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New Source of Canine Genetic Information

The new Inherited Diseases in Dogs (IDID) database at the University of Cambridge Veterinary School is a free service on the Web (http://www.vet.cam.uk/idid). It contains an extensive collection of references to research literature about genetic diseases as well as links to other genetic information. A great deal of effort has gone into scouring the literature and including references to uncommon diseases and breeds. Want to know the genetic basis of epidermis bullosa in Beaucerons? How about Coonhound paralysis? Hip problems in the Puli? You can search by breed or genetic condition– the only disadvantage is you have to know the term the author uses for a disease; there isn't any kind of thesaurus. But it's a good resource to check out if you or your vet wants to learn about a newly diagnosed disease or how a disease is inherited.

Sargan, D.R. (2004) IDID: Inherited diseases in dogs: Web-based information for canine inherited diseases. *Mammalian Genome* 15:503-506

New Genetic Test for Von Willebrand Disease

Von Willebrand disease is an inherited abnormality that causes excessive bleeding. Von Willebrand factor (vWF) is a protein in the blood plasma that circulates as long chains of connected molecules. These molecules aggregate at injury sites and stick together, contributing to clot formation. When a mutation changes the shape of the molecules and they can't form chains, clotting is impaired. Recently researchers at Cornell University have found a DNA variation in a specific line of German Shorthair Pointers that causes Type II disease, which has an autosomal dominant mode of inheritance.

Kramer, J.W., Venta, P.J., Klein, S.R., Vao, Y., Schall, W.D. and Yuzhasiyan-Gurkan, V. (2004) A Von Willebrand's factor genomic nucleotide variant and polymerase chain reaction diagnostic test associated with inheritable type II von Willebrand's disease. *Veterinary Pathology* 41:221-228.

Spondylosis deformans in Italian Boxers

Spondylosis deformans is a potentially painful disease associated with the formation of bone spurs on the vertebrae. A recent study in Italy looked at the prevalence and heritability of this condition in Boxers to assess whether improvements in the population could be made by breeding selectively. The average number of bone spurs per dog was 2.37. Surprisingly, 16% of dogs had no bone spurs at all, so the disorder is quite prevalent in this population. About 25% of the dogs had one site affected, and another quarter had two sites. More than a third of the dogs had more than two sites with bone spurs. Using an animal model accounting for the effects of age, kennel, and sex, it was found that each intervertebral site had a different heritability, where the heritability is the proportion of variance in a trait caused by genetic factors. Heritabilities ranged from 0.03 to 0.44, indicating that there was little genetic influence at some sites, while genetic factors accounted for a moderately high proportion of the variation at other sites. The sites with the highest probabilities of having heritabilities greater than 0.10 were the posterior thoracic sites and the first and last two lumbar sites. The authors concluded that it should be possible to decrease the prevalence of this disease using selective breeding.

Carnier, P., Gallo, L., Sturaro, E., Piccinini, P., and Bittante, G. (2004) Prevalence of spondylosis deformans and estimates of genetic parameteeers for the degree of osteophytes development in Itallian Boxer dogs. *Journal of Animal Science* 82:85-92.

Epigenetics

When we think about the genetics of important traits in dogs, many of these traits are controlled by a complex set of both genetic and environmental factors. Traits like elbow dysplasia, performance ability, and fertility don't have simple inheritance patterns. We often take environmental effects like season and diet into account when studying some of these traits.

Recently, more attention has been paid to heritable information that gets passed on when cells divide that is not on DNA, or epigenetic information. This information can be in the form of chemicals physically blocking the expression of genes, changes in the proteins that pack and organize DNA. A special case of epigenetic inheritance is genomic imprinting, in which the

epigenetic changes are maintained through DNA replication and silences genes depending on which parent they come from. Just as we can statistically associate genetic variation with diseases and traits, we can associate epigenetic factors with diseases and traits.

Epigenetics is thought to be particularly important in cancer. By blocking the expression of an allele, regardless of the allele's sequence, epigenetic factors can block its expression. If the blocked gene is a regulator of cell cycle events, in it's absence, the cell cycle will be under less control and cancer will be more likely. Epigenetic factors may have smaller effects on phenotype by interacting with disease alleles to prevent their expression. When the epigenetic factor is removed, the disease is unexpectedly present. Some genes associated with illnesses like schizophrenia and bipolar disorder have been shown to be expressed differently depending upon the parent of origin.

Our understanding of this new way parents can pass on information to their offspring is new, and it offers a lot of hope for our understanding of complex traits are inherited and modified by the environment.

Bjornsson, H.T., Fallin, M.D., and Feinberg, A.P. (2004) An integrated epigenetic and genetic approach to common human disease. *Trends in Genetics* 20:350-358.

Genetics of "Nose"

Olfactory receptors are protein molecules that sit in a cell's outer membrane. Each one interacts with molecules of a specific shape, and when the molecule is present, they transmit a signal to the inside of the cell. The diversity of these receptors provide an animal with the ability to detect different odors. Mammals are estimated to have around 1000 genes for these proteins, accounting for three to five percent of genes in the entire genome.

Comparing their knowledge of sequences that are essential to olfactory receptors with gene sequence databases, a recent study found 817 new canine olfactory receptors. Of these, 180 have been physically isolated from canine DNA. About 18% of these genes were found to be non-functional, while in humans this proportion is about 63%. Studying the relationships between these genes should help investigators understand how these genes evolved. When we understand more about which receptors detect which chemicals, it should also help breeders choose dogs with good collections of functional receptors.

Quignon, P., Kirkness, E. Cadieu, E., Touleimat, N., Guyon, R., Rennier, C., Hitte, C., Andre, C., Fraser, C., and Galibert, F. (2003) Comparison of the canine and human olfactory receptor gene repertoires. *Genome Biology* 4:R80 (Online at http://www.pubmedcentral.nih.gov/ articlerender.fcgi?artid=329419 & rendertype=abstract)

Which dogs make the best detectors?

A study in the UK asked handlers of detector dogs about their satisfaction with their working dogs, and their opinions about what breeds make the best dogs for their specific work. Handlers of 244 explosive detector dogs, passive drug detector dogs (who search people and luggage), and proactive drug detector dogs (who search large spaces) were included. Survey questions addressed both the handlers' perceptions of which breeds were best suited for each task, and to rate their dog on individual traits that contributed to the dog's ability to be a successful worker. English Springer Spaniels were preferred for explosives and proactive drug detection, largely because of their ability to focus on their work and their physical agility. Labradors were preferred for passive detection work. Some of the important traits were agility, the ability to be distracted from work, the ability to make independent decisions, stamina, and motivation to obtain food. The English Springer Spaniels were often the highest rated for these traits, while Labradors got the most undesirable ratings for agility and stamina, and cross-breeds got the worst scores for independence, response to food, and general distractibility. Since this study was a survey, there are chances for subjective judgements and preferences to affect these findings. However it is interesting to think about whether these traits are heritable, and I hope further work can be done to explore these breed differences.

Rooney, N.J., and Bradshaw, J.W. (2004) Breed and sex differentiation in the behavioral attributes of specialist search dogs-a questionnaire survey of trainers and handlers. *Applied Animal Behavior Science* 86:123-135.

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