Animal Models

Atherosclerosis & Related Nutritional Issues in Miniature Swine

Atherosclerotic Heart Disease

Atherosclerotic heart disease or cardiovascular disease, also known as artery disease, is the 20th century epidemic. It accounts for almost 500,000 deaths every year in the United States alone and is the leading cause of morbidity and mortality in the developed world. Cardiovascular disease is predicted to become the predominant global disease by 2020. The basic cause of coronary artery disease is a buildup of abnormal lipid and fibrous plaques (atheromas) that narrow the coronary arteries and deprive the heart of the blood and the oxygen it needs. Carotid artery stenosis (stroke) and aortic disease (aneurysm) are also associated syndromes of atherosclerosis. Humans, pigs and some primates develop spontaneous atherosclerosis whereas rodents and rabbits do not.

The major risk factors may be controlled through proper diet, physical activity, and smoking cessation. In conjunction with risk management, there are a number of therapeutic and life-saving pharmaceuticals available and better drugs with fewer undesireable side affects are in development. Traditionally, the preclinical process of drug development includes animal model studies and miniature swine are probably the best models for human cardiovascular disease.

Pigs as Models for Research

Pigs have been used for 40 years as models for research into cholesterol and lipoprotein metabolism with application to atherogenesis. The pig is an excellent model for human cardiovascular research because of a number of similarities to the human. The anatomy of the coronary arteries and the pattern for development of collateral circulation after permanent ischemic episodes are two important similarities. Development of atherogenic lesions in arteries of humans is a gradual process that begins very early in people consuming the typical U. S. diet that is high in fat and cholesterol.

Pigs naturally develop atherosclerosis; aortic streaks are observed in young pigs within a few weeks when diets are high in fat (particularly saturated fat) and cholesterol. The full blown lesion that produces partial occlusion of arteries does not appear until experimental diets are fed for months but the pathological state may be hastened by denuding the arterial intima.

There is evidence for inheritance of the propensity toward atherogenesis in pigs as in humans. Genetic mutations of miniature swine that are predisposed to hypercholesteremia have been identified, developed and maintained [Arterioscler Thromb, 12:647-656]. Pigs also have been used successfully to investigate the regression of atherosclerotic plaques. In humans and in pigs, the predominant bloodborne cholesterol transporter is lowdensity lipoprotein (LDL). Comparison of the serum lipoprotein pattern among several mammalian species indicates the pig is probably the most similar to the human.

There have been many diverse studies of nutritional influences on cholesterol and lipoprotein metabolism in miniature swine. Scientists have examined the various dietary fat sources with a wide array of fatty acid compositions, including the currently popular fish oils, protein sources, particularly comparisons of plant and animal proteins, minerals, fiber sources and other dietary factors including pharmacologically active materials. Minipigs are favorable models for nutritional studies related to cholesterol and lipoprotein metabolism because they are omnivorous, as are humans, and lipoprotein profiles are similar to humans. Turk and Laughlin (2004) have documented nine reasons why minipigs make the best model for the study of factors associated with human atherosclerosis.

Miniature Swine vs. Commercial Swine

Miniature swine are preferable to commercial swine as animal models because they maintain weight and size throughout adulthood that is similar to an adult human male. They are docile and easily handled, and they have striking physiological similarities to human digestive and cardiovascular systems.

Sinclair is experienced in producing atherosclerotic miniature swine for in-house studies or for scientists located at other institutions. Furthermore, Sinclair has access to fluoroscopy, IVAS, treadmills, and related equipment and expertise related to cardiovascular studies. Please contact us to discuss your needs.

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