AMERICAN KENNEL CLUB
CANINE HEALTH FOUNDATION

American Kennel Club and Canine Health Foundation Breeders' Symposium

Hosted By
University of California, Davis,
Center for Companion Animal Health
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ABC's of Breeding

Claudia Orlandi, PhD
Essex Junction, Vermont

The ***ABC's of Breeding Home Study Program*** is based on Dr. Orlandi's belief that **anyone** can and should understand the basic and important rules of canine genetics in his quest to breed better, healthier dogs. The ***ABC's of Breeding***'s unique, step-by-step approach to better breeding includes easy-to-answer workbook exercises along with an innovative set of flash cards, which makes learning new material fun and easy. Attendees who complete the ***ABC's of Breeding*** workbook exercises and send them in to AKC will receive a certificate of completion.

The ***ABC's*** takes a practical approach to teaching the art and science of dog breeding and focuses on six key tools and concepts. This include 1) genetics, 2) breeding systems, 3) the pedigree, 4) the selection process and the concepts of 5) genetic defects and 6) kennel blindness. Understanding each of these components can help breeders put together the pieces for a more successful breeding program.

Along with reviewing the basics of heredity, some of the common misconceptions that have been passed down from dog breeder to dog breeder are also discussed. A few of these include: What is the definition of linebreeding? Why can linebreeding beyond the fourth generation have relatively little genetic impact on a litter? Should you breed an inferior dog with an excellent pedigree? Is the pedigree more important than the dog itself?

Throughout the ***ABC's of Breeding*** program the focus is on "need-to-know," practical information, with an emphasis on making it all easy to understand and fun to learn.

Biographical Profile

Dr. Claudia Orlandi's involvement with showing dogs began as a Junior Handler. She and her husband currently have a kennel of 40 to 50 Basset Hounds under the Topsfield prefix on 200 acres in northern Vermont. They have bred over 60 champions, including record holding Bassets in several areas. A teacher by profession, Claudia has been actively involved in education within the Basset Hound Club of America and as a lecturer. She has served on the BHCA Health & Research Committee, the Judges' Education committee and is currently Chairman of Member Education for which she is designing an innovative concept called "Basset Hound University". She authors a column called "Breeder's Toolbox" in the BHCA newsletter and has designed "The Pedi-Score Tool Kit: A Recording System for Basset Hound Breeders." She has also written "Discover the Basset Hound: A Guide To This Fascinating Breed and presented the following workshops: "Tips on using the Pedi-Score Tool Kit to Evaluate a Litter," "Evaluating Forequarters in the Basset Hound" and "Evaluating Hindquarters and Balance in the Basset Hound." She has recently developed "The ABC's of Breeding: What Every Dog Breeder Should Know," which is a home study program for dog breeders. She judges Basset Hounds, Dachshunds and Junior Showmanship.

Canine Physical Rehabilitation

Jackie Woelz, MS, PT
Physical Rehabilitation Service, UC Davis

Physical rehabilitation is often indicated after injury, surgery or disability and is an essential and recognized part of the recovery process in human medicine. Medical treatment is generally directed at the pathology while rehabilitation focuses on reversing or minimizing the associated impairments. Physical therapists have been working in human medicine for over 80 years. Specialty areas in physical therapy now include neurology, orthopedics, cardiovascular and pulmonary, pediatrics, geriatrics, sports medicine, wound care and pain management.

The field of physical rehabilitation in veterinary medicine is rapidly expanding, as veterinarians, therapists and clients recognize the benefits for our canine companions. Through clinical findings and research, we are learning that many of the same principles and treatment techniques used for decades to treat people may be extended to our patients in veterinary medicine. The Physical Rehabilitation service at VMTH receives referrals and treats patients from the Neurology, Orthopedic, Soft tissue, Medicine, and Nutrition Services.

As we have seen with human rehabilitation, recoveries from injury or surgery that are guided by a rehabilitation professional will suffer fewer setbacks and achieve improved outcomes due to close monitoring throughout the healing stages. The goals of rehabilitation are to promote optimal healing, an early return to fun and function, and to prevent the complications from disuse. The art and science of rehabilitation as provided by a credentialed professional can help our companions get safely back on their feet.

Benefits of rehabilitation:

- Professionally guided, accelerated recovery from injury
- Decreased pain, inflammation and swelling
- Improved blood flow and optimal healing in the injured area
- Protects other limbs from trauma
- Controlled, early mobilization to limit the effects of disuse
- Restore normal movement patterns
- Prevent or minimize muscle atrophy
- Earlier and safer return to fun and function
- Improved attitude and happiness with improved mobility
- Owner education and home program instruction
- Communication link for veterinarian and client throughout the rehab process

Indications for rehabilitation:

- Pain: from injury, surgery or disability
- Soft tissue injuries: strains, sprains, tendonitis
- Joint injuries: contractures, arthritis
- Gait abnormalities: lameness, compensatory movement strategies after injury
- Orthopedic, soft tissue or neurosurgery

- Geriatric conditions: arthritis, decreased flexibility, muscle spasms, decreased functional mobilities
- Obesity and deconditioning
- Canine athletes and working dogs: strength and conditioning needs

Canine conditions commonly referred for rehabilitation:

- Severe muscle atrophy
- Musculotendinous injuries
- Cruciate ligament surgeries
- Femoral head ostectomy
- Fractures
- Degenerative joint disease
- Hip dysplasia
- Carpal hyperextension injuries
- Peripheral nerve injuries
- Spinal cord injuries
- Intervertebral disc disease
- Fibrocartilagenous emboli

The canine physical rehabilitation evaluation follows similar guidelines as established in human physical therapy. Our assessment includes factors related to movement dysfunction. We assess range of motion and differentiate joint from muscle limitations. Muscle strength is evaluated as it relates to the patient's functional activities such as standing up from the floor, walking over uneven terrain, or ascending stairs. The quality of the muscle tone: hypotonicity, normal or hypertonicity, will determine the plan of care established. Other important aspects of movement include accuracy, speed and responses to speed demands.

Our treatments are based on scientific rationale and the principles of neurophysiology. We recognize that normal postures and movement patterns must be established before function can occur. Our selective strengthening protocols address proximal stability which eventually will allow safe distal mobility. We also recognize that a motivated patient in an enriched environment will lead to improved outcomes. Our emphasis is on holistic treatment as we strive to maintain flexibility and creativity. Every dog is an individual and rehab should be fun!

Although we use various therapeutic modalities and exercise equipment, our hands will always be our most valuable tools. We use manual techniques for assessing and addressing soft tissue restrictions, range of motion, quality of muscle tone and strength.

Our treatment techniques include:

- Manual therapy
- Manual techniques to facilitate or inhibit muscle contractions
- Soft tissue mobilization
- Therapeutic massage
- Pain management
- Therapeutic exercise

• Balance training
• Gait training
• Proprioceptive training
• Strength and conditioning
• Hydrotherapy
• Preventive, proactive recommendations
• Home environment recommendations
• Videotape analysis of movement
• Custom orthotic fabrication

Veterinary physical rehabilitation is a newly recognized field that will continue to grow based on the collaborative effort of credentialed individuals committed to advancing the science of treatment techniques, discovery and education. We look forward to all the possibilities as we share our knowledge and clinical experiences in human and veterinary medicine.

Biographical Profile

Jackie Woelz is the supervisor and physical therapist of the Physical Rehabilitation Service of VMTH, which opened in September 2004. She completed a Bachelor's degree in Biology at UC San Diego in 1986 and a Master of Science in Physical Therapy at the University of the Pacific, Stockton, California in 1991. Her research and public education experience includes work at the San Diego Zoo's Center for the Reproduction of Endangered Species, Scripps Institution of Oceanography Physiological Research Laboratory, and the Monterey Bay Aquarium. Prior to working at VMTH, Jackie owned and operated a private practice, *Thrive* - Canine Rehab, for 4 years. Jackie has 11 years of clinical experience in human physical therapy and 5 years of experience in animal physical rehabilitation developing protocols, teaching and consulting.

Canine Forensic Genetics

Sree Kanthaswamy, PhD
Director, VGL Forensics Lab, UCDavis

Courtroom testimony based on DNA analysis of animal evidence is being used increasingly world wide. Canine biological material-based casework performed at our laboratory has been used to successfully prosecute individuals in cases of animal abuse, animal attack, and to link a perpetrator to instances of murder, burglary, and sexual assault. During this presentation we will review actual cases where evidence collected from three different canine forensic scenarios was used to charge and convict perpetrators.

Research projects using funds from the AKC have generated canine genetic databases for performing statistical analyses of match comparisons and parentage identification. The canine database also enables us to design new and improved methodologies. Some of these groundbreaking works have paved the way for other funding and research opportunities including one from the US National Institute of Justice to develop and validate a forensic quality canine genetic marker set. We have also developed an absolute quantification methodology for estimating canine DNA in trace amounts.

Ultimately, animal forensics is first and foremost dedicated to the increased understanding of and caring for animals. Thus, veterinary forensic genetics has become a part of the School of Veterinary Medicine where students, faculty and resources are similarly dedicated.

Biographical Profile

Dr. Sree Kantheswamy received his PhD in population genetics from the University of California, Davis. His research areas of emphasis include forensic and primate population genetics. Dr. Kantheswamy's forensic research concentrates on the analyses of evidentiary animal biomaterial collected at crime scenes or samples from civil cases for DNA-typing and genetic identification. He also has a keen interest in the conservation genetics of wild primate populations.

DNA & The American Kennel Club

Thomas W. Sharp
Assistant Vice President, Compliance
The American Kennel Club
Raleigh, NC

The American Kennel Club began using DNA genotyping for parentage verification and genetic identification purposes in 1998. Fifteen inspectors collect DNA samples from AKC registered litters during routine kennel inspections throughout the United States for the DNA Compliance Audit Program. The AKC also offers a DNA Certification Program that allows dog owners and breeders to collect DNA samples using a simple, non-invasive cheek swab. The sample is submitted to the AKC with payment and the sample is processed and the DNA genotype produced by MMI Genomics in Davis, CA. The dog owner receives an AKC DNA Certificate and the dog's DNA Profile Number is added to its AKC registration record to appear on pedigrees. The AKC maintains a database to evaluate the parentage of DNA Certified dogs. The information is used to verify and ensure the integrity of the AKC Registry.

Biographical Profile

Tom Sharp is Assistant Vice President of Compliance with The American Kennel Club. Mr. Sharp earned a BA from the University of North Carolina (Chapel Hill) in 1992 and an MBA from the Kenan-Flagler Business School, University of North Carolina (Chapel Hill) in 2001. He joined the AKC in 1996. In 1997, he was named Manager of the newly created DNA Operations Department, charged with setting up and running the operations. Mr. Sharp became Director of the department in 2000. In 2003 he joined the Internal Consulting Group where he spearheaded various research projects on registration trends. He was named Assistant Vice President of Compliance in January 2004. The Compliance division includes the DNA Operations, Investigations and Inspections, Case Management and Compliance Support departments. The division is entrusted with the integrity of the AKC Registry and compliance with its rules and regulations.

Homemade and Alternative Diets

Andrea J. Fascetti, VMD, PhD, Dipl. ACVIM, Dipl. ACVN
Department of Molecular Biosciences, UCDavis

The use of homemade diets by pet owners has grown rapidly in the past several years. As owners become increasingly aware of alternative therapies for themselves, they are beginning to explore these options for their pets.

With the advent of complete and balanced commercial pet foods the use of homemade diets has declined. However, over the past several years there has been a growing segment of pet owners that are electing to home cook for their pets. There are many reasons for this. Some of the more common ones included: the negative press against commercial pet foods (erroneous information in most cases), the belief that home cooked foods are better (more natural) than commercial pet foods, the feeling of a stronger bond between the owner and pet; the belief that home cooking is cheaper (not true in most cases) and the presence of a disease process that prohibits the use of a commercially available diet.

Most nutritionists agree it is in the animal's best interest to eat a commercially available food, if at all possible. A very important point to remember is that homemade diets typically have not undergone animal feeding trials or even laboratory analysis to confirm they support the life stage for which they were designed. Owners often substitute ingredients without first consulting their veterinarian or nutritionist. Frequently the recipes selected are from unknown or questionably reputable sources. Finally, ingredients (especially in recipes following dietary fads) are often difficult to acquire.

There are, however, a number of reasons to institute a homemade diet program in some patients. The major indication for placing an animal on a homemade diet is a medical condition that has special nutritional concerns not addressed in a commercial or veterinary therapeutic diet. One of the more common conditions where homemade diets have been extremely useful is in managing adverse food reactions. By feeding a homemade diet one can select a protein and carbohydrate source not available in commercial foods, avoid additives and preservatives, and maintain control over the type and amounts of ingredients used. Home cooked diets are often the only option for animals with multiple medical conditions. By selecting a commercial diet to treat one condition, the practitioner may be feeding in a method that is contraindicated for another. A common example is an animal with hyperlipidemia, or a history of severe recurrent pancreatitis, and calcium oxalate stones. Homemade diets are also useful for patients with medical conditions that necessitate the use of a prescription diet, but that diet is not well accepted by the pet for a variety of reasons.

Many veterinary practitioners successfully use homemade diets in the management of their patients. It is important to obtain homemade diet recipes from reputable sources, ideally formulated by properly trained individuals. There are a number of recipes in the veterinary literature, in textbooks and referred publications. Some of the major pet food companies have formulated and published homemade diet recipes. Be extremely cautious of recipes obtained from the Internet, or the multiple publications designed for use by the general public.

Alternatively, a better option is to have a diet specially formulated for your patient. A custom-formulated diet accounts for the patient's specific needs and abnormalities, using ingredients the pet likes. Contact the veterinary teaching college in your area to see if their clinical nutritionist provides this service (often for a fee). There are also a number of veterinary nutritionists in the private consulting sector who will custom formulate diets for a fee. Board certified veterinary nutritionists may be located through the American College of Veterinary Nutrition (AVCN) at www.acvn.org.

Recently, in addition to cooked, home-prepared diets, many owners have started to feed raw food diets to their animals. Nutritional therapy has always had a strong appeal to many owners because it is viewed as natural and therefore, but not always correctly, safe. Proponents of raw food diets proclaim many health benefits associated with this feeding regime. Arguments include that dogs and cats are carnivores, that they evolved eating raw food, and that the processing of commercial diets alters or destroys nutrients essential for these animals. While these arguments initially appear scientifically plausible and are occasionally reinforced by examples, they often do not stand up to scrutiny or are supported by strong scientific advice.

Currently there are three major categories of raw food diets fed to dogs and cats. The first are commercially available, "complete" foods, intended to be the sole source of nutrition. Combination diets are the second type of raw food diet commonly used. The client purchases a commercially available grain and supplement mix that they then combine with raw meat at home. Home-prepared complete raw food diets are a third option. These diets are often referred to by the acronym "BARF" (bones and raw food diet), although other approaches are available.

The concerns and questions surrounding this feeding approach are many. Upon closer scrutiny many of the recommended feeding regimes are not balanced or do not provide all of the required nutrients. This is of particular concern during the growth period. Other problems that may arise from this feeding approach include gastrointestinal obstructions and perforations, bacterial contamination and zoonotic diseases.

Biographical Profile

Dr. Andrea Fascetti graduated from the University of Pennsylvania School of Veterinary Medicine. Following graduation she completed an internship and medicine residency at The Animal Medical Center in New York City. She then became an adjunct instructor in physiological chemistry in the Department of Molecular Biosciences in the School of Veterinary Medicine at the University of California, Davis. She also started a graduate degree in nutrition and a clinical nutrition residency. Three years later Andrea became a Hill's Fellow in Clinical Nutrition. Her doctoral research investigated copper nutriture in the queen and its influences on reproduction and cuproenzyme activities. She is a diplomate of the American College of Veterinary Internal Medicine and the American College of Veterinary Nutrition. Andrea is currently an Associate Professor of Nutrition at the University of California, Davis. She is also the service chief for the Nutrition Support Service in the Veterinary Medical Teaching Hospital of the University of California, Davis. Her current research interests are trace mineral

metabolism in dogs and cats, improvement of pet foods and taurine bioavailability and metabolism in the dog.

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Receptor Tyrosine Kinase Dysfunction in Canine Cancer

Cheryl London, DVM, PhD
Department of Surgical and Radiological Sciences, UCDavis

Protein kinases are enzymes that play key roles in cell signal transduction, regulating pathways critical in cell growth, differentiation, survival and death. These enzymes act by phosphorylating key residues on themselves (also known as autophosphorylation) and on other molecules, thereby generating a downstream signal inside the cell, usually in response to external signals. Those tyrosine kinases expressed on the cell surface that bind growth factors are termed receptor tyrosine kinases (RTKs); 58 of the 90 known tyrosine kinases are RTKs. These RTKs are composed of an extracellular ligand binding domain, a transmembrane domain, and a cytoplasmic tyrosine kinase domain that serves to both positively and negatively regulate phosphorylation events.

Dysfunction of many RTKs has been identified in a variety of human cancers, and is just beginning to be investigated in spontaneous tumors of dogs. Kinases may be dysregulated through a variety of mechanisms including mutation, overexpression, fusion proteins, or autocrine loops. In the case of mutations, these may result in phosphorylation of the kinase in the absence of an appropriate signal. Our group has identified the presence of novel mutations in the RTK Kit that are present in approximately 30-50% of high-grade canine mast cell tumors. Recent evidence suggests that tumors with this mutation respond well to small molecule inhibitors directed at Kit. Our group has also identified the presence of a novel mutation in the RTK Met in 80% of Rottweilers. Unlike the Kit mutation, the mutation in Met is present in the germ-line of these dogs, suggesting that abnormalities in Met signal transduction may contribute to the high incidence of cancer in this breed of dog.

Biographical Profile

After graduating from Tufts School of Veterinary Medicine in 1990, **Cheryl London** worked in private practice for 2 years in Kennebunk, ME. She found she had a great interest in cancer, and subsequently completed a residency in Medical Oncology at the University of Wisconsin, Madison. During that time, Dr. London found she truly enjoyed performing cancer research in the laboratory, and when her residency was completed in 1994, she entered a PhD program in Immunology at Harvard University. Dr. London graduate in 1999, and has since been an Assistant Professor of Medical Oncology at UC Davis. Her research interests center primarily around mast cell cancer in dogs and cats, as well as in the development and implementation of novel anti-cancer agents.

Canine Vaccination

Niels C. Pedersen, DVM, PhD
University of California

The purpose of a vaccine is to provide sufficient immunity to either induce total (sterilizing) or partial (disease attenuating) immunity. Two over-riding truths apply to all vaccines: 1) no vaccine can induce better immunity than the natural infection, 2) if an infection has both acute and chronic stages; vaccines will protect against the acute disease but will not prevent the chronic infection. Parvovirus enteritis and canine distemper infections, which are not universally fatal and do not induce a chronic carrier state, are easy to vaccinate against. HIV of humans, which causes a life long infection, from which no one recovers, has defied vaccination. In the case of kennel cough, which has both acute and chronic stages, vaccines will minimize acute disease signs but not chronic infection.

Vaccines are of three basic types: 1) live, 2) killed whole agent, 3) subunit. Vaccines made from a virulence attenuated living form of the pathogen are the most common and are usually the most effective. This is because they cause subclinical infections, which greatly amplify the vaccines effectiveness. Killed whole agent vaccines are used in situations where the pathogen cannot be safely attenuated. Whole agent vaccines usually contain a chemical additive called an adjuvant. Adjuvants provide an initial stimulus to the immune system and bolster the lower immunizing potential of the killed agent. Subunit vaccines are made up of only the immunogenic parts of the pathogen, usually the outer membrane protein(s), or a product of the agent (tetanus toxoid). Subunit vaccines are administered as a whole protein with adjuvant or delivered in the form of a gene (coding for the major immunogenic protein) carried into the body by an innocuous virus vector (e.g., canary pox virus distemper). The vector will introduce the gene into the cells of the dogs; the gene is then expressed and immunogenic protein released.

Vaccines can also be grouped according to their importance. The core group of vaccines are those thought to be most important in preventing disease and are always given to puppies as a series and to adult dogs as boosters. Core vaccines for dogs include canine distemper, canine hepatitis, and canine parvovirus. Rabies is included in this group more for public health reasons than for lowering disease mortality in dogs. A secondary or optional group of vaccines is against agents that are not important causes of disease (parainflulenza) or agents that only cause disease under certain circumstances (kennel cough). There is a third group of canine vaccines that many consider to be without merit, including canine canine coronavirus and canine giardiasis. Several vaccines are somewhat in limbo, such as leptospirosis and rattle snake venom. Leptospirosis is an important disease in very select environments and for dogs that impinge on those environments. However, leptospirosis vaccine is also very strain specific and strains differ from region to region, and immunity is extremely short lived (several months). It is also the single most allergenic of the vaccines; therefore, risk must be weighed against cost and benefit. Vaccination against rattle snake venom is of yet to be determined efficacy, and would obviously only benefit dogs at very highest risk.

Vaccines are given at three basic periods of life. The first period is at puppy-hood. Core vaccines to puppies and kittens are administered as a series of immunizations, 3-4 weeks apart, starting around 6 weeks of age and ending at around 14-16 weeks of age. The second period is

approximately one year of age; a maximal anamnestic immune response is achieved when the booster dose follows the priming immunity by many months. This booster immunization is critical for immunizing the small percentage of animals that were not properly immunized as puppies, in enhancing the levels of antibodies, and in prolonging the subsequent duration of immunity. Revaccination at 3 or more year intervals has a similar purpose.

Vaccines are given to puppies as a series over a several month period. The timing of these vaccinations is based on knowledge of the immune system and of maternal immunity. The first dose of vaccine is given to a puppy when maternal immunity has waned and the immune system has started to mature (i.e., capable of responding). This time period is generally considered to be 6-8 weeks of age. Hence, immunizations should commence at 6-8 weeks of age.

The last dose of vaccine in the primary series should be given at a time when the immune system of puppies and kittens has reached a significant level of maturity and when maternal immunity has disappeared. The goal is to have 95% or more of the puppies respond to their vaccines. This period is from 14-16 weeks of age, with 16 weeks being preferable to 14 weeks. Therefore, the timing of the last dose of vaccine in the puppy series should be around 16 weeks.

The time interval between vaccines is somewhat empirical and is based more on providing immunity in the face of maternal immunity as early as possible rather than for any booster effect. Maternal immunity wanes and the immune system mature at somewhat different rates in each puppy. Therefore, one puppy may respond maximally to a single dose of live virus vaccines at 8 weeks of age, and another not until 14 or 16 weeks of age. Knowing this, one could give a dose of vaccine every day between 6 and 16 weeks of age, with the idea of providing immunity at the earliest possible time for each animal. However, it is not practical to give daily doses of vaccine, so an interval of 2-4 weeks is chosen. Two weeks is the minimum period to get any sort of booster effect, and some people are concerned that waiting for 4 weeks may put the puppy into undo danger to infection. Therefore, a period of 3 weeks between doses is often used as a compromise.

With these concepts in mind, it is possible to design a vaccine regimen for any animal. For instance, if a puppy comes in at 7 weeks of age, it should be vaccinated it at 7, 10, 13 and 16 weeks. If it comes in at 9 weeks of age, it should be vaccinated at 9, 12 and 16.

The critical zone is the stage of puppy-hood during which the animal can be infected with the virulent organism but will not yet respond to vaccination. The duration of this window is determined by level of maternal immunity; maternal immunity begins to wane at 6 weeks of age and is gone by 16 weeks. Immunity to most live agents (virulent of vaccine type) is highly effective during the first 6 weeks, and begins to disappear thereafter as maternal immunity slowly decreases. The more virulent an agent, and the higher the exposure dose, the earlier maternal immunity can be overcome and the animal infected. Conversely, the less virulent the agent, the harder it is to overcome maternal immunity. Therefore, a fully virulent field virus will always infect an animal earlier than a less virulent vaccine virus. This critical zone for parvovirus usually lasts from 8-12 weeks of age, and explains why most parvovirus vaccine breaks occur between the first and second (6-8 weeks) and second and third (8-12 weeks) vaccinations.

The age range of the critical zone, and to some extent the duration, can be altered by using more virulent vaccines; i.e., in theory the critical zone should collapse to near zero as the vaccine reaches a stage of virulence equal to field virus. However, if the puppies are genetically predisposed to CPV (such as Rottweilers and Golden retrievers), and other environmental factors (e.g., stress, level of virus in environment, nutrition, etc.) are unfavorable, earlier immunization may not translate into much difference in the overall disease problem – puppies will continue to break with parvo between the first and second, and second and third immunization.

A critical zone exists for all puppy-hood diseases for which vaccines are used. However, it is only of importance if the infectious agent is endemic in the environment at relatively high levels. Canine distemper does not have a chronic carrier state and infected dogs are relatively uncommon in this country. The likelihood of a puppy contacting distemper virus during this critical period is therefore extremely low.

Adverse reactions to vaccines are of three types: 1) immunologic; 2) adjuvant related; and 3) infectious. Immunologic reactions are mainly of an allergic nature. About 1:1000-1:5000 dogs or cats may develop an allergic reaction to a particular vaccine, or to vaccine in general. The most common allergic reaction is hives/urticaria. The second most common reaction is facio-conjuctival edema +/- some mild systemic anaphylaxis. The rarest allergic reaction is anaphylactic shock. There is no truth to the belief that mild allergic reactions will always escalate on subsequent immunizations, going from mild hives to life threatening anaphylactic shock. It is also a misbelief that that allergic reactions only occur after at least one dose of vaccine has been given. Allergic reactions, even severe ones, can occur during the very first immunization. The allergic components in the vaccine also vary. Bacterins, such as lepto, may be more allergenic than regular vaccines. However, cellular and cell-culture constituents present in live virus vaccines can also be very allergenic. There is also a belief that canine vaccines can induce autoimmune disease. Studies of this relationship in both dogs and cats have not been very convincing. Moreover, if vaccines did induce immune disorders, they would only do so in genetically predisposed individuals. An example is the HOD syndrome in Weimeraners. This appears to be a genetically associated disorder wherein young Weimeraners over-react to their vaccines and develop high fevers and other complications. This is somewhat analogous to the rare child that dies as a result of the pertussis component of their DPT vaccine. Pertussis is a potent adjuvant in induces high levels of immune mediators. If over produced, these immune mediators can be lethal. The best way to handle the problem in young Weimeraners is to wait until they are adolescents and their immune systems have matured.

Some adjuvanted vaccines may cause fever for a day or so after immunization. Adjuvants work by activating cytokines, and if enough cytokines are activated, the individual may show transient signs of fever and lethargy. Adjuvanted vaccines, in particular killed rabies, may cause a granuloma with overlying hair loss at the site of immunization. In cats, this commonly progresses to a highly malignant sarcoma, while such tumors are rare in dogs.

Some vaccines contain live agents that are capable of infecting and even causing disease under certain circumstances. Distemper vaccine virus can cause fatal distemper in puppies with congenital severe combined immunodeficiency or in very young puppies that are malnourished, highly stressed, and rife with other infections. The strain of Bordatella found in live kennel

cough vaccine is often the sole strain isolated from outbreaks of kennel cough in shelters where it is used.

There is a persistent belief among many veterinarians that vaccinating during the course of infection can reduce disease signs and hasten recovery. The earliest application of this technique was the intracerebral inoculation of distemperoid (partially attenuated) vaccine for the treatment of dogs with distemper. In spite of its widespread and continuing use by a minority of veterinary practitioners, there is no evidence that this approach has any efficacy. Moreover, the idea that you can evoke more immunity by giving a small additional amount (compared to what the natural infection is providing) of immunogen has no scientific backing.

Post-exposure vaccination has been successfully employed in the prevention of rabies in humans. However, it may not be quite as effective in dogs. Recent studies indicate that rabies immunization alone is not sufficient to protect most prior non-immunized dogs from rabies. Although no protection was found with post-exposure immunization in previously unvaccinated dogs, 0/5 dogs treated with rabies virus immune horse serum and vaccine survived; while 2/5 treated with vaccine and immune horse serum lived. The most effective treatment was the use of mouse monoclonal antibody to rabies virus; 4/5 given monoclonal antibody alone survived, while 5/5 dogs given both vaccine and monoclonal antibody lived. Therefore, vaccine did have a protective effect, but only when coupled with antibody treatment. This supports the present practice in people, where post-exposure treatment combines vaccine and hyperimmune serum.

The greatest current debate in canine vaccination concerns duration of immunity. Presently, two very different vaccine regimens are recommended. One regimen requires vaccination as puppies and yearly boosters for the rest of their lives. A second regimen is to give puppy-hood vaccinations, follow up with a booster one year later to pick up any dog that was not immunized and to provide long lasting immunity, and then immunize only every three years thereafter. It must be stated that there is no evidence whatsoever supporting the need for yearly revaccination of dogs. Most companies are now showing duration of immunity of at least three years, so there is absolutely no question that vaccines can last three years or loner. There is also good evidence that immunity for the core vaccines is actually life long, even with vaccines previously cleared only for annual use. Given the great debate over whether to move from every year to every third year vaccination, it is highly unlikely that the concept of lifelong immunity and no further vaccination after puppy-hood will ever be accepted. The important point is that vaccination is a medical and not an economic procedure. Vaccinating when not necessary is not medically justified, although it may be economically beneficial to groups selling vaccine.

Biographical Profile

Dr. Niels Pedersen did his pre-veterinary training at the University of Nevada, Reno from 1961-63 and graduated from the School of Veterinary Medicine, University of California, Davis in 1967. He interned in small animal medicine and surgery at Colorado State University from 1967-1968. After a several month stint in a private veterinary clinic in Southern California, he became a scholar at the John Curtin School of Medical Research, The Australian National University, Canberra, A.C.T., Australia. He obtained his Ph.D. in immunology and experimental pathology

in 1972 and joined the faculty of his alma mater at UC Davis the same year. He was both clinician and researcher for 20 years, before leaving the clinics and taking on a range of administrative roles and continuing an active research program. His research interests are infectious diseases of the cat and dog, animal models for human AIDS (primate and cat), and immunologic diseases. He has written over two hundred scientific publications, two textbooks, and numerous book chapters and review articles. Dr. Pedersen is currently Director of the Center for Companion Animal Health and the Veterinary Genetics Laboratory. His current research is on the genetic diversity of indigenous and feral dog populations worldwide and the co-migration of human and canine populations. He also maintains an active feline research program on the genetic basis for resistance to feline coronavirus infection.

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.

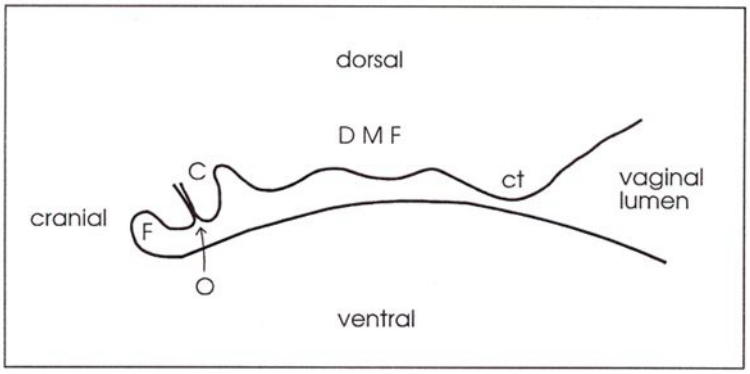

Figure 1. Graphic representation of the canine lower reproductive tract (courtesy Dr. Marion Wilson)

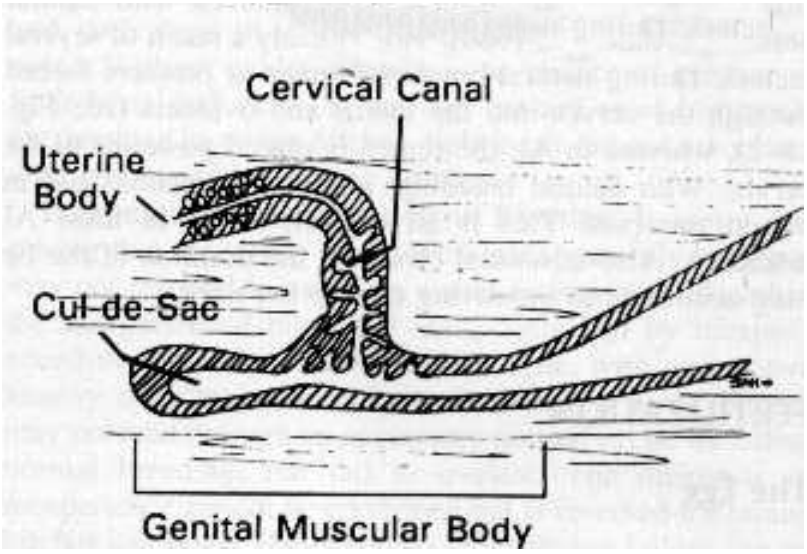

Figure 2. Graphic representation of the angle of the cervix with respect to the vagina in the bitch

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.