Cervical duplication in dogs

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Abstract

Two maiden bulldogs with cervical duplication were presented for breeding management. Dogs were successfully impregnated via endoscope-assisted transcervical insemination (TCI) and had their litters via cesarean surgery. A common uterine body between 2 cervical openings and 2 uterine horns was noticed (with no other reproductive abnormalities) at surgery. Duplication of the cervix has apparently not been previously described in dogs. With TCI becoming a more frequently used method of breeding, it is probable that defects involving failed or incomplete fusion of the paramesonephric duct during embryological development will be more frequently observed by clinicians.

Keywords: Dogs, cervical duplication, endoscopy, hereditary, paramesonephric duct

Background

During early embryonic sexual development, female reproductive tract of the dog starts to develop cranially from paramesonephric ducts. As these ducts extend caudally within the developing conceptus, they fuse to form a single uterine body, cervix, and cranial vagina.[1-3] Incomplete, inappropriate, or failure of fusion during this process leads to abnormalities of the cranial reproductive tract including, but not limited to, uterus unicornis, vaginal septae, cervical duplication, didelphis uteri, and simplex uterus.[1-3]

Cervical duplication and external os have been described extensively in cattle and are believed to be inherited conditions.[4-6] Despite cervical duplication's heritability and relevance to propagation, this condition is not a common cause of secondary complications with breeding, pregnancy, or parturition in cattle.[4-6] To our knowledge this condition has not been described in dogs.

In dogs, dystocia and cesarean surgeries are more common in brachiocephalic breeds (especially English bulldogs, French bulldogs, and Boston terriers).[7-9] To promote better animal welfare, the European Union currently has Animal Welfare Best Practices in place. As per this policy dogs must be able to breed, whelp, and rear their litters naturally and dogs that had 1 or more cesarean surgeries cannot be used for breeding.[10] Abnormalities of the female reproductive tract may affect the ability to whelp naturally, and so it would be prudent not to breed affected animals.[4-6,11-14]

Case presentations

Case 1

A 3-year, maiden female Olde English Bulldogge, was presented for breeding management and subsequent artificial insemination with fresh canine semen. Complete clinical examination was conducted. Chilled semen (from an unproven stud) was deposited in the cranial vagina using a 9-inch artificial insemination [AI] pipette (K-9 AI pipette Jorgenson Laboratories Inc., Loveland, CO) 4 days after LH surge[15,16] (determined via serum progesterone concentrations [between 2.0 - 2.5 ng/ml] and vaginal cytology). Progesterone concentrations were determined via established assays (TOSOH Bioscience AIA 360, San Francisco, CA). Plastic sterile cotton-tipped swabs were used to collect vaginal epithelial cells and were rolled on to microscope slides. Slides were stained with a commercial Romanowsky stain variant (Diff Quik, Jorgensen Labs, Loveland, CO). Pregnancy diagnosis was negative.

For the subsequent breeding, 2 TCIs (fresh semen from 1 stud dog) were used. During the initial TCI, a vertical vaginal septum was noted to extend caudally 5 - 10 cm from the fornix. A cervical os was noticed on both sides of the septum. After careful probing, catheterization of the uterus was possible through each cervical os using a flexible catheter (CH-5 TCI catheter Minitube USA, Verona, WI). One-half of the insemination dose was deposited through each cervical os. It was unclear during the procedure whether the 2 cervical openings communicated via a common cervical canal or uterine body. Prior to insemination, the owners were contacted regarding potential complications with fertility, pregnancy, and whelping. After discussion, they elected to continue the procedure.

A second TCI procedure was performed 2 days later with fresh semen and all previous endoscopic findings were confirmed.

Case 2

A 2-year, female maiden English bulldog, was presented for her first breeding management. She was managed with similar protocols and recommendations as Case 1, and after discussion with the owners, they elected to breed the dog via 2 fresh semen TCIs. Initial TCI was performed successfully without complications; no septae or cervical os abnormalities were noted. A second TCI was performed a day later and findings (a vertical septum extending caudally 5 - 10 cm from the fornix and 2 separate unobstructed external cervical ora) were similar to those observed in Case 1. Prior to insemination, owners were contacted regarding potential complications. After discussion and since initial insemination was already successfully performed, owners elected to continue with the procedure.

Differential diagnosis

Uterus didelphis, duplication of the cervix and external cervical os, and complete duplication of the reproductive tract were all potential differential diagnoses for these dogs. Due to suspected higher frequency of bulldogs to pool fluid in the cranial vagina, it was difficult to assess whether the fluid noticed near contralateral cervical os after catheterization and insemination of the first cervical os arose from normal backflow and pooling or through a common uterine body. Without performing additional endoscopy, contrast radiography, or advanced radiology including computed tomography and magnetic resonance imaging, a caudal paramesonephric duct fusion abnormality was the tentative diagnosis. Advanced diagnostics would require general anesthesia or sedation; and therefore, for dogs' and their potential litters safety, it was recommended to pursue further diagnostics after pregnancy if a diagnosis could not be elucidated at the time of elective cesarean surgery.

Outcome

Case 1

Dog was confirmed pregnant (3 viable fetuses) via abdominal ultrasonography (S9 US-diagnostic system; C611, 13 - 3.9 MHz Micro-convex transducer; SonoScape Medical Corp, Shenzhen, China) on day 48 postLH surge. No abnormalities of the uterus or cervix were noted. A communication between the 2 cervical openings could not be confirmed.

It was recommended to perform an elective caesarean surgery on or near her due date based on daily progesterone concentrations and assessment of pups' development via transabdominal ultrasonography;[17-19] however, the owners elected not to have this assessment. On day 67 postLH surge, Case 1 was presented as an emergency (signs of stage I and/or II labor > 24 hours, a green to black colored vaginal discharge, and uterine contractions without production of a fetus).[9,20] A stillborn pup was palpated vaginally and, subsequently, delivered via digital vaginal extraction. More viable pups were observed via transabdominal ultrasonography and the dog was prepared for cesarean surgery. Remaining pups were delivered via cesarean surgery and survived through discharge from the hospital. During surgery, a common uterine body between 2 cervical openings and 2 uterine horns was confirmed and no other reproductive abnormalities noted. Concurrent ovariohysterectomy was performed as per owners' decision.

Case 2

Dog was confirmed pregnant via transabdominal ultrasonography on day 31 postLH surge. Three fetal vesicles and 1 resorption site[21,22] were observed. It was recommended that the dog be scheduled for an elective cesarean surgery. Optimal timing was determined via daily serum progesterone concentrations from day 63 postLH surge and daily transabdominal ultrasonography to assess fetal heart rates and development using renal corticomedullary distinction, gastrointestinal layering, and gastrointestinal motility.[17-19] On day 65 postLH surge, progesterone concentrations were < 2 ng/ml, and pups had excellent renal corticomedullary distinction, gastrointestinal layering, and GI motility; therefore, it was determined to be the ideal timing for elective cesarean surgery.[17-19] Three pups were delivered and they survived through weaning. During surgery, a common uterine body between 2 internal cervical ora and the uterine horns was confirmed, and no other reproductive abnormalities were observed. It was recommended that ovariohysterectomy be performed following weaning of the litter.[18]

Discussion

Cervical duplication is a disorder that could be speculated to have consequences similar to those observed, although infrequently, in cattle including difficulty or inability to conceive and deliver live offspring.[4-6] Function of the cervix is to facilitate sperm movement in the uterus during fertile periods, maintain sterility of the cranial reproductive tract during pregnancy and nonfertile periods, and facilitate passage of offspring and fetomaternal membranes out of uterus during parturition.[12-14] Any abnormal orientation, structure, or cervical patency could obstruct or affect normal cervical function, thereby increasing the incidence of other reproductive issues including, but not limited to, unsuccessful breeding, ascending uterine infections, fetal resorptions, and abortions.[4-6,12-14]

Besides reproductive complications associated with cervical duplication and/or the external cervical os, it would be prudent to be concerned that the condition may be inherited in dogs as it is in cattle.[4-6] With any condition believed to be hereditary in nature, pedigree analysis is ideally performed to investigate the propagation of these conditions.[23] For these 2 cases, due to owner compliance, we were only able to obtain a pedigree for 1 dog, and therefore, we were unable to complete a pedigree analysis. Although these are apparently the first cases of cervical duplication in dogs to be published to the knowledge of the authors, in personal communications with experienced colleagues involved in canine reproduction, a number of them had observed this condition firsthand in bulldogs and other breeds. This suggests there is likely an inherited pattern for cervical duplication in dogs.

One should question the ethics and animal welfare complications of continuing to breed with affected animals as oc-

curred in these case studies. In these cases, it was our recommendation for both dogs to be sterilized following weaning of their litters[18] and their progeny to be withheld from any future breeding programs.[8] From an ethical standpoint, it is likely not in the owners' or breeding community's best ethical interest to continue to breed similarly affected animals.[8] One could argue in the case of bulldogs, it might not change the outcome of these cases, as a majority of bulldog litters are delivered via cesarean surgery;[7,9,17,19,24] however, with increasing changes to the breeding guidelines of brachiocephalic breeds, such as banning elective cesarean surgery in such breeds in European Union and banning the breeding of any English bulldogs and Cavalier King Charles spaniels in Norway, female animals with abnormalities of the reproductive tract should not be bred.[8,10]

One could also argue that as we do not have enough information on Müllerian duct fusion abnormalities in dogs to make such claims; however, this might be an inherited condition that, with further gene expression or mutation, progresses to more diffuse fusion defects that could have detrimental effects on fertility, pregnancy rates, litter sizes, or animal welfare.[23] Any increase in the risk for dystocia or pyometra could be detrimental to an animal's welfare.[8]

Most common causes for dystocia in dogs are primary uterine inertia, fetomaternal disproportion, and fetal malposition.[9,19,24] Most English bulldogs have delivery via cesarean surgery due to higher prevalence of dystocia in this breed;[7,9] therefore, caudal paramesonephric duct abnormalities might not commonly be detected in these breeds when inseminated without endoscopy. This might raise concern that the true prevalence of these abnormalities remains under-detected. The expectation would be that the true prevalence will be better elucidated as the use of TCI and/or vaginal endoscopy increases. It is probable that use of TCI will continue to increase over time due to pregnancy rates and litter sizes being substantially higher for TCI in comparison to other methods of insemination including surgical or vaginal AI.[25,26] With the increase in TCI as a method of insemination, we would expect to have an increased incidence of abnormal findings in the caudal urogenital tract; although, as seen with the second case example, these abnormalities can still go undetected even when endoscopy is used. Potential causes for the failure to detect the cervical duplication during the first TCI could be lack of appropriate insufflation during the procedure; user experience; knowledge of endoscopy or TCI practices; patient temperament, attitude, cooperation, and movement during the procedure; or endoscope-related technical issues including lens clarity.

In the cases presented, cervical duplication was an incidental finding at the time of breeding. Although 1 case resulted in dystocia and emergency cesarean surgery, it is heavily suspected that this outcome was more likely due to breed predisposition[7,9,24] and owner compliance, rather than from pathology of the cervix. Our reasoning is this is not a typical outcome for this condition in cows[4-6] and the stillborn pup was completely within the vaginal canal at presentation; though since we do not have any information on this condition in dogs, it cannot be completely ruled out as a cause. The potential for more case reports of this condition will likely increase as endoscopic inseminations increase, thereby giving us more information about this abnormality. With more information about this condition, increased promotion of ethical breeding and animal welfare,[8,10] and better breeding practices,[8,10] cervical duplication could remain an anomaly instead of becoming another increasingly observable heritable condition.

Learning points

- Cervical and external cervical os duplication have been described as a hereditary disorder in cattle, but not in dogs
- Cervical and external cervical os duplication are disorders of sexual development involving incomplete fusion of the paramesonephric ducts that has the potential for increasing dystocia in animals
- External cervical os duplication may become a more commonly observed disorder of sexual development in clinical practice due to the increased frequency of endoscope-assisted breeding
- Ethics of breeding should always be considered when potentially harmful (in terms of animal welfare) hereditary disorders are present

Conflict of interest

None to report

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