

Top 5 Genetic Diseases of Dogs

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Genetic diseases, common in crossbred and purebred dogs, are typically associated with evolutionarily ancient disease-liability genes that preceded the separation of breeds and are dispersed in the domestic dog genome. In the past century, the most common diseases in dogs have resulted from infectious, nutritional, and environmental causes. As clinicians have learned to manage the causes of these diseases (eg, through vaccination and proper diet), genetic predisposition has become a more frequent etiology of disease. Frequency of common genetic disorders varies among breeds¹ and may be caused by random changes (ie, genetic drift), popular sire syndrome, selection for aesthetic traits linked on chromosomes to disease-liability genes, or anatomic or conformational aspects that can alter disease liability.¹

The hallmark of inherited disease is predictability of onset and progression. Recognizing predictable triggers and modifying factors that influence the expression of genetic disorders can help improve diagnosis, treatment, and control.

TOP 5 GENETIC DISEASES OF DOGS

1. Allergic Skin Disease
2. Canine Hip Dysplasia
3. Brachycephalic Obstructive Airway Disorder
4. Myxomatous Mitral Valve Disease
5. Cranial Cruciate Ligament Rupture

1 Allergic Skin Disease

According to insurance claims and centralized hospital databases, allergic skin disease manifestations (eg, chronic inflammatory otitis, recurrent hot spots) are the most frequent disease presentations in clinical practice.²⁻⁵ These presentations are commonly seen in crossbred and purebred dogs; some breeds have a higher incidence than others.⁶⁻⁸ A study of atopic dermatitis in golden and Labrador retrievers showed heritability (ie, percent of liability due to genetic influence) at 47%, which indicates a significant environmental contribution.⁹ A molecular genetic study of atopic dermatitis in German shepherd dogs identified an associated segment of chromosome 28.¹⁰

No genetic-liability tests are available. Predictable seasonality can be recognized in 15% to 62% (median, 30%) of allergic dogs with chronic presentations.⁷ For these patients, interventional measures to manage pruritus should be prescribed before it progresses to clinical disease.

2 Canine Hip Dysplasia

Hip dysplasia, which occurs across all crossbred and purebred dogs, is the most common inherited musculoskeletal disorder.¹¹ Of all dogs for which radiographs are submitted to the Orthopedic Foundation for Animals (ofa.org), 14.59% are rated as dysplastic. This is likely a low estimate, as clinically apparent cases may not be submitted for evaluation.¹¹ Small dogs with hip dysplasia usually do not show the pain and discomfort seen in larger dogs; this demonstrates a size–weight relationship to clinical presentation.¹² Radiographic diagnosis is made through ventrodorsal view or distraction index.¹²

Palpable hip laxity can predict hip dysplasia and later osteoarthritic changes.¹³ A gentle Ortolani procedure during puppy examina-

tions and palpation for hip laxity under anesthesia during neutering should be performed. Dogs with severe laxity identified at an early age may benefit from interventional surgery.¹²

Estimated breeding values and genotypic breeding values based on DNA marker panels are being experimentally developed to assist with selection for hip normalcy.¹⁴ Breeders should select for familial breadth and depth of normalcy as seen in vertical pedigrees.¹⁵

3 Brachycephalic Obstructive Airway Syndrome

Brachycephalic obstructive airway syndrome (BOAS) is a disorder of breathing difficulty in short-snouted and “bully” breeds.¹⁶ Breeds with the highest prevalence include bulldogs, French bulldogs, and pugs.¹⁷ BOAS occurs because of a mismatch in the proportions of the skull and soft tissue in the nose and pharynx. Clinical signs include dyspnea, exercise intolerance, heat intolerance, abnormal and increased respiratory noise, cyanosis, syncope, and death.¹⁸ In one study, 16.7% of high-risk dogs died of respiratory failure at an average of 8.6 years of age.¹⁹

This syndrome includes stenotic nares, an elongated soft palate, everted laryngeal sacs, laryngeal collapse, and/or a hypoplastic trachea.¹⁶ Brachycephalic dogs may be presented with facial skin fold dermatitis and corneal ulceration. For dogs experiencing significant morbidity, corrective surgery can include rhinoplasty for stenotic nares, soft palate resection, and laryngeal sacculotomy.^{16,20} Breeders should select for dogs that do not show signs of BOAS and that have a muzzle at least one-half the depth of the cranial length (from occiput to the front of the cranium), a normal-diameter trachea (ratio of lumen diameter at the thoracic inlet to the width of the proximal third rib should be ≥ 2 on a lateral radiograph), and nostrils that are 33% the width of the nose.^{18,20}

4 Myxomatous Mitral Valve Disease

Myxomatous mitral valve disease (ie, mitral valve endocardiosis) is primarily seen in toy breeds and small patients.^{21,22} For some breeds (eg, Norfolk terrier, Cavalier King Charles spaniel), it may lead to heart disease at an average age of 6.25 years.²³ As this is beyond breeding age, some Cavalier King Charles spaniel clubs have established a generational breeding-control program in which dogs are only bred if both parents are free of a murmur and Doppler evidence of mitral regurgitation. When this program is applied, the frequency of this disorder has decreased.²⁴

5 Cranial Cruciate Ligament Rupture

Cranial cruciate ligament rupture is a common traumatic injury. Although it is not typically considered a hereditary disease, studies show increased risk in rottweilers, West Highland white terriers, golden retrievers, Yorkshire terriers, Staffordshire bull terriers, and some crossbreed dogs.^{1,25}

Studies of cranial cruciate ligament rupture in Newfoundlands show 27% heritability.^{26,27} Genetic predisposing factors for rupture may include issues with ligament extracellular matrix metabolism, degeneration, and/or inflammation. Other predisposing factors may also involve biomechanical and conformational variations (eg, bone length, stifle angulation, tibial plateau variation, narrowed distal femoral intercondylar notch).²⁸

Conclusion

The WSAVA Canine and Feline Hereditary Disease (DNA) Testing website (research.vet.upenn.edu/WSAVA-LabSearch) is an excellent source for DNA tests, lists of susceptible breeds, and testing laboratories.²⁹

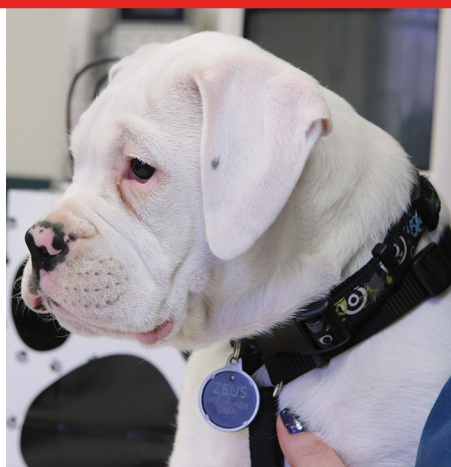
Dogs affected by genetic disorders should not be selected for breeding. Because most of these genetic diseases are complexly inherited, genetic risk for carrying disease-liability genes should be based on knowledge of clinical disease or normalcy in first-degree relatives of prospective breeding dogs. ■

OTHER COMMON CANINE GENETIC DISEASES¹⁻⁶

- ▶ Patella luxation
- ▶ Autoimmune thyroiditis
- ▶ Cancer predisposition (lymphoma, hemangiosarcoma, mast cell tumor, osteosarcoma)
- ▶ Hereditary cataracts
- ▶ Nonstruvite bladder stones
- ▶ Elbow dysplasia
- ▶ Cryptorchidism
- ▶ Hepatic shunts
- ▶ Epilepsy
- ▶ Glaucoma
- ▶ Deafness
- ▶ Blindness
- ▶ Renal dysplasia
- ▶ Addison disease

IDENTIFIED MENDELIAN LIABILITY GENES: COMMON DISORDERS³⁰

- ▶ Arrhythmogenic right ventricular cardiomyopathy (boxers, boxer crossbreeds)
- ▶ *MDR1*-related ivermectin and drug sensitivity
- ▶ Lens luxation
- ▶ Degenerative myelopathy
- ▶ von Willebrand disease
- ▶ Progressive rod-cone degeneration form of progressive retinal atrophy



BOAS = brachycephalic obstructive airway syndrome

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