Proceedings of the Southern European Veterinary Conference
- SEVC -

Sep. 30-Oct. 3, 2010, Barcelona, Spain

Next SEVC Conference:

Sep. 30-Oct. 2, 2011 - Barcelona, Spain

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Concepts in feline cardiology
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Identification, evaluation and treatment of feline cardiovascular diseases is often a challenge for the veterinary surgeon, since the differential diagnostic of clinical signs shown by the patient can often involve the administration of medical treatments completely contraindicated if we are not able to correctly identify the causal pathology.

Usually, feline clinical signs associated to heart disease are acute, e.g. dyspnea secondary to pulmonary edema or hind limb paresis caused by aortic thromboembolism. However, in many patients the heart disease is diagnosed by chance in routine examinations of completely asymptomatic patients. For cats showing clinical signs, the signs most often observed are dyspnea, acute paresis, weakness, syncope, hypothermia, or completely unspecific signs. If the patients show congestive heart failure, tachypnea and dyspnea are usually observed, but without cough. Cats with congenital diseases can show unspecific signs, including growth delay, hypoxemia, cyanosis, tachypnea,…

Physical examination

It is essential to obtain a good clinical history during the patient examination. We must know what is the animal activity level, its usual respiratory pattern, its diet, whether it has good appetite, the water volume intake, whether it has access to toxics, potential history of vomits, anorexia, administration of drugs, previous diseases,… At general examination vital parameters must be assessed, including rectal temperature, pulse frequency and respiratory frequency, and a correct heart and pulmonary auscultation must be conducted.

It must be taken into account that cats with fever use to develop functional systolic murmurs and sinus tachycardia. Many patients with reduced cardiac output use to be hypothermic. Tachypnea may be associated to pulmonary edema or pleural effusion. Inspiration dyspnea is characteristic both of congestive heart failure and pleural effusion, whereas expiratory dyspnea uses to be associated to pulmonary edema. Cyanosis can be caused by congenital malformation, pulmonary complications or right-left communications. Abdominal distention can be caused by organomegalia or ascites, when right congestive heart failure is present.

Under normal conditions, the frequency and pulse are influenced by factors like body temperature, fever, hypothermia, stress level, heart frequency, potential arrhythmias,… It is also important to evaluate the jugular pulse. Health cats use to show jugular pulsations in the thorax inlet, whereas cats with right heart disease (right heart failure, pericardial effusion, tricuspid dysplasia,...) the pulse is detected much more dorsally, even at mandibular ramus level. This datum may be very useful for patients with pleural effusion in which heart auscultation is difficult and fluid collected in pleura does not allow the radiographic evaluation of the heart silhouette. With regard to heart auscultation, systolic murmurs are best detected close to the apical area and at sternum level. Pulse deficits are good indicator of the presence of arrhythmias, so that it is important to auscultate heart beat while palpating the femoral pulse. Heart rhythm can be classified as normal, bradicardic (below 150 bpm) or tachycardic (over 200 bpm).
**Additional diagnostic test**

Thorax radiographies are the additional diagnostic test more often used to try to detect a potential heart disease. Radiology is very useful to observe heart dilatation and heart dysfunction signs like pulmonary veins congestion, pulmonary edema, dilatation of large vessels, pleural effusion,… Dilatation in atria, as well as ventricular dimensions are best observed in the dorsoventral view. The lateral view is useful to determine whether the pleural effusion is associated to cardiomegaly, since the distance between the base and the apex can be measured. Anyway, this circumstance is not always fulfilled, since both pleural effusion and the presence of mediastinum masses can enlarge the heart silhouette. Compared with dogs, the feline heart is relatively smaller and more elongated. Intra-pericardical fat located in the ventral area of the heart silhouette may simulate the presence of cardiomegaly. Older patients normally show cranioventral displacement of the heart silhouette. In cases of decompensated patients showing marked dyspnea, the treatment may lead to collapse and death. Under these circumstances, radiography must be postponed and until the cat is stabilized. In some cases, if heart or respiratory sounds are dimed, preventive therapeutic thoracocentesis before carrying out the radiography is indicated in order to confirm the presence of pleural effusion and to improve the dyspnea degree.

Ultrasonography is the most reliable test that will confirm or rule out the existence of heart disease, since it allows to evaluate the heart function and integrity and correct anatomy of all structures (valves, cavities, walls,…). Before confirming that our patient has a primary heart disease, it is necessary to rule out the presence of other extracardiac systemic diseases (e.g. systemic hypertension or hypothyroidism) since these may cause heart structural changes.

**Clinical signs of the various heart diseases**

Left heart failure:

Clinical signs of left heart disease are associated to decrease of cardiac output and increase of pulmonary veins pressure. Clinical signs associated to low cardiac output include weakness, syncope, hypothermia, pre-renal azotemia, peripheral vasoconstriction,… Increase of pulmonary veins pressure is responsible for pulmonary edema. Serious cases may show tachypnea, respiratory distress and pulmonary crepitations. Unlike dogs, cats with pulmonary edema rarely show cough. Patients with severe or chronic pleural effusion use to show pericardial effusion.

Right heart failure:

Clinical signs of the right heart failure include jugular vein distension, positive hepatojugular reflux, hepatomegaly, ascites, pleural effusion, pericardial effusion and, sometimes subcutaneous edema. It is not usual to detect large volumes of ascites in cats compared with dogs. Pericardial effusions are very usual in cats with biventricular or right heart failure.

Aortic thromboembolism

Aortic thromboembolism uses to present acutely in cats. It is often a secondary complication to cardiomyopathy in the most cases. The thrombus may be formed both in the left atrium and the left ventricle. Affected cats use to show marked
atrial dilatation. Patients in whom the atrium diameter exceeds 16 mm show blood circulation slowing with the subsequent platelet aggregation and formation of thrombus. If the thrombus (or a fragment of it) is able to move to systemic circulation, the aortic trifurcation will be blocked in 90% of cases. Diagnostic is performed according to the clinical history and physical examination. Characteristic clinical signs include functionality loss and pulse of affected limbs, cyanosis in hind limbs nails and foot pads compared with fore limbs, affected limbs are very cold, there is contracture of gastrocnemius muscle and intense pain. Some cats are able to move the tail, which slightly improves the prognosis. Ischemic neuropathies and myopathies can also develop. The differential diagnostic includes intervertebral disk lesions, osteoarthritis, myopathies and any other disease that leads to the hindquarters weakness. Although some cats are able to recover the functionality of hind limbs, the prognosis in these cases is always reserved, since consequences may occur and there may be complications associated to the reflow damage.

**Cardiomyopathies**

The most part of feline primary cardiomyopathies are idiopathic and classified according to its morphology. Primary cardiomyopathies include hypertrophic, idiopathic dilated, restrictive, non-classified and arrhythmogenic cardiomyopathies. Unspecific or secondary cardiomyopathies include the nutritional (due to taurine deficit), metabolic (hyperthyroidism, acromegaly), infiltrative (due to amyloidosis, neoplasia), inflammatory (due to toxins, immunitary reactions, infectious agents), genetic (dilated, hypertrophic) and secondary to toxical agents (doxorubicin, heavy metals) cardiomyopathies. The most usual cardiomyopathies are next briefly described.

1.- Hypertrophic cardiomyopathy

This is a concentric primary hypertrophy of the ventricular myocardium (wall/septum thickness exceeds 6 mm during diastole). Walls hypertrophy does not always affect all the ventricular myocardium, since there may be cases of symmetrical hypertrophy, asymmetrical hypertrophy, or hypertrophy affecting only partly the septum... Before establishing the definitive diagnostic of hypertrophic cardiomyopathy, any other primary concomitant problem must be ruled out. Due to the myocardial hypertrophy, ventricular diastolic dysfunction is generated, responsible for the pressure increase inside the left atrium and the subsequent dilatation. This diastolic failure is responsible for the retrograde venous congestion and will cause left congestive failure. The atrium dilatation may predispose to formation of thrombi.

2.- Dilated cardiomyopathy

Patients affected show idiopathic systolic failure. Due to the low cardiac output, compensatory mechanisms start working, which boost increase of volemia, increase of diastolic pressure and marked dilatation of ventricular cavities with walls thinning. Many patients use to show acute congestive failure, hypothermia and risk of systemic thromboembolism.

3.- Restrictive cardiomyopathy

This cardiomyopathy is characterized by restriction of ventricular filling. This diastolic dysfunction can be associated to lesions in the endocardium, subendocardium or myocardial fibrosis. Ultrasonography findings are quite variable and include marked dilatation of the left atrium with normal dimensions of the inner cavity of the left ventricle. In the most cases systolic function is preserved.
4.- Non-classified cardiomyopathy

This includes all patients which morphological alterations detected by ultrasonography do not fit in with any of the previously described cardiomyopathies. Pathophysiology in these cases is uncertain, although they seem to be more similar to a diastolic dysfunction.

**Differentiation of heart diseases from other problems**

The fact that the heart disease signs are so unspecific (cough, dyspnea, synapses, intolerance to exercise, sudden death, collapse,...) and can be mistaken for other diseases leads to the risk of erroneous diagnostics.

The cough, even being one of the characteristic signs of canine heart decompensation, is rarely seen in cats with heart problems. In fact, cough in cats more probably shows airways problems. Weakness, intolerance to exercise and collapse may appear due to heart diseases but also associated to vagus problems, hypoxia, anemia, acute hemorrhages, hypocalcaemia, hypoglycemia, hyponatremia, hypo and hypercalcemia, renal failure, liver failure, muscle-skeletal diseases, thrombosis, medullar problems,... In cats, dyspnea is a very characteristic sign of heart failure but it can also appear secondarily to airways or pulmonary parenchyma diseases, due to non-cardiogenic pleural effusions, hyperthermia, anemia, shock, pleural diseases, diaphragm breakage,...

**References**