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Review On Pathophysiology, Clinical Manifestations And Diagnosis Of Hypertension And Associated Cardiovascular Diseases

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Abstract
The objective of this review article is to summarise the current knowledge on the significance of laboratory tests, biomarkers of cardiac injury and studies of proteomics and the microbiome in cardiovascular diseases in the diagnosis and treatment of cardiovascular diseases. Point-of-care analysers are capable of detecting elevated cardiac troponin 1 levels, which have been shown in patients with congestive heart failure. In order to achieve significant improvements in the treatment of cardiovascular illness, better understanding of the pathophysiology of cardiovascular diseases in man and animals is required. It has been shown that effective experimental animal models may be used in this context. The best animal model of cardiovascular disease should be able to mirror human cardiovascular diseases, their pathophysiology and clinical manifestations. With the use of genetically engineered animal models, researchers have been able to alter the expression of a particular target (a gene or protein) in order to better understand its function in pathogenesis. Cardiovascular diseases that mostly result from hypertension include myocardial infarction, heart failure, hypertrophic cardiomyopathy and vascular damage.
Diagnostic approaches for detection of hypertension and cardiovascular diseases include measurement of blood pressure, electrocardiography, echocardiography, radiography and computerized tomography (CT) scan.
Therefore, excellent knowledge of hypertension, pathophysiology of cardiovascular diseases, and effective use of diagnostic procedures will help in prompt detection of the diseases and in their proper management to prevent organs damage and mortality in man and animal.
Keywords: *Hypertension, Myocardial infarction, Animal models, Electrocardiography, Echocardiography*

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I. Introduction

Hypertension

Hypertension is a major cardiovascular disease of man and animal. It was described as the symptom that manifest when there is high resistance of blood vessels against the blood movement in systemic circulation. (Magder, 2018). A garden hose connected to a fire hydrant is an excellent metaphor. The hydrant's tremendous pressure might compress the line to the point of explosion. Blood vessels may also be influenced in the same way. (Acierno, 2020)

In dogs, bleeding and subsequent loss of blood flow are often seen only after a more serious injury has occurred over an extended period of time. Similarly, hypertension is a "silent killer" that often remains undiagnosed until major harm has been caused (Groenewegen, 2020). Dogs and cats with hypertension have a systolic blood pressure of more than 160 or diastolic blood pressure than 100, putting them at risk of organ failure (Acierno, 2020).

Frequently, hypertension has an influence on the eye. In dogs, retinal damage may result in a rapid or progressive loss of vision. Hypertensive injury to the kidneys, heart, and brain may result in an increase in renal problems, heart failure, and paralysis (Rosik, 2018).

Animals with hypertension have often been linked to a variety of illnesses and health concerns. Not only chronic renal disease and Cushing's disease are implicated; obesity, heart disease, and hyperthyroidism also play a role.

Animal Modelling and Pathophysiology of Hypertension

The pathophysiology and therapeutic options for hypertension have been widely researched using animal models. Both the validity of animal models in simulating human forms of hypertension, including therapeutic responses, and the quality of research conducted in such models are crucial for advancing our understanding of the aetiology, prevention, and treatment of hypertension and its comorbidities (such as reproducibility and experimental design). Unmet needs in this field include the development of models that accurately mimic the various clinically recognised hypertensive syndromes, the resolution of long-standing debates about the pathogenesis of hypertension, and the development of novel strategies for the prevention and treatment of hypertension and its complications. These unmet requirements may be addressed via the use of animal models (Arrigo, 2020).

Dyspnoea, tiredness, an inability to exercise, and fluid retention in the lungs and peripheral tissues are all symptoms of heart failure (HF) (Arrigo, 2020). One of the most prevalent causes of heart failure is the heart's inability to pump sufficient blood into and out of the body's tissues to maintain normal function.

HF is a significant public health problem that affects individuals in both developed and developing countries. Each year, an estimated 5.8 million people over the age of 20 in the United States are diagnosed with HF (Rosik, 2018). Again, the social cost of HF is projected to reach 39.2 billion dollars in the United States. Patients with ischaemic heart disease may live longer partly because of improved treatment and survival rates in younger patients, however, there is high chances of developing heart failure later in life (Groenewegen et al., 2020).

While current HF medicine improves outcomes, the illness progresses, requiring the discovery of new therapeutics capable of avoiding, postponing, or reversing the anatomic and functional abnormalities associated with a failing heart. Preclinical research in appropriate animal models is usually required to identify novel HF treatment targets (Rosik, 2018). Scientists must understand numerous key aspects of HF in order to construct an animal model that correctly replicates the clinical symptoms of HF patients, which is exactly what this statement aims to do. Human examples of HF caused by particular reasons are discussed, as well as animal models that mimic similar clinical situations. Higher sympathetic nervous system activity, greater heart filling pressures, and increased cellular activity, for example, are all frequent HF symptoms. This statement will go through how to create HF animal models with important clinical features such as valve disease (pressure and volume overload), hypertension, myocardial ischemia, and other diseases or genetic disorders that cause dilated and hypertrophic cardiomyopathies. Therapeutic targets developed and tested in animal models imitating human heart failure have a greater probability of benefiting human heart failure patients (Bruyette, 2020).

Experts believe that HF may be caused by a variety of factors. Patients with coronary artery disease and high blood pressure are more likely to have stroke or heart attack (Rosik, 2018). A number of acquired, structural, and genetic disorders may also influence the clinical appearance. Animal models may be a fair approximation of human situations in certain cases. Acute treatments like coronary occlusion may be used to mimic a single discrete time point in the course of a chronic illness that might develop across a lifetime in certain people (Quer, 2021). Animal models often lack the genetic variation seen in human populations, resulting in a large range of symptoms linked to a single monogenic disease. Despite these drawbacks, well-designed animal models have the potential to improve therapeutic treatment significantly. This research might lead to the identification of novel therapeutic targets and disease progression markers in patients with early and late heart failure. (Groenewegen, 2020). The development of well-characterised HF animal models that mirror key characteristics of HF in people might help in the development of novel HF therapeutics (Bruyette, 2020).

Valvular lesions, dilated cardiomyopathies, hypertension, and limited cardiomyopathies are four separate clinical disorders that may induce HF. Each section will go through the clinical phenotypes and clinical features that should be present in an animal model that is meant to mimic the human condition. The complexity of human illnesses that result in HF, according to specialists, is difficult to duplicate in the majority of animal models (Rosik, 2018).

It is critical to understand the biology of cardiovascular disease and to test novel therapies experimentally and therapeutically, in order to make progress in the treatment of the condition. A mouse-based experimental animal model has shown to be beneficial in this situation. Animal models of cardiovascular disease should be metabolically and pathologically equivalent to human models (Magder, 2018). Using genetically changed animal models, researchers have been able to manipulate a specific target (a gene or a protein) and investigate its role in pathogenesis (Bruyette, 2020). Consequently, a wide range of potential therapeutic targets have been discovered. Animal models have likely generated unique insights into a number of key aspects of cardiovascular disease, given the diverse character of the condition. As a result, no one species can be used to study every kind of cardiovascular illness. This means that using the right model for studying different aspects of cardiovascular disease is crucial. Human research based on groundbreaking scientific discoveries may be jeopardised if this step is not taken. The development of appropriate experimental models for cardiovascular disease research is a desired and effective strategy to enhance this discipline (Bruyette, 2020).

II. Cardiovascular Diseases Associated With Hypertension

Myocardial infarction

Inadequate energy and/or oxygen in the heart muscle are the most prevalent reasons for decreased or impaired diastolic function, a symptom of diminished or impaired ventricular relaxation. Diastolic dysfunction becomes more prevalent as heart failure worsens. Poor ventricular myocardial relaxation may arise as a consequence of pericardial disease or hypertrophic cardiomyopathy (a condition in which the muscle is excessively thick, inflexible, and noncompliant) caused by hypertension (Magder, 2018). Cats are the most often affected with hypertrophic cardiomyopathy. Around 85% of cats that suffer from cardiac problems have hypertrophic cardiomyopathy (Magder, 2018). In a small proportion of cats, restrictive cardiomyopathy (previously known as nonspecific cardiomyopathy) or valvular disease develops, in which the heart does not fill adequately due to stiffer than usual walls.

Heart failure

Systolic myocardial failure is a word that relates to cardiac contractile dysfunction, which is defined as a reduced force of contraction for a certain preload (Protsenko, 2018). Under optimal circumstances, the heart contracts without resistance, while a failing heart generates less energy from ATP breakdown or shortens its fibres more slowly. Myocardial insufficiency and direct assessment of cardiac contractility are both difficult problems to solve.

Dilated cardiomyopathy (DCM) in large or giant breed dogs (Dobermans, Great Danes, Irish Wolfhounds, etc.), DCM-phenotype in Boxer cardiomyopathy, and DCM-phenotype in cats that are frequently taurine deficient or in the late stages of other types of cardiomyopathy, as well as long-term systolic dysfunction (Bruyette, 2020). Myocarditis, gluten-free diets, and tachycardia-induced cardiomyopathy have all been linked to DCM phenotypes (inflammation of the heart muscle). This results in an inotropic condition, or reduced contractile activity, of the heart muscle. Idiopathic DCM is generally used in large-breed dogs since the cause is uncertain (Grande and Aseni, 2019).

Myocardial insufficiency may occur in almost every animal with heart illness that leads in enlarged chambers or thickening heart walls, however, these animals may stay compensated for a long length of time before exhibiting clinical indications of heart failure (Arrigo, 2020).

When an animal has low output heart failure (LOHF) or congestive heart failure (CHF), the heart and blood arteries act in concert to cause symptoms. Low output heart failure occurs when the cardiac output is inadequate to provide sufficient oxygenated blood to the organs during rest or exercise. The lung and systemic organs are two of the most often impacted organs by CHF. Organs that are clogged with blood may either malfunction or become oedematous as a result of the blood build-up. The most current and most practical categorization of heart failure, according to the ACVIM (American College of Veterinary Internal Medicine.) Consensus Statement on canine chronic valvular heart disease, is based on the course of heart disease (A, B1, B2, C, and D) (Grande and Aseni, 2019).

III. Clinical Manifestations And Diagnostic Approaches To Cardiovascular Diseases

. Clinical manifestations in hypertension including pedal oedema, pulmonary oedema, pleural effusion, cardiac arrhythmia, exercise intolerance, syncope, fainting, paralysis, hypertensive retinopathy, hypertensive choroidopathy, hypertensive encephalopathy and renal failure. (Ives, 2020).

The history and symptoms, physical examination, blood pressure measurement, cardiac biomarkers (NT-proBNP, BNP, cardiac troponin I), radiography, electrocardiography (perhaps with 24-hour Holter monitoring), and echocardiography (2D, M-mode, colour and spectral Doppler, 3D) are used to diagnose cardiovascular disease. Only a few of the most current diagnostic procedures include catheterization under fluoroscopic monitoring for diagnostic reasons, cardiac MRI, and CT scan with angiography. To be correctly interpreted, radiography, electrocardiography, and echocardiography all need acceptable images (Quer, 2021).

Cardiovascular problems such as mitral regurgitation and dilated cardiomyopathy may be strongly suspected based on physical examination and radiography. Electrocardiography may be performed to find out whether the heart is having arrhythmia (manifesting as atrial fibrillation, sick sinus syndrome or ventricular premature contractions) (Rosik, 2018). In cats, echocardiography may be used to detect heartworm, caval syndrome, pulmonary hypertension, cardiac tumours, and pericardial disease, as well as confirm suspected diagnoses and assess valve regurgitation and stenotic lesions. At the systolic and diastolic levels, echocardiography may be used to determine chamber enlargement and myocardial function (Magder, 2018). Thoracic radiographs are recommended when pulmonary hypertension is present to look for evidence of current CHF or to investigate the underlying cause further. The blood antigens of adult female heartworms are the most efficient way for identifying heartworm disease (dogs). Antigen and antibody testing, as well as thoracic radiography and echocardiography, may be used to diagnose heartworm disease in cats (Grande and Aseni, 2019).

Certain breeds have a higher risk of developing heart disease than others. Coughs, laboured breathing, and intolerance to exercise in elderly dogs should be suspected of mitral regurgitation; however, a chronic obstructive pulmonary disease with fibrosis can present with nearly identical signs; echocardiograms and the NT-proBNP test may be needed to distinguish between cardiac and noncardiac causes of dyspnea (Groenewegen, 2020).

Dilated cardiomyopathy is nearly always present in any middle-aged, melancholy, coughing, exercise-intolerant Doberman pinscher with a rapid, unpredictable heart rate. Sick sinus syndrome should be investigated in Miniature Schnauzers of middle age or older who have syncope (Rosik, 2018).

Any Boxer who faints on a regular basis should be suspected of having arrhythmogenic right ventricular cardiomyopathy; however, Boxers can also have neurocardiogenic syncope or sick sinus syndrome, in which case Holter monitoring may be required to determine the cause of syncope and the best treatment strategy (Magder, 2018).

Heart disease (most commonly hypertrophic cardiomyopathy, which can lead to heart failure or aortic thromboembolism) may be present in an older cat with laboured breathing, intermittent lameness, and possibly behavioural changes, whereas hyperthyroidism may be present in an older cat with weight loss and behavioural changes and can lead to systemic hypertension and worsen the cardiac disease (Grande and Aseni, 2019).

Radiography, echocardiography, and NT-pro BNP tests may be required to distinguish between cardiac and noncardiac causes of dyspnea. Animals with cardiovascular disease may manifest any of the following signs or symptoms: a rapid, slow, or irregular heart rate (and not due to respiratory sinus arrhythmia) (Rosik, 2018).

Heartbeats outnumber arterial pulsations, which might be strong, weak, or irregular (pulse deficits). The animal faints or has a poorer tolerance for exercise in the absence of skeletal muscle disease or fat. Mucosal membranes are intensely cyanotic in the absence of underlying pulmonary disease (Magder, 2018).

Electrocardiography and echocardiography are unmatched when it comes to identifying heart and major artery enlargement (Grande and Aseni, 2019). The severity of the sickness is often related to the level of chamber enlargement or subsequent cardiac remodelling. The amount of pulmonary infiltrates and the degree of left ventricular wall motion impairment or thinning on radiographs may both be used to predict heart failure severity (Arrigo, 2020). Hemodynamic and echocardiographic data, unfortunately, are seldom linked to symptoms or mortality risk. Elevated heart and respiratory rates, as well as exercise intolerance,, are all linked to the severity of cardiac illness. NT-pro BNP testing may also help in the detection of heart disease and heart failure (Bruyette, 2020).

Additional tests such as a CT scan with angiography, diagnostic catheterization under fluoroscopic supervision, transesophageal echocardiography, or cardiac MRI may be advised if basic cardiovascular testing is inadequate to establish a diagnosis. More complicated diagnostic procedures, on the other hand, need the use of a general anaesthetic (Arrigo, 2020).

IV. Measurement Of Blood Pressure In Animals

Blood pressure measuring technology for experimental animals have advanced dramatically over the last decade, and a variety of choices are now available for continuous, round-the-clock monitoring of blood pressure profiles in awake, unrestrained, and unstressed animals (Mills, 2020). The study discusses these strategies, as well as their advantages and disadvantages. Blood pressure (BP) may be measured in experimental animals using both indirect and direct methods (Grande and Aseni, 2019). The cuffing technique is one of the most often used indirect techniques for monitoring blood pressure. It includes measuring the pressure within a cuff to determine how much blood flow varies when it is blocked or released. Externally placed transducers or radiotelemetry are often employed to get direct blood pressure readings (Bruyette, 2020). Radiotelemetry's benefits may not be essential in many situations when externally connected, fluid-filled catheters may be utilised to measure blood pressure. With minor technical alterations dependent on the species under investigation, the great majority of blood pressure measurement techniques are applicable to a wide variety of animals. Techniques should be chosen largely on the basis of the research issue, rather than the kind of animal being researched (Magder, 2018).

Direct blood pressure measurement methods are preferable over indirect approaches because they allow for thorough monitoring of blood pressure's dynamic nature. Finally, the study aims should direct methodology selection, ensuring that the procedures used are relevant for the experimental concerns under investigation. In light of the study's purpose and the relative merits and demerits of the different blood pressure measurement techniques, suggestions have been made for the ideal method of blood pressure measurement. (Grande and Aseni, 2019) The investigator should select a monitoring method that provides a comprehensive picture of the overall BP load on the vasculature, regardless of whether the primary objective is to determine whether a new drug protects against atherosclerosis or cardiovascular damage without affecting blood pressure. Even if the blood pressure measures are very exact, they are of limited utility in this kind of investigation (Magder, 2018).

Anaesthesia should be avoided wherever possible owing to its well-documented adverse effects on cardiovascular function. This is true regardless of the blood pressure monitoring device employed. Analgesics have been shown to impact several areas of the circulatory system and to result in significant changes in integrated cardiovascular responses between awake and anaesthetized animals (Rosik, 2018). Extra elements that may affect BP include the number of animals in a cage unit, their proximity to other animals undergoing experiments, and the availability of additional things such as treadmills, toys, and hiding locations inside the cage unit. Due to the fact that environmental factors may have a significant impact on cardiovascular function, it is crucial to keep this in mind while obtaining blood pressure measures, whether indirect or direct (Sies and Jones, 2020).

Invasive and Non-invasive Methods

The force generated by blood flow against the artery wall is measured in millimetres of mercury (mmHg) and is known as arterial blood pressure (BP). The three components of systemic arterial blood pressure are systolic arterial blood pressure, mean arterial blood pressure, and diastolic arterial blood pressure (Rosik, 2018). The highest of the three components is systolic arterial blood pressure. The highest intra-arterial pressure during each cardiac cycle is systolic arterial blood pressure; the lowest intra-arterial pressure preceding the next heartbeat is diastolic arterial blood pressure; and mean arterial blood pressure is the average area under the pulse pressure waveform, which tends to be closer to diastolic arterial blood pressure because of the amount of time spent in diastole during each cardiac cycle (Meneton, 2005). The arterial blood pressure of a range of conscious and anaesthetized veterinary animals has been shown to be within normal norms.

It is important to remember that arterial blood pressure values differ depending on the anatomic location from which they are acquired while assessing non-invasive blood pressure monitoring devices. A stronger muscle walls and increased resistance to pressure waves reflected by smaller arterioles in the periphery result in an increase in systolic arterial blood pressure in the periphery, while diastolic arterial blood pressure decreases slightly and mean arterial blood pressure remains largely constant. The systolic arterial blood pressure from the dorsal pedal and femoral arteries is higher in anaesthetized dogs than the systolic arterial blood pressure from the carotid artery, while there are significant differences in arterial pressure in smaller peripheral arteries. When anaesthetized dogs are awake, the dorsal pedal artery has a higher systolic arterial blood pressure than the lingual artery, whereas when anaesthetized horses are awake, the metatarsal artery has a higher systolic arterial blood pressure than the facial artery and transverse facial artery during normotension (Reichard, 2010). Pulse pressure is defined as the difference between the systolic and diastolic arterial pressures within a certain time period. Aortic pulse pressure rises as a result of an increase in systolic arterial blood pressure, which is transmitted to the periphery (Bruyette, 2020). In humans, the difference is around 15 millimetres of mercury.

Electrocardiography & Echocardiography

History and signalling, physical examination (e.g., inspection, auscultation, palpation), blood pressure measurement, cardiac biomarkers (NT-proBNP, BNP, cardiac troponin I), radiography, electrocardiography (possibly with 24-hour Holter monitoring), and echocardiography (2D, M-mode, colour and spectral Doppler, 3D) are the gold standards for the diagnosis of cardiovascular disease (Setogawa and Kawai, 1998). More modern diagnostic procedures include CT scans with angiography, diagnostic catheterization under fluoroscopic monitoring, and cardiac magnetic resonance imaging (Reichard, 2010). In order to deliver correct and appropriate interpretations, clean images in radiography, electrocardiography, and echocardiography are required; otherwise, it would be impossible.

The existence of a cardiovascular problem may usually be ruled out using a physical examination and radiography (for example, mitral regurgitation or dilated cardiomyopathy). Electrocardiography is a test that detects irregularities in the heart's beat (eg, atrial fibrillation, sick sinus syndrome, ventricular premature contractions) (Meneton, 2005). You can use echocardiography to confirm the tentative diagnosis, assess the severity of valvular regurgitation and stenotic lesions, evaluate chamber enlargement and quantify systolic and diastolic myocardial function in cats, detect cardiac tumours or pericardial disease, diagnose pulmonary hypertension or heartworm caval syndrome, and detect congenital cardiac defects in cats (Bruyette, 2020). Thoracic radiographs are the most reliable diagnostic technique for evaluating the lungs for signs and symptoms of present Congestive Heart Failure (CHF) or, in the event of pulmonary hypertension, for further inquiry into the cause. The most reliable approach to detecting heartworm disease is to look for antigens of adult female heartworms in the blood (dogs). Heartworm disease in cats may be detected via thoracic radiography or echocardiography. Cardiovascular diseases diagnostic methods in dog and cats are also heartworm antigen and antibody testing, as well as thoracic radiography and echocardiography (Reichard, 2010).

Different breeds of dogs are more prone to various heart disorders than others. Coughing, laboured breathing, and intolerance to exercise in an older Cavalier King Charles Spaniel should raise suspicion of left-sided CHF due to mitral regurgitation; however, a chronic obstructive pulmonary disease with fibrosis can present with nearly identical signs and thoracic radiographs (Rivlin and Tator, 1977).

Boxers with frequent fainting should be suspected of having arrhythmogenic right ventricular cardiomyopathy; however, Boxers can also have neurocardiogenic syncope or sick sinus syndrome, in which case Holter monitoring may be required to determine the cause of syncope and the best treatment strategy (Rosik, 2018)

Heart disease (most commonly hypertrophic cardiomyopathy, which can lead to heart failure or aortic thromboembolism) in a middle-aged cat with laboured breathing, intermittent lameness, and possibly behavioural changes, as opposed to hyperthyroidism in an older cat with weight loss and behavioural changes, which can lead to systemic hypertension and worsen the cardiac disease (Rivlin and Tator, 1977).

Echocardiography

When it comes to identifying enlargement of the heart chambers and major arteries, echocardiography is more successful than radiography, which is more effective than electrocardiography (Meneton, 2005). In general, the magnitude of chamber expansion or subsequent cardiac remodelling is inversely proportional to the severity of the underlying condition. In addition to the degree of pulmonary infiltrates found radiographically, other factors such as the degree of left ventricular wall motion impairment or thinning of the left ventricular walls may be utilised to predict the severity of heart failure in patients. Unfortunately, there is not usually a significant relationship between hemodynamic or echocardiographic characteristics and symptoms or mortality risk. Increased heart and respiratory rates, as well as inability to do physical activities, seem to have a stronger relationship with the severity of heart disease (Bruyette, 2020). It is also possible to employ NT-pro-BNP tests to aid in the diagnosis of cardiac disease and heart failure.

The four basic types of echocardiography are three-dimensional echocardiography, two-dimensional echocardiography, M-mode (one-dimensional echocardiogram), and Doppler echocardiography. Two-dimensional echocardiography is a real-time imaging technology that shows the heart in a wedge-shaped two-dimensional image. For dogs, cats, horses, and cows, as well as other animals, a significant number of standard long- and short-axis pictures obtained from standard imaging windows on the thorax have been produced (Meneton, 2005). When a one-dimensional ultrasound beam reaches the heart and generates an "ice-pick picture" over time, an M-mode echocardiogram may be obtained. On a computer screen, the tissue surfaces that the beam contacts are visually shown. As the frame rate of two-dimensional echocardiography rose, so did the utilisation of this type of assessment. Previously, it was used to assess chamber size and wall thickness, as well as valve motion and large vessel diameters... Three-dimensional echocardiography is still in its early stages, despite being the most current modality. Doppler echocardiography may be used to estimate the velocity of a moving item when an ultrasonic beam collides with it (e.g., RBCs, heart wall). Techniques employed include spectral (pulsed and continuous wave) analysis, colour flow analysis, and tissue analysis. Wave that keeps going on and on endlessly Doppler is used to monitor high-velocity flow and, as a result, to estimate pressure gradients, which are most often encountered between valve zones, using the modified Bernoulli equation (4 velocity2). In order to evaluate regional myocardial function in the heart, tissue Doppler imaging is used to identify the motion of cardiac components with a lower velocity, which is most often ventricular walls. For example, variations may be detected in strain and strain rate data (Bruyette, 2020).

Electrocardiography

Electrocardiography is the evaluation of the electrical activity of the heart performed from the surface of the body (surface ECG). Its primary role is to detect and diagnose arrhythmias in the heart. Additionally, it has been used to detect chamber enlargement in both dogs and cats, as well as abnormal conduction patterns, among other things (Meneton, 2005). The base-apex lead is the most often utilised ECG lead in big animals because it generates substantial deflections and may be used for rhythm analysis. ECGs are good for clinical diagnosis of cardiovascular disease and it helps clinician and cardiologists in proper management of disease that primarily affect the heart and the systemic diseases that indirectly affect the heart, ECGS should be used to characterise an arrhythmia in an animal with an auscultatory arrhythmia and to monitor rhythm while the animal is anaesthetized (primarily for changes secondary to coronary artery disease) (Bruyette, 2020).

The presence of irregular waveforms in dogs and cats may signal the presence of chamber enlargement. In dogs and cats, P waves that are broad or notched in lead II indicate left atrial enlargement, while rising P waves indicate right atrial enlargement. The presence of large R waves in leads with the positive electrode located on the left and/or caudal parts of the body indicates the presence of left ventricular hypertrophy (leads I, II, aVF, CV6LL, and CV6LU). Right ventricular hypertrophy is indicated by the presence of deep S waves in the same leads with the positive electrode on the left side of the heart or the presence of a right-axis deviation in the same leads. It is possible to witness wide QRS complexes in animals that have had their right or left ventricles enlarged, but they may also be caused by conduction problems (Meneton, 2005). The ECG is ineffective in detecting changes in chamber size that are modest to moderate in magnitude, and it is completely ineffective at detecting excessive expansion. Despite the fact that false-positive results are less common than false-negative findings, they do occur. Consequently, the accuracy is inferior, particularly when compared to echocardiography and even thoracic radiography, which are both available (Meneton, 2005).

V. Biomarkers For Cardiovascular Injury And Hypertension

Traditional diagnostic methods include biochemical, haematological, and coagulation profiles, urine and faeces analysis, blood culture, and effusion analysis may be influenced by cardiovascular problems, but they are not specific. On the other hand, developing unique and specialised tests or biomarkers that may provide information about myocardial damage and be used to research and monitor individuals with heart disease is crucial. In recent years, specific haematology markers like troponin and natriuretic peptides have gotten a lot of attention, and a pioneering study on the microbiota and proteome of dogs with heart disease was published.

It is possible to think of an acute coronary syndrome biomarker in terms of a molecule that is particular to the heart and released in proportion to the extent of damage sustained during the disease state. Cardiomyocyte transthyretin (cTnI) and two separate types of B-type natriuretic peptide (BNP) are the two cardiac biomarkers in dogs that have received the most attention (Regitz-Zagrosek, 2016). As an approach for decoding complicated cellular and molecular features, as well as for uncovering circulating biomarkers and therapeutic targets, proteomics is rising in popularity. Numerous innovative and promising findings in people and dogs have already been achieved using the relatively new use of proteomics known as cardiac proteomics. According to research that employed a proteomic method to uncover novel biomarkers for mitral regurgitation caused by mitral valve prolapse, those with mitral valve prolapse had reduced levels of haptoglobin, platelet basic protein, and C4b. This raises the possibility that these molecules have a role in the development of mitral regurgitation and prolapse (and pathways in which are involved).

VI. Conclusion

Hypertension is a notable cardiovascular disease of man and animal and a risk factor for other cardiovascular disease mentioned in this article. The importance of better understanding of the disease its pathophysiology and diagnostic procedure as a critical tool for effective management of cardiovascular diseases cannot be over emphasised. Researchers and clinicians therefore need to understand the dynamics of the disease and there implications on the cardiovascular health as a veritable tool for further research, effective diagnosis and management of hypertension and other cardiovascular diseases.

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