last rib, extending vertically from just ventral to the epaxial muscles to the top of the mammary gland (avoid incising the mammary glands). The skin, subcutaneous tissue and outermost abdominal muscle are incised. There is often a small artery within the muscle fibers of the transverse abdominis, near the top of the incision that will need to be clamped or ligated. Blunt dissection is used to split the external and internal abdominal obliques along the direction of their fibers. Advantages to the flank incision are that the uterine horns are easier to exteriorize than with a midline incision, as they do not need to be lifted as high and are not trapped in the sides of the abdomen. Lateral recumbency, as opposed to dorsal recumbency (for a midline incision), reduces pressure on the diaphragm, increases her ability to breathe, and decreases the need to augment ventilation. Furthermore, the incision is away from the mammary glands, reducing irritation of the incision by nursing puppies. Due to the location of the incision, there is a decreased chance of herniation or evisceration if the sutures fail. Disadvantages of the flank approach include a slightly longer surgical time, as all layers of the abdominal musculature must be sutured separately, and inexperience of most small animal practitioners with this approach.

5.2. Uterine incision(s)

Laparotomy sponges should be placed under the uterus to reduce leakage of uterine contents into the abdomen. This is especially important if the uterine lumen is known or suspected to contain infectious material.

The decision concerning the site of the uterine incision should be made on a case-by-case basis. A guiding principle is that rapid delivery of the neonates increases their survival. A puppy that is stuck in the pelvic canal is more easily removed via a uterine body incision, making it the first puppy retrieved and resuscitated. A separate incision in each uterine horn hastens removal of large litters however two incisions must be sutured. In either approach, care should be taken to prevent laceration of a neonate or a placental site. Following uterine incision, each successive neonate is milked to the incision site, with care to avoid tearing the uterine incision during delivery.

5.3. Fetal membranes

Fetal membranes are traditionally removed during Cesarean section of the dog and cat; however, they

may be left *in situ* and allowed to pass naturally [1]. In some cases where the fetal membranes are still firmly attached to the maternal tissue, attempts at removal may cause excessive bleeding. In women, there was significantly less hemorrhage and endometritis when placentas were allowed to pass spontaneously, instead of being removed during surgery [16–18]. Because placental types differ between humans and domestic carnivores, a randomized clinical trial is needed to provide definitive advice regarding removal of tightly adhered fetal membranes. Although no randomized clinical trials have been performed in dogs and cats, if the fetal membranes are tightly adhered to the uterine wall, this author routinely leaves fetal membranes in the uterus and allows them to pass spontaneously if the cervix is open at the time of surgery. However, if the cervix is not open, the membranes are removed gently and slowly with uterine massage. If the membranes are tightly adhered, removal is delayed until all neonates have been delivered. Due to the zonary configuration of the canine and feline placenta, they must be ruptured to allow passage of the next neonate through the previous neonate's fetal membranes.

5.4. Closure

The entire uterus and pelvic canal should be palpated prior to closure to ensure that a fetus (including small mummies or macerated feti) was not missed. Closure of the hysterotomy incision is done by this author using a simple continuous pattern, avoiding penetration of the lumen, followed by an inverting Cushing pattern, with 4–0 rapidly absorbable suture. All knots are buried so that suture exposure to the peritoneal cavity is decreased or absent, ensuring that adhesion formation is minimal. Interestingly, a paper was published comparing closure versus non-closure of the uterine incision in 11 bitches undergoing elective Cesarean section (six non-closure, five closure). Both groups had complete healing and the non-closure group had significantly less adhesion formation than the closure group [19]. However, additional studies are necessary before this can be recommended in dogs, as spread of infection into the peritoneal cavity would be a major concern if metritis were to develop. Furthermore, death due to uterine rupture following Cesarean section has been reported [20]. After uterine closure, oxytocin may be administered to assist in uterine involution, decrease bleeding from placental sites, and facilitate the detachment of fetal membranes if they were not removed. Oxytocin administration should be avoided prior to closure of the

hysterotomy incision, as involution makes suturing more difficult.

Following closure of the uterine incision, the abdomen should be lavaged and suctioned to remove any debris that may have entered the abdomen. Prior to lavage, the surgeon's gloves and the instruments used on the uterus are changed or rinsed [21]. The abdomen and skin are closed routinely, but if a midline approach has been used, special care should be taken with the linea alba as it has been thinned and stretched under the influence of increased abdominal pressure and relaxin. The abdomen is closed in three layers (more if the flank approach is used) and surgeons should take large bites and anchor knots in the non-incised portion of the linea. Use of either polydioxanone (PDS) or non-absorbable monofilament suture will provide the greatest holding strength. In the skin, subcuticular or intradermal sutures with the knots buried can help prevent bitches from picking at their sutures.

6. En bloc surgery

In this technique, the ovarian and uterine arteries are clamped or ligated and the entire uterus is removed and passed to waiting assistants. These assistants then remove the puppies or kittens, and begin resuscitation. Only one study has been completed looking at neonatal mortality following en bloc Cesarean section in dogs and cats [22]. This study had no control group, with a survival rate of 75% in dogs and 42% in cats. They concluded that the surgery was equal to standard Cesarean section procedures. However, recent studies of traditional Cesarean section methods have reported a 92% survival rate post surgery [1,9,10], suggesting that survival may have been better if the puppies in this study had been removed prior to ovariohysterectomy.

En bloc removal is ideal when the dam is to be spayed and infectious material is suspected to be present in the uterus, the dam is in critical condition and surgery must be as rapid as possible, or when the litter is known to be dead. If this surgery is performed in a uterus containing live puppies or kittens, the time period from first clamp of the vessels to the point where all puppies have been extracted from the removed uterus should ideally be <60 s [21].

This surgery is not recommended when fetuses are already bradycardic and hypoxia is a major concern, due to suppression and ultimately elimination of uterine blood flow. A randomized controlled clinical trial is necessary to determine if this procedure is safe for stressed, as well as unstressed, neonates.

7. Lactation and ovariohysterectomy

Ovariohysterectomy may be performed at any time following delivery of a litter. Since lactation is dependent on oxytocin and prolactin (both are derived from the pituitary), and not ovarian hormones, the ability of the bitch or queen to nurse her neonates is unaffected by removal of the ovaries. Decreased milk production may result from a decrease in blood pressure during surgery, or lack of adequate control of post-surgical pain (if it leads to decreased food and water intake and decreased mothering responses).

8. Pain management

Care must be taken regarding medications for lactating dams. There is little information concerning the safety of drugs in dogs and cats during lactation. Most non-steroidal anti-inflammatory drugs (NSAIDs) will not reach therapeutic levels in human infants after ingestion of concentrations typically present in the milk [23]. Levels in milk are low due to NSAIDs being weak acids and milk being weakly acidic and lipophilic. Definitive research has not been done in the neonatal dog and cat, but NSAIDs are contraindicated in breastfeeding mothers of premature infants because the COX-2 enzymes are essential for neonatal renal development [24] and even small amounts of NSAIDs could theoretically cause damage. Therefore, these products should be used cautiously or preferably avoided, especially selective COX-2 inhibitors. Opioids enter the milk in approximately the same concentration as maternal serum; however, effects on the neonates is minimal, because the total dose ingested is low [23]. Planning the timing of nursing to avoid suckling at the time of peak blood levels of the medication may decrease the amount of drug ingested by the neonates, but is often time consuming and difficult for the owner. This author routinely uses butorphanol in lactating bitches for post-Cesarean analgesia. A review of NSAID and opioid administration during lactation was done by Karol Mathews in 2005 and can be consulted regarding specific drug therapy [11].

9. Episiotomy

This procedure is rarely necessary, as the placental hormone relaxin is generally adequate to help stretch most strictures and allow passage of the pups. Also, in this author's experience, vulvar strictures were less frequent than vestibule–vaginal strictures. However, episiotomy can be useful when the puppy or kitten has

become lodged at the opening of the vulva. This is most common in breeds with large heads (e.g. Chihuahuas).

After protecting the neonate (to prevent accidental laceration), a local anesthetic is infused in the dorsal commissure of the vulva and underlying tissues. An incision is then made from the dorsal commissure of the vulva along the midline toward the anus. The smallest incision possible to allow delivery of the neonate should be made. If additional neonates are to be delivered, their status should be assessed before deciding to attempt further vaginal deliveries or to determine if a Cesarean section is necessary. Closure of the vaginal mucosa, muscles and subcutaneous tissue, then skin can be performed under local, regional or general anesthesia. Cold compresses following delivery, and for the next 2–3 d, may reduce swelling [21]. It should be mentioned to the owner of the dam that if she is bred again, there is a possibility that obstruction may recur and that the episiotomy site may scar, leading to an even smaller opening.

10. Conclusions

This article does not attempt to exhaustively discuss any portion of the entire Cesarean section procedure. In particular, anesthetic protocols have many variations and exceptions to every guideline. The most important variable in management of dystocia is time, as rapid intervention is crucial to optimize fetal and maternal survival. When medical management of dystocia has failed or is inadvisable, prompt surgical intervention is recommended. The necessity of Cesarean section is primarily based on the conditions discussed above, including health of the dam, progression of labor, and fetal heart rate. There are several options for each portion of the surgery, including the choice of anesthetic protocol, abdominal approach, uterine incision location, and post-surgical pain management. This article has attempted to discuss the alternatives that may be selected for management of each individual case.

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