

The Dog Breeder's Guide to Successful Breeding and Health Management

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By

Margaret Root Kustritz

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*Non nobis nomine domine,
sed nomini tuo da gloriam.*

MV Root Kustritz

To my family

R Root

To my family

T Root

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FOREWORD

Welcome to *The Dog Breeder's Guide to Successful Breeding and Health Management*. My intention is to provide you with veterinary information I consider valuable to serious breeders of superior dogs. This presupposes that you have a working relationship with a veterinarian; no text can provide you with the breadth of information veterinary professionals accumulate in their years of undergraduate and graduate training. However, I have always found my breeder-clients to be intelligent and thirsty for knowledge and have long wished to provide dog breeders with a resource that answers their questions from a scientific perspective. **Information in this text is not my opinion and is not based on anecdotal reports.** Pertinent references from the veterinary literature are included where appropriate. This text is intended to be an in-depth resource for you and is written to that level of detail.

The book is arranged to permit readers to easily find specific information of interest to them. A table of contents and "Take-Home Points" for each chapter are provided at the front of the book. Each chapter begins with a list of frequently asked questions (FAQs) and ends with one or two cases to test your understanding. References are provided in each chapter. Appendices include a list of hereditary disorders by breed, a glossary, information on where to access references, descriptions of the management of common problems and emergencies, and specific reference articles about dog breeding and common practices of dog breeders. The final appendix contains information for licensed veterinarians.

Not all of your questions may be answered in this text, but that may be because not all of your questions are answerable. A study performed in 2011 demonstrated that of all the veterinary literature devoted to reproduction, there was only half as much in the dog as there was in cattle and that overall only about 7% of the studies published were adequate in study design and statistical analysis to allow veterinarians to draw conclusions from that work (Simoneit C, Heuwieser W, Arlt S. Evidence-based medicine in bovine, equine and canine reproduction: Quality of current literature. *Theriogenology* 2011;76:1042-1050). Veterinary training permits your veterinarian, especially if that veterinarian is a specialist trained in theriogenology, to look broadly across the literature to

help you see what is valuable for you and your animals in your unique situation. If you can't find something you're looking for in this text or if you find something confusing, please contact me at rootk001@umn.edu. I am happy to educate any dedicated and ethical breeder and to help create the beautiful animals with which you allow me to work every day.

Acknowledgments

I wish to thank my mentors, Drs. Shirley Johnston and Patricia Olson, and my parents, Arnold and Jeannette Root, without whom I would not be a theriogenologist today. I thank the University of Minnesota College of Veterinary Medicine for giving me the time to create this updated edition. I thank my supportive family members, especially my husband, Jason, and our three children, Cecilia, Marie, and Monica, and my sisters, Teresa and Rosemary, without whom this well-illustrated, well-edited, and well-indexed book would not exist. My greatest thanks to my clients and patients.

TAKE-HOME POINTS

Chapter One: Nutrition

- Optimum nutrition for breeding bitches and stud dogs has not been defined in the veterinary literature.
- There is no one diet that is best for all dogs, as nutritional needs vary with life stage (age, pregnancy, activity level) and there is variability in how individual animals break down and use different ingredients.
- Dogs are not required to eat meat to live. However, it may be more difficult to provide a complete and balanced diet for them using only plant sources for protein.
- Diets should be complete (contain all required nutrients) and balanced. Commercial products should state on the label that they are complete and balanced via the guidelines of the Association of American Feed Control Officials (AAFCO).
- Homemade diets must be complete and balanced; dog breeders who make their own diets are encouraged to work with a veterinary nutritionist.
- Raw diets are available commercially or can be made at home. Concerns about raw diets revolve around food safety and minimizing the risk of contamination with bacteria, viruses, and parasites.
- Once weaned, puppies should be fed a diet specific for growth and should be meal-fed; food should not be available at all times, as that makes housetraining more difficult and may be associated with growth abnormalities in large and giant breed dogs that grow too quickly.
- Adult dogs should be fed a maintenance diet specific to their activity (hunting or agility versus regular activity at home) and physiologic state (pregnancy, lactation).
- Pregnant dogs should be fed their pre-pregnancy food and amount until mid-gestation (about 4 weeks after breeding). At that time, they should gradually be switched to a performance or puppy food. During lactation (milk production), the bitch should continue to receive a performance or puppy food and can be free-fed or fed several times daily.
- There is very little information in the literature about supplements, which may include herbs, vitamins, and foods such as dried liver or

brewer's yeast. The breeder must weigh the known pros and cons of giving any supplements and must remember that if the dog is eating a substantial amount of any supplement or food, it is eating less of its balanced diet.

Chapter Two: Pharmacology

- Drugs do not always act the same way in animals that they do in humans.
- Many drugs used in animals have not been specifically approved for use by the U.S. Food and Drug Administration (FDA); breeders should work with their veterinarian to ensure that the proper drug is being given at the right dose and by the correct route.
- Very few drugs have been investigated for use in puppies, so we know very little about the optimum use of most drugs, including pain medications, in these patients.
- Veterinarians cannot legally prescribe drugs to a client unless they have a valid veterinarian-client-patient relationship.
- Drugs will eventually be distributed throughout the body no matter how they are administered (intravenously, subcutaneously [under the skin], transdermally [across the skin], orally [by mouth], or into the eye, ear, or nose).
- Dosing is set to make sure that an adequate amount of drug is in the system at all times. Because drugs are taken up by, distributed throughout, and removed from the body at different rates, the timing, dose, and route of administration of drugs varies with the specific medication and, sometimes, by the age or physiologic state of the patient.
- Antibiotics are drugs that control bacteria and fungi. They should be used only with a specific reason, usually a positive culture with sensitivity results demonstrating that the chosen antibiotic will control that specific organism. Use without a specific reason leads to antibiotic resistance, which is the growth of bacteria that cannot be controlled with currently available drugs.
- Viruses can be controlled only with a specific class of drugs (antivirals); this class of drugs is rarely used.
- Anesthetics are agents that readily move into tissue (local and regional anesthesia) or throughout the system (general anesthesia) to control pain and mediate consciousness. General anesthesia must be administered under the direct supervision of a veterinarian.
- Anti-parasitic agents control parasites, including intestinal worms,

heartworms, and fleas and ticks. Products are available through veterinarians or over the counter; those available through the veterinarian generally are more effective, as they may be unique compounds or may be able to be dispensed at a higher dose with veterinary oversight.

- Hormones that are used as medications differ from the other classes of drugs because they have far-reaching effects in the body, including increasing or decreasing the dog's own hormone production.

Chapter Three: Microbiology

- Bacteria, viruses, and fungi are everywhere in the environment, and humans and animals host a variety of microorganisms in their bodies that are necessary for normal health.
- Bacteria are classified by where they grow, their shape, how they take up stain, and their growth characteristics. There are many normal bacteria living in and on the body.
- Culture is the specific nurturing of bacteria from a sample (tissue, discharge, the environment) to identify what is growing at that site. Interpretation of culture results requires knowledge of whether or not bacteria would normally live at the area sampled and which bacteria are more likely to cause disease than others. Sensitivity testing is the determination of which antibiotics can control the growth of a specific organism.
- Antibiotics should be used only with a specific reason, usually a positive culture with sensitivity results demonstrating that the chosen antibiotic will control that specific organism. Use without a specific reason leads to antibiotic resistance, which is the growth of bacteria that cannot be controlled with currently available drugs.
- Viruses will not necessarily die readily in the environment but cannot reproduce without a host. When an animal is infected with a virus, that virus uses the animal's cells as its host and eventually destroys those cells so many new virus particles can be produced and spread. Viruses cannot be identified as easily as bacteria; laboratories may be able to do testing to identify whether or not specific viruses are present in a given patient. There are no viruses that are considered a normal inhabitant of the body.
- Fungi may live independently or may use a host to reproduce. Fungi can be cultured. Sensitivity testing is rarely performed, as a given species of fungus usually responds to a small group of antifungal agents. There are no fungi that are considered a normal inhabitant of the body.

- Mycoplasmas and ureaplasmas are unusual organisms that are most similar to bacteria. They are normal inhabitants of the body, but overgrowth can be associated with disease. They are difficult to culture.

Chapter Four: Parasitology

- Parasites are organisms that use another organism for survival to the detriment of the host.
- Some parasites require more than one type of host to complete their life cycle. Some also require vectors, species that transmit the parasite and may or may not also act as a host.
- Many parasites reproduce by laying eggs, but some may form cysts or give birth to live young.
- Diagnosis of a given parasite varies with its life cycle and which point in that life cycle is best identified in the host animal. For example, fecal flotation testing is done to test for intestinal parasites that lay eggs because those eggs are shed into the feces and so are easily retrieved and identified.
- Common parasites in dogs in the United States are roundworms and hookworms (intestinal parasites that lay eggs), tapeworms (intestinal parasites that shed segments into the feces), coccidia and Giardia (intestinal parasites that can be identified directly in fresh feces), heartworm (worms that live in the heart and large blood vessels and give birth to small worms that circulate in the bloodstream), and fleas and ticks.
- Treatment varies with the type of parasite and its life cycle. Products are available through veterinarians or over the counter; those available through the veterinarian generally are more effective as they may be unique compounds or may be able to be dispensed at a higher dose with veterinary oversight.
- One effective way of controlling parasites in puppies is by treatment of the bitch late in pregnancy.

Chapter Five: Immunology

- The immune system exists to dispose of foreign material introduced into the body. This includes physical means of removing foreign material, such as coughing, and cellular means of responding to that foreign material.
- Usually the immune system will recognize foreign material as a foreign protein, for example, on a virus or on plant material that has

been inhaled. The two main cell types involved in the immune response are T cells and B cells.

- Normal immune function involves the body recognizing the foreign protein (also called an antigen) and responding both by directly destroying it with T cells and by stimulating B cells to make antibodies, which bind to the antigen and enhance its destruction. This is called active immunity.
- Puppies begin life with passive immunity. This is the presence of antibodies in their system that were not produced by the puppy. Most commonly, these antibodies are taken in by ingesting colostrum, the first milk produced by the bitch after whelping.
- We recognize infection when the immune system is incapable of controlling these foreign invaders, permitting them to invade host tissue and cause inflammation and other changes associated with disease.
- Auto-immune disease occurs when the dog's immune system attacks normal tissue as if it were a foreign invader.
- Vaccination is controlled introduction into an animal's body of an organism, usually a virus, to generate a controlled immune response. This includes formation of antibodies to protect the animal now and creation of a specific type of immune cell, the memory cell, which can readily respond to subsequent exposures to the foreign protein and quickly build up a large number of antibodies in the future.
- The passive immunity of puppies may prevent them from responding to vaccines. Their own immune function develops gradually over the first months of life. For this reason, pups are given a series of booster vaccinations.
- Core vaccines are those that protect against diseases that cause significant illness or are life-threatening, that spread rapidly, or that can be transmitted to humans. Core vaccines are recommended for all dogs. Non-core vaccines may be recommended by your veterinarian for your particular dog depending on where you live and in what activities your dog is involved.
- Duration of immunity in adult dogs for most diseases for which we vaccinate is at least 3 years. Current guidelines recommend providing core vaccines for adults every 3 years. Work is ongoing regarding how best to measure antibody titers in a given dog and use that to tailor its vaccine schedule.
- The frequency of rabies vaccination is mandated by local law, and veterinarians must follow that law. Rabies vaccinations must be administered under the direct supervision of a veterinarian.

Chapter Six: Endocrinology

- Endocrinology is the study of hormones. Hormones are chemical substances secreted from glands into the surrounding tissue or the bloodstream.
- A tissue can respond to a given hormone only if that tissue has receptors on it to which the hormone can bind, a lock-and-key sort of mechanism. Binding of the hormone to the receptor sets off changes within that tissue.
- Hormones are secreted in response to specific stimuli. These stimuli may increase or decrease secretion of a given hormone. Concentration of the hormone in the bloodstream may itself act as a stimulus altering further secretion of that hormone.
- Hormones that are used as medications differ from the other classes of drugs because they have far-reaching effects in the body, including increasing or decreasing the dog's own hormone production.
- Examples of specific hormones and their effects include estrogen (signs of heat), luteinizing hormone (LH; ovulation), progesterone (maintenance of pregnancy), prolactin (milk production), oxytocin (milk let-down, mothering behaviors), thyroid hormone (cell metabolism), and testosterone (production of spermatozoa).

Chapter Seven: Embryology

- Embryology is the study of development from the fertilized egg to an individual.
- Fertilization takes place in the uterine tube. One or more eggs are released from each ovary at the time of ovulation and are caught by fingers of tissue and drawn into the uterine tube. Spermatozoa introduced by natural breeding or artificial insemination move to the uterine tube and attach there until the eggs are ready to be fertilized, living for up to 11 days. Multiple spermatozoa attempt to fertilize each egg. When the first spermatozoon reaches the inner layer of a given egg, a reaction is set off that blocks all other spermatozoa such that the new single cell contains one complete set of DNA, half from the dam (the egg) and half from the sire (the spermatozoon).
- The fertilized eggs move into the uterus, where they are nourished by secretions from the uterine glands as they begin development. About 17 days after ovulation, the embryos invade into the uterine lining and placentas form. Each pup is contained within its own sac of fluid (the amniotic sac) and is connected to its own placenta by an umbilical

cord. The placenta is the site of exchange of oxygen, nutrients, and other substances between the bitch and the pup.

- Early embryonic development is cleavage of the fertilized egg (zygote) to form two cells, then cleavage of those two cells to form four cells, and so on. These identical cells eventually move within the outer lining of the egg to form a disc on one side (the inner cell mass), which will go on to form the embryo. The rest of the cells contribute to the placenta.
- The concept of fraternal twins does not really apply to bitches or to any animal that routinely carries more than one offspring at a time. Bitches have been documented to produce identical twins. This occurs when there is splitting of the embryo very early in development, such that the two pieces go on to produce two new individuals.
- Complete development takes place over about the first half of pregnancy, and the puppies are embryos during this period. After mid-gestation, the puppies are no longer developing but are only growing and so are called fetuses.
- Teratogens are substances that cause birth defects. Puppies are most susceptible to teratogens in early pregnancy, when they are still undergoing development.

Chapter Eight: Anatomy and Reproductive Physiology of the Bitch

- The reproductive tract anatomy of the bitch makes it difficult for veterinarians to gather samples and perform procedures. The vagina is very long and very narrow, with a fold of tissue that hangs from the ceiling blocking the vaginal vault for much of its length. The cervix is very far forward and hangs from the ceiling of the vagina. The cervical canal lies at a right angle to the vaginal vault. This combination of anatomic features makes it difficult to access the uterus through the vagina.
- The average bitch has her first heat at about 10 months of age. In general, small breed bitches have their first heat earlier in life than large breed bitches.
- The average bitch goes through heat about every 7 months. This includes about 9 days of proestrus, about 9 days of estrus or standing heat, about 60 days of diestrus, and about 4.5 months of anestrus.
- Proestrous physical changes include swelling of the vulva and passage of blood-tinged discharge through the vulva. The male is interested, but the female will not allow him to mount and breed her.

- Estrous physical changes include softening of the vulva and passage of blood-tinged to tan discharge through the vulva. The female will allow the male to mount and breed her.
- As the bitch enters diestrus, she may pass a small amount of mucoid discharge through the vulva for a day or two. The male will no longer be interested in her.
- Anestrus is a long period during which there is no overt reproductive activity. It is normal for all bitches to undergo a prolonged anestrus as part of their heat cycle.

Chapter Nine: Breeding Management

- Well before a bitch is bred, she should be evaluated for genetic disorders specific to her breed and tested for canine brucellosis. She should be brought to a veterinarian for a complete physical examination, including an examination of her vagina to make sure she can be bred and can whelp naturally. Well before a male dog is used for breeding, he also should be evaluated for genetic disorders and tested for brucellosis and should undergo a complete physical examination, including palpation of his prostate and testes and evaluation of semen.
- Some breeders desire a negative vaginal culture from a bitch before breeding. This is an unrealistic expectation, as there is a normal bacterial population in the vagina that is necessary for the normal health of that tissue.
- If a pre-breeding vaginal culture is determined to be necessary, it is best performed when the bitch is early in proestrus so the veterinarian is capturing the discharge associated with heat, which arises from the uterus.
- Antibiotics should be administered pre-breeding only if the results of a pre-breeding culture are significant. They should be administered at least until the onset of diestrus and may be given until the time of pregnancy diagnosis, at mid-gestation.
- Vaginal cytology is a method for determining where the bitch is in her estrous cycle by assessing the population of cells present on a swab taken from the vagina. Vaginal cytology cannot be used to determine ovulation day or the optimal day to breed a bitch.
- Ovulation timing is valuable for breeding management because bitches will stand to be bred for a wide window of time around ovulation. If the exact ovulation date is known, the veterinarian can ensure that bitches are bred at the right time; optimal breeding occurs 2-4 days

after ovulation.

- Hormone assays that can be used to determine ovulation day include those for luteinizing hormone (LH) and progesterone. LH peaks two days prior to ovulation. Progesterone concentration is 4-10 ng/mL on ovulation day. Some bitches are best evaluated not by looking for specific numerical values to define ovulation day but instead by doing a series of progesterone assays and watching for a significant rise, which generally occurs on ovulation day.
- No specific progesterone concentration in blood denotes the optimal breeding day, as there is great variability between bitches.
- Other methods for determining ovulation day are nonspecific and include assessment of crenation or wrinkliness of the vaginal mucosa, changes in the vulva or in the bitch's behavior, changes in appearance of vulvar discharge as it dries (ferming), measurement of glucose in vulvar secretions, and measurement of electrical resistance across the vaginal mucosa.
- Natural breeding includes the following: The receptive bitch will hold her tail to the side and stand firmly in place (flagging). The male will mount the bitch and clasp his forelimbs just in front of her hindlimbs. He will thrust vigorously and will introduce his penis before it is fully erect. Spermatozoa are forcefully deposited into the cranial vagina at this time. The male's penis continues to engorge, with the most significant increase in size in the area of the penis nearest his body. This becomes caught in the lips of the vulva of the female (the tie, or copulatory lock). The male steps off the female with his penis still trapped in the vulva and swings one leg over her back so they stand rear-to-rear. During this time, he secretes waves of prostatic fluid and her vagina contracts, presumably to help move spermatozoa forward in her reproductive tract. Dogs do not need to tie for pregnancy to occur, and there is no correlation between the duration of the tie and fertility.

Chapter Ten: Pregnancy

- Bitches can carry pups that have different sires in one litter. This is called superfecundation.
- Fertilization occurs in the uterine tubes. The fertilized eggs move into the uterus, where they are nourished by secretions from the uterine glands as they begin development. About 17 days after ovulation, the embryos invade into the uterine lining and placentas form. Each pup is contained within its own sac of fluid (the amniotic sac) and is connected to its own placenta by an umbilical cord. The placenta is the

site of exchange of oxygen, nutrients, and other substances between the bitch and the pup.

- Gestation length in bitches is 62-64 days from ovulation or 58-71 days from a single breeding.
- Abdominal palpation for pregnancy diagnosis must be performed in a window around mid-gestation and cannot provide accurate information about litter size or the size of individual pups.
- Ultrasound for pregnancy diagnosis is accurate from as early as about 20 days, although most people prefer to wait until nearer mid-gestation to increase accuracy. Ultrasound also can be used to assess how viable the pups are by assessing heart rate and movement and can be used to estimate gestational age; it is less useful for determining litter size and the size of individual pups.
- Radiographs (x-rays) for pregnancy diagnosis are not accurate until after 42-45 days of pregnancy, when bone starts to mineralize, and cannot be used to assess how viable the pups are with the same accuracy as ultrasound. Most people wait to use radiography until the last week of gestation, when it can be used to assess litter size and the size of individual pups.
- Litter size is impacted by the timing of breeding, by the age and breed of the bitch, by the type of breeding (natural versus artificial insemination, type of semen used), and by the extent of inbreeding.
- Puppies grow to fill the size available to them; a small litter usually will be associated with large individual pups.
- There is a hypothesis that breeding a bitch early will result in more female pups; this has not been well borne-out in scientific studies.
- Pregnant dogs should be fed their pre-pregnancy food and amount until mid-gestation. At that time, they should gradually be switched to a performance or puppy food.
- In the week or so prior to expected whelping, a whelping box or area should be provided. If the bitch has long hair in the perivulvar and mammary areas, it should be clipped.
- Infectious causes of pregnancy loss (spontaneous abortion) include brucellosis, herpesvirus, and bacterial infections. The most commonly reported non-infectious cause is hypoluteoidism, or insufficient secretion of progesterone to maintain pregnancy.

Chapter Eleven: Estrus Suppression and Sterilization / Pregnancy Termination

- It is not as easy in the bitch as in other species to manipulate the heat cycle to try to make sure that she is in heat and will whelp on your schedule.
- Two drugs have been approved by the U.S. Food and Drug Administration (FDA) for suppressing heat in dogs. One, megestrol acetate, is no longer commercially available as a veterinary product but is available through human pharmacies. It is not recommended for use on a bitch's first heat or for suppression of more than two heats in a row. Duration of time until return to heat after stopping the drug is unpredictable. The other, mibolerone, is no longer commercially available as a veterinary product but is available through compounding pharmacies. It never was approved for use in breeding bitches. It must be started at least 30 days before a bitch's next expected heat and is given daily as long as the owner wishes to keep the bitch out of heat. Return to heat after stopping the drug is unpredictable.
- To completely control reproduction and reproductive behaviors, most owners choose sterilization, with ovariohysterectomy (complete removal of the uterus and both ovaries; also known as spay) the most common surgery performed.
- The primary benefits of spaying are decreased incidence of mammary neoplasia (breast cancer) and pyometra (uterine infection). The primary detriments are urinary incontinence, obesity, and possible increase in some orthopedic diseases and some uncommon forms of cancer.
- Other surgical forms of sterilization are ovariectomy (removal of the ovaries only), hysterectomy (removal of the uterus only, also known as ovary-sparing spay), and tubal ligation. Studies done to date have shown no difference in the frequency of short- or long-term complications in dogs undergoing ovariectomy compared to dogs undergoing ovariohysterectomy. There is little research documenting short- or long-term complications of ovary-sparing spay. Tubal ligation is very rarely performed in bitches.
- Non-surgical sterilization techniques are currently under study. Immunosterilization ("spay vaccine") may be available in the future, but no commercial products exist for dogs as of this writing.
- Bitches bred accidentally may be spayed as a means of pregnancy termination; this generally is better done early in pregnancy.
- Bitches bred accidentally who are intended for future breeding ideally should be checked for pregnancy before any medical therapies to

terminate pregnancy are used.

Chapter Twelve: Parturition and Dystocia

- The terms for a bitch giving birth are parturition and whelping.
- Materials to have on hand prior to whelping are a whelping box, towels, a bulb syringe, sewing thread or dental floss, iodine, a small scale, vanilla ice cream or yogurt, and your veterinarian's phone number.
- Gestation length in bitches is 62-64 days from ovulation or 58-71 days from a single breeding.
- Puppies born too early will not survive, as they do not lay down the lining of their lungs (surfactant) until very late in pregnancy.
- In late pregnancy, bitches may need to be fed more frequently, as they physically cannot eat as much at a given time. The onset of pre-whelping behaviors and physical changes, including nesting and milk production, is variable.
- The fetuses initiate labor. Bitches with very low litter size or who are carrying dead fetuses may not go into labor.
- The onset of labor in some bitches is accompanied by a decrease in body temperature, as a reflection of changes in hormone concentrations in their bloodstream.
- During the first stage of normal whelping, the cervix is dilating. Strong abdominal contractions are not visible. This stage can last up to 12 hours.
- During the second and third stages of normal whelping, the puppies and their associated placentas are passed. This stage can vary in length, depending on litter size. The first pup should be born within 4 hours of seeing strong abdominal contractions, and there should be no more than 2 hours between pups.
- The bitch should be observed while in labor but should not be stressed. If a pup is born within its amniotic sac (clear membrane) and the bitch does not tear it away, the owner should tear it open, vigorously rub the pup with a warm towel, and use a bulb syringe to suction fluid from its mouth and nose. Historically, people would swing the pup head down to move fluid out of its respiratory tract; do not do this. Tie off the umbilical cord with thread or dental floss about 1" away from the pup's body, and cut it off. Clean the exposed tissue with iodine.
- Remove the placentas so the bitch does not eat them, if possible. Placentas that are retained in the uterus generally break into pieces and pass over the first couple of days post-partum.

- It is normal for the bitch to pass an odorless vulvar discharge for up to 3 weeks after whelping; this discharge may vary in color from blood-tinged to green to brown and should decrease in volume over time. The bitch's rectal temperature may be slightly elevated for several days after whelping but should never be above 102.5°F (39.2°C).
- The pups should be weighed at birth and daily thereafter. All pups should ingest colostrum, the bitch's first milk, which is rich in antibodies, within the first day of life, ideally within the first 8 hours after they are born.
- Dystocia (difficult or abnormal whelping) may be due to problems with either the dam, such as lack of abdominal contractions (uterine inertia) or low blood calcium (hypocalcemia or eclampsia), or with the pups, such as being oversized or abnormally positioned.
- If the bitch appears abnormal (disoriented or vomiting, for example), if time limits described for normal whelping have been exceeded, or if the bitch has abnormal vulvar discharge (overt hemorrhage, green discharge before any pups are born), a veterinarian should be called.
- Diagnostic tests routinely performed to identify the cause of and the best plan to address dystocia include a physical examination and digital vaginal examination of the bitch, radiographs (x-rays), and possibly ultrasound and/or bloodwork.
- Treatment of dystocia depends on the cause and on the number of pups present. Medical therapy with oxytocin may be attempted in some situations. Cesarean section (C-section) is indicated in some situations. Planned C-section is where the owner and the veterinarian decide together that the risk of allowing the bitch to try normal delivery is too great. Timing of a planned C-section is essential to ensure that the pups are not too premature to be born; this may include information from the time of breeding and progesterone assay, radiographs, or ultrasound performed at term.

Chapter Thirteen: Neonatology

- It is not uncommon for one or more pups in a litter to die before weaning, even in well-managed facilities.
- Puppies are born with reduced function of the immune system, kidneys, and liver compared to adult dogs. This alters how the veterinarian interprets physical examination and bloodwork findings for puppies and administers medications to and vaccinates puppies.
- All puppies should be weighed at birth and daily thereafter. Puppies may lose a small amount of weight in their first day of life but should

hold steady or gain weight every day after that, doubling their birth weight by 7-10 days of age.

- Puppies cannot control their own body temperature until they're up and moving (about 3 weeks of age). Normal rectal temperature for puppies less than 3 weeks of age is lower than it is for adult dogs.
- Normal puppies sleep most of the day. Puppies that are restless, cry constantly, or lie apart from littermates or the dam should be seen by a veterinarian immediately.
- Eyelids open at about 2 weeks of age.
- Puppy teeth are present by about 6 weeks of age. Permanent teeth erupt, replacing the baby (deciduous) teeth, from 4-6 months of age.
- Hypothermia (low body temperature), hypoglycemia (low blood sugar), and septicemia (infection) are common puppy emergencies. Sick puppies should be seen by a veterinarian as quickly as possible. Rewarming puppies should be done gradually with radiant heat (not heating pads or hot water bottles).
- If a pup did not ingest colostrum, blood can be drawn from any vaccinated adult dog by a veterinarian and refined into a product that can be given to puppies to provide them with antibodies.
- "Fading" describes puppies that do not thrive or that were doing well and suddenly are failing. There are many causes for fading, including internal and external parasites, infectious diseases including septicemia, maternal neglect, and presence of overt congenital abnormalities (physically identifiable anomalies) or covert congenital abnormalities (abnormal metabolism).
- If a puppy dies and your veterinarian wishes to evaluate it by necropsy (animal autopsy), wrap it in plastic (for example, a freezer bag) and refrigerate the body. Do not freeze it.

Chapter Fourteen: Disorders of the Puerperium

- The puerperal period is the time from whelping until complete repair of the uterus, about 12 weeks.
- There is no specific need for breeders to take their bitch in for a "clean out" shot of oxytocin after whelping as long as pups are nursing. The lactating bitch is releasing her own oxytocin.
- The three biggest concerns during this period are hypocalcemia, mastitis, and metritis.
- Hypocalcemia (also known as eclampsia in bitches) is most common at peak lactation (2-3 weeks after whelping) in small breed dogs nursing a

large litter. Signs include neglect of pups, trembling, wobbly gait, scratching at the face, and, eventually, seizures. This is an emergency. Treatment is administration of calcium by a veterinarian.

- Metritis is inflammation and infection of the uterus. The bitch neglects the pups and has a thick, malodorous vulvar discharge. Treatment is with antibiotics; in some bitches, medications to cause uterine contractions or surgical removal of the uterus may be required.
- Mastitis is inflammation and infection of the mammary glands. One or more mammary glands in affected bitches are red and firm, and the bitch will react with pain when pups nurse. Treatment is with antibiotics.

Chapter Fifteen: Disorders of the Ovaries

- Ovarian follicular cysts produce estrogen. Affected dogs have a prolonged heat cycle, specifically with prolonged proestrus and estrus. Follicular cysts can be diagnosed by vaginal cytology and ultrasound. They are treated by a veterinarian, either by inducing ovulation medically or by surgically removing the ovaries.
- Ovarian neoplasia (cancer) is uncommon in dogs and usually is cured with surgical removal of the ovaries.
- Ovarian remnant syndrome is the appearance in a spayed dog of signs of heat associated with estrogen production. Diagnosis requires demonstration of estrogen and progesterone secretion or direct observation of the tissue by ultrasound or advanced imaging (for example, MRI or CT scan). Treatment is surgical removal of the remnant tissue.

Chapter Sixteen: Disorders of the Uterus and Cervix

- Metritis is inflammation and infection of the uterus and is seen after whelping or some other insult to the uterus. The bitch neglects the pups and has a thick, malodorous vulvar discharge. Treatment is with antibiotics; in some bitches, medications to cause uterine contractions or surgical removal of the uterus may be required.
- Pyometra is a two-step disorder. A thickening of the uterine lining called cystic endometrial hyperplasia develops from repeated heat cycles over the bitch's life, and pyometra develops when this abnormal uterus becomes infected. It is seen in diestrus or anestrus (after standing heat) and is not associated with whelping. It is more common in older bitches. All dogs with pyometra present with fever, lethargy,

and possibly increased thirst and urination. If the cervix is open, foul-smelling vulvar discharge is present. If the cervix is closed, the abdomen is distended. Diagnosis is by radiographs (x-rays) or ultrasound and bloodwork. Spaying is the best treatment, but medical therapy exists for bitches with an open cervix who are intended for breeding.

Chapter Seventeen: Disorders of the Vagina and Vulva

- Discharge from the vulva may be normal (for example, during heat or after whelping) or abnormal (for example, if associated with uterine or vaginal infection).
- Vaginal anomalies are anatomic abnormalities including pillars or walls of tissue or circumferential strictures. Dogs may show no clinical signs, may have difficulty being bred or whelping, or may have chronic urinary tract or vaginal infections. Diagnosis is by vaginal examination. Treatment depends on the type and extent of the abnormality.
- Vaginal prolapse is protrusion of vaginal tissue through the lips of the vulva. This is associated with estrogen secretion and so is most commonly seen during heat. Diagnosis is by physical examination. Treatment involves removing the influence of estrogen and so may involve inducing ovulation, spaying, or just waiting for the normal decrease in estrogen that occurs during the heat cycle.
- Juvenile or puppy vaginitis may be seen in bitches before their first heat; this usually is a benign condition that resolves with no treatment.
- The most common form of vaginitis is seen in adult, spayed dogs, who present with mucoid vulvar discharge, vulvar licking, and possibly urinary signs such as incontinence or recurrent urinary tract infections. Diagnosis is by vaginal examination and culture and evaluation of the urinary tract. Treatment depends on identification of an underlying cause (for example, an anatomic abnormality causing urine pooling) or associated problems (for example, urinary incontinence). Allergies may be a component of vaginitis in some dogs.

Chapter Eighteen: Disorders of the Mammary Glands

- Mastitis is inflammation and infection of the mammary glands. One or more mammary glands in affected bitches are red and firm, and the bitch will react with pain when pups nurse. Treatment is with antibiotics.