NOVEL INSEMINATION AND OBSTETRICAL TOOLS FOR SMALL ANIMAL REPRODUCTION

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INTRODUCTION

The clinical practice of canine theriogenology is a rewarding subspecialty in veterinary medicine. Although demanding of the clinician's time and expertise, the breeder client tends to be very loyal and compliant. A good reproductive practice generates its own referrals, and usually is quite busy. Obstetrics and pediatrics are undeniably rewarding parts of the specialty. Theriogenology incorporates the interesting fields of reproductive physiology, endocrinology, embryology, genetics, metabolism, nutrition, critical care, anesthesia, pharmacology and anatomy. The theriogenologist's practice is uniquely both medical and surgical. Success equates to new litters of desirable puppies and happy clients. Recently, new technologies and equipment enhance this practice.

NOVEL INSEMINATION TOOL

Access to the canine uterus has long been hampered by the anatomy of the cranial vagina and cervix. Historically, both intrauterine sampling (culture, cytology or endometrial biopsy) and intrauterine insemination have required laparotomy in the bitch. Laparotomy requires general anesthesia and is invasive, aspects which some clinicians and breeder clients find objectionable for elective procedures such as artificial insemination. Laparoscopic approaches to the canine uterus have been infrequently used, especially in the practice setting, as they require special equipment and expertise. The transcervical approach to the canine cervix has always been desirable, but only recently technically feasible due to the relative inaccessibility of the cervix from the vaginal approach.

The vagina of the bitch is long - the total length from cervix to vulva, including the vestibule has been reported to be 10 –14 cm in an 11 kg bitch. The cervix is not accessible to digital palpation through the vagina in the bitch. The length of equipment necessary to visualize or approach the canine cervix is consequently long, up to 29 cm in large breeds such as the St. Bernard & Newfoundland. The cranial vagina, described as the paracervix, is dominated by a well-defined fold, the dorsal median fold (DMF), which extends caudally from the vaginal portion of the cervix (figure 1). The DMF forms a distinct tubercle where it ends in the caudal vagina. When viewed through a speculum the caudal tubercle and narrow crescentic vaginal lumen have been described as giving the misleading appearance of the vaginal portion of the cervix and external uterine ostium. When insemination catheters are introduced into this area there is often some resistance and then a distinct 'give' which may explain why some clinicians believe they do intrauterine inseminations routinely when in fact they are only inseminating into the paracervical area. The true cervix is approximately 2.5 cm cranial to the caudal tubercle of the DMF. Cranially, the paracervix ends in the fornix, a rounded space cranioventral to the vaginal cervix, which appears as a blind pocket when viewed endoscopically. The paracervix has particular

relevance to cervical catheterization because the reduction of the vaginal lumen by the DMF limits the size of the equipment that can be passed through this area. The cervix lies diagonally across the uterovaginal junction with the canal of the cervix directed cranio-dorsally from the vagina to the uterus. The vaginal cervix appears as a large tubercle. The internal (uterine) os of the cervical canal faces almost directly dorsally whereas the external (vaginal) os is directed toward the ventral vaginal floor (figure 2) The vaginal os is located ventrally in the cervical tubercle in the center of a rosette of distinct mucosal furrows. The cervical canal varies in diameter; with maiden bitches often having a narrower lumen. The actual appearance and general orientation of the vaginal cervix can vary slightly from day to day during the estrous cycle.

The first transcervical approach to the canine uterus was described in Norway (Fougner et al.) in the early 1970s, developed for intrauterine insemination in foxes, and later adopted for use in the bitch (Anderson). It consists of a rigid stainless steel catheter inside a large nylon sheath. The sheath is placed into the vagina and the catheter is then passed through the cervix using blind digital manipulation. This "Norwegian" methodology has met with success in Europe, but less so in the United States, likely due to the steep learning curve associated with its use. Additionally, many clinicians have been reluctant to use methodology with the potential for uterine or vaginal trauma, resorting to vaginal inseminations or laparotomy to gain access to the uterine lumen.

Recently a novel method ("New Zealand") of endoscopic catheterization of the canine cervix has been developed, permitting visualization of the entire vaginal vault, and vaginal portion of the cervix (Wilson). A polypropylene catheter is passed through the endoscope into the caudal cervical os, and beyond into the uterine lumen. The rigidity of the scope permits manipulation of the catheter at its tip into a plane, which parallels the path of the cervical canal, allowing smooth insertion of the catheter into the os. This method also has a learning curve, but is readily mastered with practice. Bitches tend to tolerate transcervical catheterization very well, especially during estrus. Most bitches can be lightly restrained in a standing position during the procedure, and participation of the breeder client is encouraged. The use of videoendoscopy permits audience visualization of the entire insemination procedure. With proper table restraint the procedure can be accomplished with one operator. The endoscopic transcervical catheterization technique was developed by Dr. Marion S. Wilson, whose description follows: "The equipment used is a rigid cysto-urethroscope[a] which comprises a telescope with a 30° oblique viewing angle, a sheath, bridge and cold light source; the working length of the assembled endoscope is 29 cm. A video camera can be attached to the endoscope but this is not essential. When this technique is being used for insemination, an 8 French-gauge urinary catheter is appropriate in the majority of bitches for cervical catheterization, although a 6 French-gauge is sometimes required in small or maiden bitches. The bitch is restrained in a standing position on a specially designed platform on a hydraulic table; the platform provides a tie point to the dog's collar and a canvas band around the abdomen that restricts sideways movement and discourages any attempt to sit. The use of a hydraulic table and chair ensures the optimum position of the bitch relative to the operator during the procedure and is helpful but not essential. The endoscope is introduced into the vagina and advanced through the vaginal folds by observing the direction of the vaginal lumen. In pro-oestrus and early oestrus the rounded vaginal folds can

make advancing the endoscope more difficult as they tend to fill the lumen; as oestrus progresses dehydration of the folds results in a more obvious route for advancement of the endoscope. The caudal tubercle of the DMF is usually a prominent landmark and at this point the lumen can become quite narrow in some bitches, requiring manipulation of the endoscope to the widest space. This may result in the endoscope being pushed to one side of the DMF rather than continuing ventrally under the DMF. The vaginal portion of the cervix appears as a distinct tubercle but as the cervical os faces caudo-ventrally or ventrally it usually is not immediately obvious. In order to locate the os, the scope must be advanced under the cervical tubercle; the os is situated in the centre of a rosette of furrows in most bitches but in some its position can only be identified by observing serosanguinous fluid flowing from the cervix. The position of the os can appear to change through oestrus with the dehydration of the vaginal folds. The catheter is advanced into the cervical os by manipulation of the endoscope and catheter. The rigidity of the endoscope is used to move the cervical tubercle, line up the os and change the angle of the canal. Once the tip of the catheter is introduced into the os it is steadily advanced using a twirling movement to aid its passage through the cervical canal. For semen deposition, the catheter is passed in as far as it will go without force; it is important to observe the semen being inseminated to ensure the catheter is correctly placed and backflow does not occur. In the event of semen backflow the insemination is stopped and the catheter repositioned, either further in or withdrawing slightly. Air insufflation is frequently used in association with endoscopic techniques but when the above procedure is used in the oestrous bitch for insemination and general vaginoscopic assessment air insufflation has been found to be unnecessary. Air insufflation can be achieved by connecting intravenous tubing and a syringe with a 3-way stopcock to one of the channels, useful when performing routine vaginoscopy in the non estrous bitch to improve visualization of the vaginal lumen."

Clinicians must make a substantial investment in equipment for video endoscopic transcervical catheterization unless rigid endoscopy is already a part of the practice. The investment however is soon returned, however, as the approach is very popular with breeder clients wishing to avoid surgery and anesthesia for intrauterine inseminations. Additional use of the equipment for diagnostic procedures such as intrauterine cytology, culture and endometrial biopsy improves its value. The ease of transcervical catheterization can be recorded for each bitch (1 = very easy, less than 5 minutes, 5 = not achievable). Repeat inseminations providing better coverage during the fertile period of the estrous cycle improve success rates for artificial insemination. Clinicians should consider offering transcervical insemination at a reduced fee to increase caseload during their learning period. Successful catheterization of 5 to 10 bitches is usually enough experience to make the procedure relatively easy. Concerns surrounding potential introduction of vaginal flora into the uterine lumen using transcervical insemination have not been realized thus far, and are unlikely given recent knowledge that normal vaginal flora can be found in the uterus during proestrus and estrus. Certainly vaginal flora is introduced into the uterine lumen with natural breedings; the uterus has an inherent ability to normalize its flora after estrus. Maintenance of the equipment is minimal; a 10 minute soaking of the immersable parts in dilute chlorhexiderm solution, and thorough rinsing with distilled water is optimal. Stronger disinfectants raise concerns because of their spermicidal potential. The wide acceptance of TCI by practitioners implies very acceptable conception rates in field situations. As with all reproductive procedures, the success is greatly influenced by the timing of ovulation in the bitch and the quality of the

semen from the male. An increased number of inseminations with fewer viable sperm per insemination may improve conception, and is now feasible with this equipment and technique.

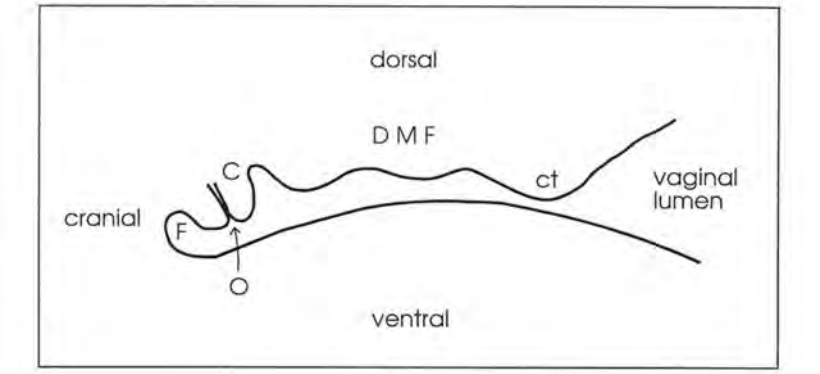

Figure 1. Graphic representation of the canine lower reproductive tract (courtesy Dr. Marion Wilson)

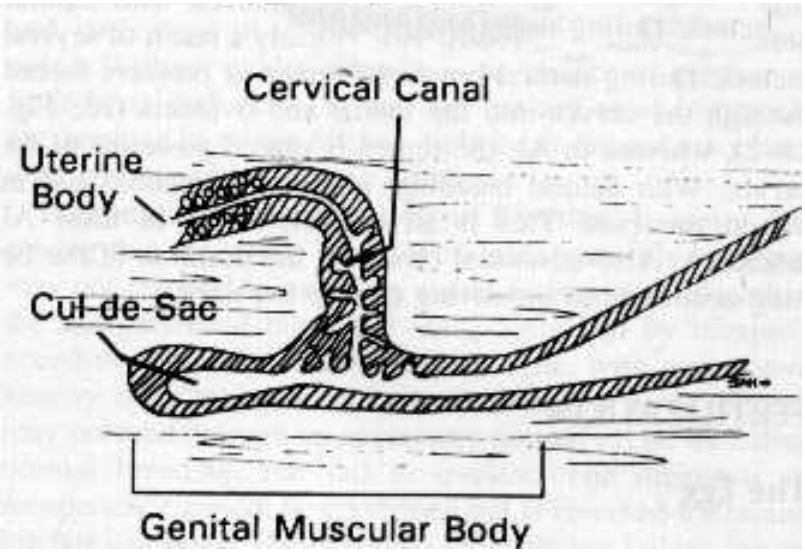

Figure 2. Graphic representation of the angle of the cervix with respect to the vagina in the bitch

NOVEL OBSTETRICAL TOOL

The standard approach to labor management in the bitch has involved client monitoring of the bitch's behavior, temperature drop, and progression of whelping and the physical condition of the neonates. Little accurate and timely information is made available to the clinician concerning uterine activity or fetal viability using this technique. Telephone consultations between the veterinarian and breeder usually entail interpretation of subjective data, such as time between deliveries, color of vaginal discharge, and presence of externally visible contractions. While generally acceptable for the uneventful delivery in a young, healthy bitch, disaster cases are familiar to most clinicians with a reproductive practice. Additionally, many veterinarians are reluctant to encourage the expense and risk of an unnecessary caesarian section. With higher risk pregnancies and valuable litters, better monitoring is desirable.

The length and quality of labor correlate closely with the number of liveborn, vigorous neonates. The uterus exhibits characteristic patterns of contractility, varying in contraction frequency and strength during different the stages of labor. During late term, the uterus may contract once or twice an hour before actual labor is initiated. Contractions vary in frequency from 0 to 12 per hour, and in strength from 15 to 40 mm Hg, with spikes to 60 mm Hg. Contractions during active labor can last 2 to 5 minutes in duration. Recognizable patterns exist during pre labor and active (stages 1-3) labor. Abnormal, dysfunctional labor patterns can be weak or prolonged, and be associated with fetal distress.

A novel approach to canine obstetrical monitoring involves the use of external monitoring devices to detect and record uterine activity and fetal heart rates. These devices can be used in the home setting or the veterinary clinic. Interpretation of the contractile pattern in strips produced by the uterine monitor requires training and experience. Commercially available monitoring devices currently transmit recorded information by modem to obstetrical personnel capable of interpretation and subsequent consultation with the attending veterinary clinician. Recordings are made on a twice daily, hour long basis when pre labor home monitoring is performed, intermittently as indicated during labor, or on site in the veterinary clinic for short periods of time when dystocia is suspected. Sensors detect changes in intrauterine and intra amniotic pressures, as well as doppler monitoring of fetal heart rates. The presence of normal pre labor uterine activity can be detected. The onset of an organized pattern of uterine activity, with increased frequency and strength of contractions heralds the onset of stage 1 labor. Because a prodromal drop in body temperature can be missed and correlates with the onset of first stage labor loosely, this detection of early labor can be very valuable, indicating the need to monitor the bitch closely as whelping is imminent. In one study, 20% of bitches monitored for a drop in temperature had none. Only 38% experienced a demonstrable temperature drop within 36 hours of the onset of labor. The use of a uterine monitor permits proactive identification of labor for planned caesarian sections when gestational length is not accurately known. The identification of premature labor, perhaps resulting in stillborn or premature puppies can be made with uterine monitoring as well.

The presence of fetal distress is reflected by deceleration of the heart rates. Normal fetal heart rate at term is from 170 to 230 beats per minute (bpm). Decelerations associated with uterine contractions suggest mismatch of the fetus and dam, or fetal malposition, malpresentation or malposture. Transient accelerations occur with normal fetal movement. Fetal heart rates of $\leq$150 to 160 bpm indicate stress. Fetuses with heart rates $\leq$130 bpm have poor survival if not delivered within 2 to 3 hours, and fetuses with heart rates $\leq$100 bpm are an indication for immediate intervention.

The use of uterine and fetal monitors allows the veterinary clinician to detect and monitor labor, as well as manage labor medically with insight. The administration of oxytocin and calcium gluconate can be directed and tailored based on the results of monitoring. Generally, the administration of oxytocin increases the frequency of uterine contractions, while the administration of calcium increases their strength. Oxytocin is effective at mini doses, starting with 0.25 units SC or IM to a maximum dose of 4 units. Higher doses of oxytocin or intravenous boluses can cause tetanic, ineffective uterine contractions that compromise fetal oxygen supply by placental compression. The frequency of oxytocin administration is dictated by the labor

pattern, and is generally not given more frequently than hourly. Calcium gluconate 10% is given SC at 1 ml/10 lb BW as indicated by the strength of uterine contractions, generally no more frequently than every 4-6 hours.

The benefits of objective uterine and fetal monitoring become evident immediately. Much of the guesswork of obstetrics is eliminated. In bitches with a history of delivery of immature, nonviable fetuses, for which no infectious or traumatic cause can be found, uterine monitoring can detect premature labor. Contrary to common belief, hypoluteiodism has never been documented as a cause of premature delivery in the bitch. Rather, premature labor probably initiates luteolysis through the action of prostaglandins released from the placenta and uterus. Pharmaceutical intervention to slow or stop uterine contractions with terbutaline can be effective if premature labor is diagnosed. At normal term, absolute indications for caesarian section are detected with monitoring before fetal death or maternal compromise occurs. The mortality rate of neonatal puppies (up to 7 days of age) reportedly declined from 33% to 6% with the use of uterine and fetal monitoring. Overall, the anxiety level of owners is diminished, and the level of participation of the veterinarian improved. The cost to the client for monitoring is generally less than the price of 1 puppy. Client acceptance is generally excellent; in 50 initial cases the author had only 2 clients express dissatisfaction with the system due to technical demands.

Biographical Profile

Dr. Autumn Davidson obtained her BS and MS at the University of California, Berkeley, with an emphasis in wildlife ecology and management. Dr. Davidson is a graduate of the School of Veterinary Medicine, University of California, Davis. She completed an internship in Small Animal Medicine and Surgery at Texas A&M University, and a residency in Small Animal Internal Medicine at the University of California, Davis. She became board certified in internal medicine in 1992.

Dr. Davidson is a clinical professor at the School of Veterinary Medicine, University of California, Davis, in the department of medicine and epidemiology. She specializes in small animal theriogenology and infectious disease.

Additionally, Dr. Davidson practices at the Animal Care Center of Sonoma, a private referral practice, where she receives both internal medicine and reproduction cases.

From 1998 to 2003, Dr. Davidson served as the Director of the San Rafael veterinary clinic at Guide Dogs for the Blind, Inc., overseeing the health care of 1000 puppies whelped annually, as well as a breeding colony of 350 and approximately 400 dogs in training.

Dr. Davidson served on the board of directors for the Society for Theriogenology from 1996-1999, and the Institute for Genetic Disease Control from 1990-2002. Dr. Davidson consults with the Smithsonian Institution National Zoological Park in Washington D.C. concerning theriogenology and internal medicine. She has authored numerous scientific publications and book chapters, and is a well known international speaker on the topics of small animal theriogenology and infectious disease. Dr. Davidson was the 2003 recipient of the Hill's Animal

Welfare and Humane Ethics Award, which recognizes an individual who has advanced animal welfare through extraordinary service or by furthering humane principles, education and understanding.

Dr. Davidson has been a breeder and exhibitor of Labrador Retrievers since 1972.