



# Hereditary cardio - vascular anomalies in dogs

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Genetic anomalies arise either from random gene mutation immediately or in the ancestral past or by unethical inbreeding. Gene mutations may occur at anytime or place, completely at random irrespective of breed. On the other hand breeders breeding to an ideal may precipitate a recessive anomaly by excessive inbreeding without careful screening and prompt elimination of affected or 'Carrier' animals. A genetic anomaly is first noticed when it appears in several litters of related parents and the affected pups can be traced back to a common ancestor. Not all familial conditions have a genetic basis and may occur when groups of related dogs are fed, reared identically and are exposed to some common environmental factor causing the anomaly. On contrary most genetic abnormalities occur rarely depending on the type of inheritance and can be traced to an individual stud or bloodline. Majority of these mutant genes are recessive in nature. If the causative gene is rare, the majority of matings will be between homozygous normal and apparently normal heterozygote. The 'carrier' stage of the apparently normal heterozygote is discovered only when this dog/bitch produce an anomalous pup.

An anomaly, which is inherited as a dominant trait, will be present in at least one of the parents. Normally such anomalies are eliminated quickly from the population unless it is selected for or if it appears after the individual was used for breeding. eg. Merlegene (M) is homozygous condition (MM) produces a white dog with ocular and auditory anomalies but produce harlequin or merle colour. When heterozygous (Mm) which is much sought after by breeders for certain breeds like Great Dane. Such Merle coloured dogs are purposely mated to normal coloured dogs to produce merle coloured progeny thus perpetuating the M gene in the dog population. Similarly certain anomalies may come to be identified with some breeds due to willful selective breeding for certain characters considered as important exhibition feature. Eg. Short muzzles in breeds such as pugs, boxers that can cause obvious respiratory distress, abnormal breathing or prolapse of soft palate. In other cases the dominant gene persist in the population because the clinical symptoms are not noticed early enough to prevent the use of such individuals for breeding. Few other dominant anomalous traits show incomplete penetrance i.e., the defective gene though dominant fails to manifest in a percentage of dogs. Such individuals are apparently normal but can transmit the gene to the next generation.

The cardiovascular defects are anomalies of heart structure or associated major blood vessels. In most cases they are not severe enough to cause death by heart failure but can severely impair the quality of life. It is crucial to distinguish a hereditary heart defect with a congenital, developmental defect or an acquired heart defect. Though several researchers have reported underlying genetic influence for many cardiovascular defects in dogs only in few cases it could be proved and the precise mode of inheritance could be presented. The scope of this review is limited to only such cardiovascular anomalies.

## 1. Cardiomyopathy

Condition affects the myocardium seen in many breeds like Doberman, Great Dane, hounds, boxers more prone to cardiomyopathy and it is one of the most common causes of sudden, unexpected death in both young and old individuals. A disturbance in





electrical conduction causes heart to contract early producing an extra beat - premature ventricular contraction. Large number of such contractions occurring together prevent the normal heart contraction resulting in lack of blood flow to vital organs including brain and heart itself, causing a seizure. Cardiac arrest or syncope may occur in prolonged cases. It is similar to arrhythmogenic right ventricular dysplasia (ARVD) in human. Usually this condition is undetected until a seizure or death occurs. Hence screening of suspected apparently healthy dogs using Holter monitor (24 hrs EKG) is advisable.

## 2. Aortic/Sub-aortic valvular stenosis

It is another common genetic heart defect occurring in Boxers and Newfoundland breeds. In most cases a fibrous ring of tissue below the aortic valve produces stenosis or constriction of aorta. The left ventricle has to work harder to pump necessary amount of blood to vital organs resulting in hypertrophy of ventricular wall. Ballooning of the aorta due to increased pumping pressure and syncope are common clinical symptoms. Ultrascan can confirm the diagnosis. The exact mode of transmission of the gene is still unknown.

## 3. Congenital lymphoedema

An affected individual at birth exhibit varying extent of oedema affecting only hind limbs to a condition in which the whole body and tail is affected. The oedema is not painful but is accompanied by high mortality among more severely affected. In others the condition improves with age. The condition is due to a dominant gene Ly (Patterson et al., 1967).

## 4. Chylothorax

It occurs as an acquired condition with a clear hereditary predisposition in Afghan Hounds. The condition develops as a result of chest trauma and obstruction of anterior vena cava or thoracic duct, which results in accumulation of chyle in pleural cavity.

## 5. Congenital Heart Disease (CHD)

Congenital heart disease is a syndrome, which includes a number of specific malformations of heart and great vessels exiting the heart. The CHD includes the following defects (Patterson, 1974; 1976).

### (i) *Dysplasia of atrioventricular valves*

Due to malformation of either mitral or tricuspid valve there is back flow of blood into the atria when the heart contracts. Valvular incompetency leads to left or right-sided heart failure.

### (ii) *Pulmonic stenosis*

This condition is characterised by malformed or narrow pulmonary artery as it leaves the right ventricle. The condition results in right-sided congestive failure. The condition is genetically inherited in Beagle.

### (iii) *Septal defects*

Defect can occur in atrial or ventricular septa so called the hole in the heart. Blood flows from high pressure left side to lower pressure right chamber resulting in right-sided heart failure.

### (iv) *Patent ductus arteriosus*

If the ductus arteriosus persist even after birth some blood is pumped directly from the aorta back to the lungs resulting in pressure overload. Left sided heart failure may occur. The condition is known to have genetic inheritance in Minature Poodle.

### (v) *Abnormal development of great vessels*

Persistent right aortic arch may occur resulting in abnormal slaunting of blood.

### (vi) *Tetralogy of Fallot*

Complex, multiple congenital disorder of heart, pericardium and blood vessels which so severely compromises function that it is fatal within 6 months of age. Condition is inherited in Keeshond.

## Guidelines for elimination of genetic anomalies

In an extreme step one could render or destroy all suspected animals. But this desperate move causes apart from distress to pet owners, loss of valuable breeding stock. Elimination procedures should be adopted depending on mode of inheritance of the trait. In case of a dominant trait as congenital lymphoedema the most effective measure could be to prevent breeding of any affected individuals. Exceptions should be allowed only in case of trivial anomalies in otherwise outstanding individuals. Those animals cured of the condition by corrective surgery should not be used for breeding. Once an anomaly is detected it should be traced back to the origin. The affected individuals should be removed from breeding programmes and other apparently normal suspect individuals should be monitored and suitably screened to ensure that they do not carry the allele for the defect.

In case of recessive anomalies the elimination depends upon the detection of 'carrier' individuals. Carrier individuals can be detected by test crossing with a known carrier or affected homozygous (in case of trivial cases). If the progeny show the defect then the tested parent is a carrier. If the gene responsible for

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