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Infertility in the Dog and Cat

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AT A GLANCE

- Infertility in dogs
  - *Improper timing of breeding is the most common cause of apparent infertility in dogs.* Measure progesterone in serum to optimize breeding timing (see Chapter 2).
  - Subclinical uterine infection may occur. Collect a specimen for culture from the anterior vagina,

using a guarded swab, early in proestrus. Moderate to heavy growth of a single organism is significant. Treat with an appropriate antibiotic, based on culture and sensitivity testing, for 2-4 weeks.

- Brucellosis is associated with infertility in bitches and dogs. Regular serologic testing is recommended in all breeding animals (see Chapter 7).
- Hypothyroidism is associated with irregular cycles in the bitch and poor semen quality in the male dog. Concurrent measurement of free thyroxine (T_4) by dialysis and of canine thyroid-stimulating hormone (cTSH) in serum is the diagnostic scheme of choice. Appropriate supplementation of hypothyroid animals may or may not effect a change to normal fertility. Hypothyroidism may be hereditary.
- Abnormal semen quality may be associated with apprehension at the time of breeding or semen collection, prostate disease (see Chapter 17), testicular disorders (see Chapter 16), brucellosis (see Chapter 7), or hypothyroidism.

- Infertility in cats
  - Queens are seasonally polyestrous. If the environment is such that the queen is not exposed to at least 10 hours of light daily, she may not cycle.
  - A queen should be brought to the tom's environment. Copulation must take place at least four times during estrus to reliably induce ovulation. Serum

progesterone concentration greater than 2 ng ml after the queen goes out of behavioral estrus is indicative of ovulation having occurred.

- Viral causes of pregnancy loss in the queen include feline leukemia, feline infectious peritonitis, feline herpesvirus (rhinotracheitis), and panleukopenia. Toxoplasmosis and bacterial infections are uncommon causes of pregnancy loss in queens.
- Semen evaluation in tom cats is challenging; cystocentesis after copulation is a noninvasive technique that allows assessment for spermatogenesis but not evaluation of semen quality. Electroejaculation can be performed in anesthetized tom cats.

Infertility in the Dog

1. The bitch is cycling. (Proceed to 2.)

1′. The bitch has never cycled.

- Primary anestrus is lack of estrous activity in a bitch by 24 months of age.
- Causes include the following:

  Husbandry: Bitches that are malnourished or that are under stress because of heavy work or show schedules may not cycle. Housing with cycling bitches may stimulate estrous activity in anestrous bitches.

Previous ovariohysterectomy: Previous ovariohysterectomy may be diagnosed based on history, palpation or observation of an ovariohysterectomy scar at the ventral abdominal midline, or exploratory laparotomy. In spayed bitches, serum concentrations of the gonadotropins, luteinizing hormone (LH) and follicle-stimulating hormone (FSH), are elevated because of lack of negative feedback from the absent ovary to the anterior pituitary. Elevated LH concentration in blood may be identified in bitches with an in-house LH assay (Status-LH; Synbiotics, San Diego, Calif.). Measurement of serum estradiol 60-90 minutes after administration of gonadotropin-releasing hormone (GnRH) or human chorionic gonadotropin (hCG) has been described; concentrations below the sensitivity of the assay used may be indicative of previous ovariohysterectomy in that bitch.

Silent heat: Silent heat is follicular development and ovulation in the absence of physical signs of heat, such as vulvar swelling and exudation of serosanguineous vaginal discharge. Diagnosis requires weekly assessment of vaginal cytology and monthly measurement of serum progesterone con-

centration, with serum progesterone concentration greater than 2 ng/ml indicating ovarian activity. Dogs bred appropriately during a silent heat are fertile.

Hermaphroditism (see Chapter 1): Abnormalities of sexual differentiation described in dogs include true hermaphroditism (presence of ovarian and testicular tissue), male pseudohermaphroditism (presence of testes and female or ambiguous external genitalia), and female pseudohermaphroditism (presence of ovaries and male or ambiguous external genitalia). Diagnosis of abnormalities of sexual differentiation usually requires exploratory laparotomy and histopathologic examination of excised gonadal tissue. Karyotyping also may be necessary.

Hypothyroidism: Hypothyroidism has been associated with primary anestrus, irregular interestrous intervals, low litter size, and general infertility. Poor semen quality has been described as occurring in hypothyroid male dogs, perhaps because of concurrent autoimmune thyroiditis and orchitis. Extrareproductive signs of hypothyroidism, such as lethargy, weight loss, and bilaterally symmetric alopecia of the trunk, may or may

not be present. Hypothyroidism is considered a familial disorder. Predisposed breeds include the golden retriever, Doberman pinscher, dachshund, Shetland sheepdog, Irish setter, Pomeranian, miniature schnauzer, and American cocker spaniel. The current preferred method of diagnosis is with concurrent measurement of serum cTSH and free T_4 by dialysis. In hypothyroid dogs, cTSH is elevated and free T_4 is decreased. Measurement of total T_4 in serum alone is not diagnostic because many extraneous factors cause artifactual decreases in total T_4. Dogs with hypothyroidism are treated by supplementation with T_4 at a dosage of 0.01-0.02 mg/kg administered orally twice a day. Serum thyroid hormones should be reevaluated every 6 months while dogs are receiving supplementary T_4. Although supplementation with T_4 may effect a return to normal reproductive function, the heritability of the disorder should be remembered when considering use of the animal for breeding.

Systemic disease: Systemic conditions, such as hyperadrenocorticism or diabetes mellitus, may affect reproductive function. A complete physical examination, complete blood

count, serum chemistry profile, and urinalysis should be evaluated in animals presented for infertility.

2. The interestrous interval is normal in length. (Proceed to 3.)

2′. The interestrous interval is abnormally long (longer than 12 months).

- *Breed:* Some breeds normally cycle less frequently than the average interestrous interval of every 7 months. These breeds include the basenji, dingo, and wolf-dog hybrids, all of which cycle yearly.
- *Hypothyroidism:* See 1′.

2″. The interestrous interval is abnormally short.

- *Breed:* Some breeds normally cycle more frequently than the average interestrous interval of every 7 months. These breeds include the German shepherd dog, rottweiler, and basset hound.
- *Split heat:* Split heat is defined as proestrous activity for 1-2 weeks, followed by an anestrous period averaging 1 month in duration before normal ovulatory estrus occurs. Diagnosis requires measurement of progesterone in serum during the intermediary anestrous period (serum progesterone concentration less than 2 ng/ml indicates that ovulation has not occurred) and after the second period of

estrous activity (serum progesterone concentration greater than 2 ng/ml indicates that ovulation has occurred). Split heat is not associated with infertility unless the bitch is forcibly bred during the anovulatory portion of the split heat.

- *Uterine disease* (see Chapter 12): Bitches with cystic endometrial hyperplasia (CEH) or subclinical uterine infection may more readily release prostaglandin from the endometrium, prematurely lysing the corpora lutea and increasing cycle frequency. CEH may be visible ultrasonographically as a fluffy thickening of the uterine wall. Because of the relative inaccessibility of the canine uterus, uterine infection usually is best diagnosed by anterior vaginal culture in estrous bitches.

2‴. The bitch is in persistent estrus.

- *Ovarian cyst* (see Chapter 11): Ovarian cystic disease in the bitch usually is caused by lack of ovulation of a cystic follicle. Persistent estrogen secretion is manifested clinically as persistent estrus. Although the presence of persistently elevated serum estrogen concentrations is diagnostic, estrogen assay is difficult and may not be available. Identification of cornified vaginal epithelial cells for 6 weeks or longer also is diagnostic of persistently

elevated serum estrogen concentrations. Ovarian follicular cysts may be visible with transabdominal ultrasound but often are difficult to see. Response to treatment with GnRH (50 μg administered intramuscularly) or hCG (1000 IU, half of which is administered intramuscularly and half of which is administered intravenously) may be diagnostic.

- *Granulosa cell tumor* (see Chapter 11): Functional granulosa cell tumors of the ovary may be manifested clinically as persistent estrus. A granulosa cell tumor may be palpable as a mass in the cranial abdomen or may be visible on survey radiographs or with transabdominal ultrasound. Ovariohysterectomy is the treatment of choice.

3. Normal copulation occurs. (Proceed to 5.)

3′. Normal copulation does not occur. (Proceed to 4.)

4. The male shows normal breeding behavior, but the bitch does not allow copulation.
   - *Behavior:* Dominant bitches may not allow male dogs to mount and achieve intromission. The problem is best circumvented by artificial insemination (see Chapter 3).
   - *Congenital vaginal abnormalities* (see Chapter 13): The congenital vaginal anomalies most often described as occurring in the dog are

vaginal septa of varying lengths and circumferential vaginal strictures. Most develop just cranial to the urethral papilla and are therefore palpable on digital vaginal examination and may be observed with almost any size vaginoscope. Depending on the extent of the anomaly, surgical repair may be attempted or the problem circumvented with artificial insemination and possible cesarean section; vaginal anomalies may relax sufficiently under the influence of the hormone relaxin late in gestation to permit spontaneous whelping.

- *Vaginal fold prolapse* (see Chapter 13): Vaginal fold prolapse is protrusion of edematous vaginal tissue through the vulvar lips. This is an estrogen-mediated phenomenon that subsides when serum estrogen concentrations decline and that often recurs during subsequent heat cycles. Bitches with vaginal prolapse usually must be bred by artificial insemination because male dogs mount but have difficulty achieving intromission of the penis in the presence of the prolapsed vaginal tissue. Vaginal prolapse may redevelop near the time of parturition and may or may not cause dystocia.

4′. The bitch shows normal breeding behavior, but the male does not mount or achieve intromission and ejaculation.

- *Behavior:* Submissive male dogs may be hesitant to breed a dominant bitch. Similarly, a male dog may be hesitant to approach a bitch that has been aggressive toward him, as may occur if the bitch is presented to the male too early in her season. Male dogs that consistently have been disciplined for showing breeding behavior at inappropriate times may inadvertently have been trained not to show such behavior.
- *Pain:* Male dogs with prostate disease (see Chapter 17) or pain of the spine or rear limbs may be unable or unwilling to mount the bitch and ejaculate. Complete physical and neurologic examinations and a workup for prostate disease, including semen cultures and imaging with possible aspirate or biopsy of the prostate, may be needed to localize the source of pain.
- *Poor libido:* Libido is variable in male dogs, and those with poor libido are difficult to manage clinically. Ejaculation may be effected by administration of GnRH (1-2 μg/kg subcutaneously 2-3 hours before attempted breeding). GnRH causes release of endogenous LH, which stimulates release of testosterone. This technique for enhancing reproductive performance should not be used routinely in

valuable stud dogs because persistent stimulation of testosterone release may lead to a decrease in the normal, pulsatile spontaneous release of testosterone, which is necessary for maintenance of spermatogenesis.

5. The bitch conceives after copulation.* (Proceed to 6.)

5′. The bitch does not conceive after copulation.* (Proceed to 7.)

6. Pregnancy is maintained.

6′. Pregnancy is not maintained.

- Infectious causes of pregnancy loss include the following (see Chapter 7):

  Herpesvirus: Canine herpesvirus causes fetal death and is manifested as pregnancy loss late in gestation, stillbirths, and early neonatal death. Dogs infected in the last 3 weeks of gestation or during the first 3 weeks of life are most likely to show clinical signs. Bitches infected before or after the last 3 weeks of pregnancy usually are asymptomatic. Most bitches lose at most one litter to canine herpesvirus, apparently creating enough

*Dogs do not produce any hormone unique to pregnancy, precluding pregnancy diagnosis early in gestation. Therefore lack of conception cannot be differentiated from early embryonic death. Conception is proved by positive pregnancy diagnosis (see Chapter 8).

memory cells to permit an appropriate immune response if reexposure occurs. The virus is weakly antigenic, so titers are likely to be elevated in bitches only at the time of pregnancy loss. No vaccine is commercially available.

Canine brucellosis: Brucella canis infection is characterized by late gestation pregnancy loss. Puppies born live to infected bitches may have low birth weight and poor weight gain. Infected bitches also may have chronic vaginal discharge. Male dogs infected with *B. canis* show epididymitis and a decline in semen quality. Both male and female dogs with brucellosis may be asymptomatic. Brucellosis testing usually is done with serology. Agglutination tests are good screening tests because they are sensitive, virtually never yielding a false-negative result. Both tube agglutination tests, which yield a titer, and slide or card agglutination tests, which yield a yes or no response, are available. Agglutination tests are not specific, however, so a positive result on an agglutination test always should be reevaluated with the agar gel immunodiffusion test available at Cornell University. *B. canis* is not curable in dogs, but titers can be decreased and

shedding of organisms reduced with antibiotic therapy and neutering of the infected animal.

Subclinical uterine infection: Aerobic bacteria and mycoplasma that are part of the normal vaginal flora have been implicated in pregnancy loss in dogs. Diagnosis requires culture of vaginal discharge from the bitch and stomach content or organ tissue from an aborted fetus.

- Noninfectious causes of pregnancy loss include the following:

Hypoluteoidism: Hypoluteoidism is inadequate progesterone secretion from luteal tissue during pregnancy. Insufficiency of corpora lutea may predispose the bitch to premature labor as serum progesterone concentrations fall too early in gestation. Serum progesterone concentration must be greater than 2 ng/ml to support pregnancy. Routine supplementation with progestogens is not recommended during pregnancy because excessive progesterone may masculinize female fetuses and prevent expulsion of nonviable fetuses. If serum progesterone concentrations are documented to decrease too early in gestation, supplementation may be instituted with progesterone in oil

(2 mg/kg administered intramuscularly every 3 days) or ally-trenbolone (Regumate; Hoechst-Roussell, Kansas City, Mo.; 0.088 mg/kg administered orally once daily) to no later than 61 days after ovulation. Serum progesterone concentrations must decline before labor is initiated in bitches; maintenance of pregnancy beyond 65 days after ovulation by artificial supplementation with progesterone causes fetal death.

7. Semen quality is normal. (Proceed to 8.)

7′. Semen quality is not normal. (Proceed to 9.)

8. In a bitch with no reproductive tract disease bred to a male with normal semen quality in which pregnancy does not occur, poor breeding management is the most likely problem. *Improper timing of breeding is the most common cause of apparent infertility in dogs.* Breeding management is optimized with measurement of progesterone in serum to pinpoint ovulation time within the bitch's estrous cycle. Serum progesterone concentration is 5-8 ng/ml on ovulation day, and the optimal breeding day in bitches is 2 days after ovulation (see Chapter 2).

9. Semen quality, although abnormal, is adequate to effect pregnancy. (Proceed to 10.)

   A minimum of 250 million normal spermatozoa per ejaculate must be introduced into the

bitch's reproductive tract to reliably effect pregnancy. Male dogs with abnormal motility or morphology of spermatozoa and a high total number of spermatozoa in the ejaculate may still be capable of effecting pregnancy. For example, a male with 1 billion spermatozoa in his ejaculate, only 50% of which are morphologically normal, still has 500×10^6 morphologically normal spermatozoa, which is well above the 250×10^6 required. Optimization of conception rate by breeding 2 days after ovulation, as assessed by serial measurement of serum progesterone concentrations, is strongly recommended when using a subfertile male dog.

9′. Semen quality is insufficient to effect pregnancy.

- *Normal semen quality* is defined as 300 million to 2 billion spermatozoa in the ejaculate, with more than 70% of the spermatozoa exhibiting progressive motility and more than 80% of the spermatozoa being normal in morphology.
- *Azoospermia* is absence of spermatozoa in the ejaculate. Causes may be pretesticular, testicular, or posttesticular. Pretesticular causes include apprehension at the time of semen collection or breeding; administration of drugs that impair spermatogenesis, such as high dosages of glucocorticoids or antineoplastic agents; hypothyroidism (see 1′); and

inguinal or scrotal hernia. Diagnosis of incomplete ejaculation as a result of apprehension may be made based on measurement of alkaline phosphatase in seminal fluid. Alkaline phosphatase in semen arises from the cauda epididymis; concentrations of less than 5000 IU/L in seminal fluid suggest that no fluid from the epididymis is present in the seminal fluid. Measurement of alkaline phosphatase in seminal fluid cannot differentiate incomplete ejaculation from obstructive causes of azoospermia. Testicular causes include intersex states; bilateral cryptorchidism; any thermal or physical insult to the testicular tissue, such as high fever or trauma occurring during the 2 months or more preceding lack of spermatozoa in the ejaculate; and testicular neoplasia (see Chapter 16). Posttesticular causes include sources of epididymal occlusion, such as spermatocele or sperm granulomas. Epididymal occlusion may be visualized during scrotal ultrasonography.

- *Oligozoospermia* is presence of fewer than 300 million spermatozoa in the ejaculate. Apparent oligozoospermia may occur in dogs with retrograde ejaculation, which is movement of spermatozoa into the urinary bladder during ejaculation instead of through the

penile urethra. The cause of retrograde ejaculation in dogs is unknown. Diagnosis is made based on a collection of urine by cystocentesis after ejaculation, with demonstration of an abnormally large number of spermatozoa in the urine sediment. Antegrade ejaculation can be effected by administration of the sympathomimetic drug, pseudoephedrine (4-5 mg/kg administered orally 1 and 3 hours before breeding). Teratozoospermia is presence of less than 80% morphologically normal spermatozoa in the ejaculate. Asthenozoospermia is presence of less than 70% progressively motile spermatozoa in the ejaculate. Oligozoospermia, teratozoospermia, and asthenozoospermia often occur concurrently. Causes include infection of the reproductive tract, localized either in the prostate (see Chapter 17) or testes (see Chapter 16) and including canine brucellosis (see 6′), testicular neoplasia (see Chapter 16), and hypothyroidism (see 1′).

10. A diagnosis of idiopathic infertility must be made.

Infertility in the Cat

1. The queen is cycling normally. (Proceed to 2.)

1′. The queen is not cycling.

Causes for lack of estrous cycling in queens include the following:

- *Sexual immaturity:* Queens go through puberty at 5-10 months of age, with longhaired breeds entering puberty later than shorthaired breeds. Cats will not enter puberty during the seasonal anestrus, from mid-October through December at temperate latitudes.
- *Previous ovariohysterectomy:* Previous ovariohysterectomy may be determined based on history, palpation or observation of an ovariohysterectomy scar at the ventral abdominal midline, or exploratory laparotomy. In spayed bitches, serum concentrations of the gonadotropins LH and FSH are elevated because of lack of negative feedback from the absent ovary to the anterior pituitary. There are no commercially available assays for feline LH and FSH.
- *Inadequate environmental stimuli:* Cats housed with 10 hours or more of continuous light daily cycle year round. Those housed with minimal lighting may enter a prolonged anestrus. Queens housed with or exposed to a tom may be more likely to show signs of estrus or may be more visible to the owner when in estrus because of the change in behavior of the tom.
- *Systemic illness of the queen:* Queens that have a systemic disease, such as diabetes mellitus, or a

chronic complaint, such as vomiting, may be less likely to cycle. Similarly, medications the cat has received in the past, such as those used for estrus suppression and pregnancy termination, may have affected her fertility (see Chapter 5). Lack of cycling has been reported to occur in cats with feline leukemia virus.

- *Silent heat:* Apparent lack of cycling may occur in queens with silent heat. Silent heat is defined as normal ovarian follicular development in the absence of estrous behaviors. Silent heat may be more common in cats low in the social hierarchy. Collection of weekly vaginal cytology specimens permits assessment of the cornification of vaginal epithelial cells associated with estrus. Queens diagnosed in estrus by cytology stand for breeding and are fertile.
- *Chromosome abnormalities:* True lack of cycling has been reported in cats with karyotypic abnormalities (38,XO) and in male pseudohermaphrodites (retained testes and female external genitalia) (see Chapter 1).
- *Miscellaneous causes:* Older queens may cycle less frequently. Lack of cycling after ovulation induction without conception (false pregnancy; see Chapter 2) and while nursing (lactational anestrus) is normal in cats.

2. Normal copulation is occurring. (Proceed to 3.)
2′. Normal copulation is not occurring. (Proceed to 4.)
3. The male mounts and achieves intromission. (Proceed to 5.)
3′. The male cannot mount and achieve intromission.

Causes for inability to mount and achieve intromission include the following:

- *Presence of a penile hair ring:* Hair is compacted at the base of the penis. This is easily diagnosed via inspection and usually is easily removed.
- *Apprehension:* Tom cats should be bred in their home territory and may benefit from socialization with the queen in the days before breeding.
- *Physical causes of poor libido and inability to mount:* Causes include pain of the spine or rear limbs, malnutrition, and obesity.

4. The queen allows the male to mount. (Proceed to 3.)
4′. The queen will not allow the male to mount.

A vaginal cytology specimen should be evaluated to determine whether the queen is in estrus, with cornification of vaginal epithelial cells indicative of elevated serum estrogen concentrations and presence of an ovarian follicle.

5. The queen is induced to ovulate (evidenced by elevation in serum progesterone concentration to greater than 2 ng/ml by 7 days after breeding). (Proceed to 6.)

5′. The queen is not induced to ovulate.

The amount of LH released depends on the number of copulations and the time during the estrous cycle when copulation occurs. Less than 50% of queens bred only once ovulate. More than four copulations during a given estrus are required to ensure LH release adequate for ovulation. Queens that cannot be induced to ovulate by copulation may be treated with GnRH (25 μg administered intramuscularly 12-24 hours after breeding). Physical stimulation of the vagina with a cotton-tipped swab or glass rod does not reliably induce ovulation in queens.

6. The queen conceives after copulation.* (Proceed to 7.)

6′. The queen does not conceive after copulation.* (Proceed to 8.)

*Cats do not produce any hormone unique to pregnancy, precluding pregnancy diagnosis early in gestation. Therefore lack of conception cannot be differentiated from early embryonic death. Conception is assumed to have occurred if the queen was bred an adequate number of times by a known fertile tom.

7. Pregnancy loss occurs after conception.
   - Loss of pregnancy near midgestation may not be clinically evident because the queen may resorb the fetal tissues. Abortion after midgestation usually is accompanied by discharge of fluid or fetal tissues from the vulva, although the occasional queen will resorb late in gestation with no clinical signs of pregnancy loss.
   - Causes of pregnancy loss in the cat include the following:

     Luteal insufficiency: Feline abortion may be caused by abnormally low serum progesterone concentrations. Insufficiency of the corpora lutea or possible placental sources of progesterone may predispose the queen to premature labor because serum progesterone concentrations fall too early in gestation. Serum progesterone concentrations must be greater than 2 ng/ml to support pregnancy. Routine supplementation with progestogens is not recommended during pregnancy because excessive progesterone may masculinize female fetuses, prevent expulsion of nonviable fetuses, and induce diabetes mellitus and mammary abnormalities. If serum progesterone concentrations are documented to decline too quickly during gestation, supplementation with

megestrol acetate (Ovaban; Schering-Plough, Kenilworth, NJ; 2.5 mg administered orally every other day through day 55 of pregnancy) can be attempted.

Bacterial infection: Bacterial infection of the uterus and subsequent pregnancy loss is uncommon in healthy cats housed in a clean environment. Cats aborting because of intrauterine infection with *Escherichia coli, Staphylococcus* species, and *Streptococcus* species usually have anorexia; depression; fever; straining; and fetid, yellow-brown vaginal discharge. A sample of the vaginal discharge should be collected for culture and sensitivity, and empirical treatment with amoxicillin (20 mg/kg administered orally twice a day) should be instituted pending culture results. Radiography or ultrasonography may be necessary to ensure complete expulsion of uterine contents. Bacterial abortion may occur in cats infected with feline leukemia virus (FeLV) secondary to viral immunosuppression.

Protozoal infection: Toxoplasmosis is a protozoal cause of abortion in the queen. Although most queens infected with toxoplasmosis are asymptomatic carriers, those that become systemically ill may abort and may show dys-

pnea, lethargy, diarrhea, lymphadenopathy, and central nervous system disturbance. Abortion occurs secondary to debilitating disease of the queen. Toxoplasmosis is an uncommon cause of feline abortion.

Viral infection: Viral infections that may cause abortion in queens include feline herpesvirus (FHV; rhinotracheitis), panleukopenia, feline infectious peritonitis (FIP), and FeLV. Abortion secondary to FHV usually occurs at 5-6 weeks of gestation and is most likely a nonspecific reaction to the upper respiratory infection induced because the virus has not been demonstrated in aborted placental or fetal tissues in cats inoculated with FHV. This virus is easily controlled with vaccination. Cats entering the cattery from outside should be vaccinated well before entry. The intranasal vaccine can safely be used in kittens as young as 3 weeks. Panleukopenia infection can cause abortion, stillbirths, and cerebellar hypoplasia in kittens infected in utero, with or without classic gastrointestinal signs in the queen. The organism is shed in all body secretions from infected animals but is easily killed by bleach. Vaccination of all animals in the cattery and any animals entering the

cattery should be required. Pregnant queens should not be vaccinated with the modified live virus vaccine. Abortion resulting from infection with FIP occurs late in gestation and often is associated with prolonged vaginal bleeding. The disease is difficult to diagnose with serologic testing because titers of the coronavirus causing FIP are indistinguishable from those of the nonpathogenic enteric coronavirus. Control involves good hygiene and avoiding use of communal feeding dishes. Inbreeding increases susceptibility to infection with FIP; removal of adults that sire offspring that become infected may be warranted in problem catteries. FeLV has been reported to cause abortion from 3 weeks of pregnancy to term. Because FeLV requires intimate contact between animals for spread, testing and removal of infected animals constitute an effective method of control.

8. The male has normal semen quality. (Proceed to 9.)

8′. The male does not have normal semen quality.

- Semen quality is difficult to assess in cats because of difficulty in obtaining a semen sample. Gross evaluation of semen quality may be attempted by collecting a vaginal cytology

specimen from the queen immediately after breeding. Retrograde ejaculation, movement of spermatozoa into the urinary bladder during ejaculation, occurs in normal toms. Collection of a urine sample by cystocentesis immediately after breeding, with centrifugation and examination of the sediment, also may allow gross evaluation of semen quality. Electroejaculation also may be performed; this requires general anesthesia and use of specialized equipment.

- Causes for abnormal semen quality in tom cats include the following:

  Karyotype abnormalities (calico and tortoiseshell male cats): Calico (black, white, and orange) and tortoiseshell (black and orange or gray and cream) male cats often are infertile. White coat color is carried on an autosome. The gene for black or orange coat color is carried on the X chromosome. Normal male cats, which have a single X chromosome, can exhibit either black or orange, but not both. Calico and tortoiseshell male cats must have two X chromosomes, suggesting either triploidy (39,XXY) or mosaicism/chimerism (XX/XY, XY/XY, XXY/XY). Azoospermia (absence of spermatozoa in the ejaculate) often accompanies this abnormal karyotype.

Testicular atrophy: Poor semen quality may be caused by malnutrition, hypervitaminosis A, elevated testicular or intrascrotal temperature secondary to fever or scrotal trauma, or advancing age.

9. A diagnosis of idiopathic infertility must be made.

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