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Comparison different stages of treatment mechanism and significance of mitral regurgitation in human and canine heart

Yanlung Li[1,2]

[1]Guangdong experimental high school, Guangzhou, China

[2]631401040216@mails.cqjtu.edu.cn

Abstract. Both humans and dogs have a high incidence of mitral regurgitation with increasing age. Nowadays, because of the improvement of life quality, people pay more attention to the health of themselves and their pets and pursue a higher and better life. This paper mainly introduces the comparison of mitral regurgitation between human and canine. MR Can be divided into acute bicuspid insufficiency and chronic mitral insufficiency according to the progression of the disease. Acute mitral insufficiency: mild cases can only slight labor dyspnea, severe cases can quickly develop acute left heart failure, even acute pulmonary edema, cardiogenic shock. Chronic mitral insufficiency. The degree of clinical symptoms experienced by patients with chronic mitral insufficiency is influenced by the degree of mitral regurgitation, the rate at which the condition progresses, the amount of left atrial and pulmonary venous pressure, and other factors, the level of pulmonary artery pressure, and the combination of other membrane damage and coronary artery disease. Heart structure, routine interventions, diagnosis, treatment, and MR Phases were analyzed. Through comparative analysis, this paper can better let people understand and pay attention to the disease of mitral regurgitation in dogs.

Keywords: canine, mitral regurgitation, surgery, medicine.

1. Introduction

This paper mainly introduces the comparison of mitral regurgitation between human and canine. MR Can be divided into acute bicuspid insufficiency and chronic mitral insufficiency according to the progression of the disease. Acute mitral insufficiency: mild cases can only slight labor dyspnea, severe cases can quickly develop acute left heart failure, even acute pulmonary edema, cardiogenic shock [1]. Chronic mitral insufficiency. The severity of clinical symptoms in patients with chronic mitral insufficiency depends on the severity of mitral regurgitation and the rate of progression of mitral insufficiency, the level of left atrial and pulmonary venous pressure, the level of pulmonary artery pressure, and the combination of other membrane damage and coronary artery disease [1].

Surgical treatment in humans: Common surgical treatments for bicapical reflux include bicapical prosthesis and membrane replacement, but not all patients are suitable for surgical treatment. Indications for surgical treatment include: patients with severe mitral regurgitation and clinical symptoms; Asymptomatic but accompanied by pulmonary hypertension (mean pulmonary artery pressure >50mmHg); Patients with new atrial fibrillation or left ventricular dysfunction (left ventricular ejection fraction ≤60% or left ventricular end-systolic diameter ≥45mm) with severe mitral

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regurgitation, etc. Depending on the individual condition of the patient, the doctor will choose different surgical methods for treatment. Open-heart surgery in dogs is dangerous because the patient's heart must be completely stopped during the procedure [2]. A special instrument is used to pump oxygenated blood to the patient's body instead of the heart. Mitral valve repair surgery is a type of open-heart surgery that involves repairing a damaged or malfunctioning mitral valve by attaching a ring around the valve to help it close properly. The procedure is usually done under general anesthesia and involves making an incision in the dog's chest into the heart. During this procedure, the diseased mitral valve is replaced by a mechanical or biological valve. Mechanical valves are more durable but require lifelong anticoagulant treatment, while biological valves are less durable but do not require anticoagulants. Surgical mitral valve replacement (valve replacement) is rarely performed in dogs due to the high incidence of complications. Mitral valve repair is much better. This involves replacing any broken or stretched chords with artificial chords made of GoreTex. A drawstring suture is also placed around the valve annulus to pull it back to a smaller size. These two steps combine to improve the contact between the edges of the valve, which means less leakage occurs in the mitral valve. Minimally invasive surgery. The procedure involves using a catheter, a thin tube-like device, to inflate a small balloon in a narrowed or blocked heart valve. To widen the valve and improve blood flow. The procedure involves using a catheter, a thin tubular device, to insert a device that can repair or replace a damaged heart valve. The technology has been used successfully in human medicine and is now being applied to veterinary medicine. Advantages of transcatheter valve repair over traditional thoracotomy include faster recovery time, reduced risk of complications, and reduced pain and discomfort in the dog [3].

Patients with acute mitral regurgitation should seek medical attention as soon as possible when symptoms such as dyspnea and palpitation occur due to the rapid progression of the disease, regardless of the severity of the symptoms. Patients with chronic mitral regurgitation and those with bicuspid regurgitation during pregnancy should seek medical attention as soon as possible when exertive dyspnea, paroxysmal dyspnea at night, palpitation and other symptoms occur if they are asymptomatic at ordinary times. If the symptoms are stable under the control of drugs, they should also seek medical attention as soon as possible when symptoms worsen or new symptoms appear. Heart structure, routine interventions, diagnosis, treatment, and MR Phases were analyzed.

Acute mitral regurgitation is all part of the mitral valve damage that will lead to acute MR. Infective endocarditis can cause leaflet perforation and chronic leaflet rupture [1]. Spontaneous chords tendon rupture may occur in patients with mitral valve myxoma. Papillary muscle rupture often occurs in patients with ST-elevation myocardial infarction and is mostly seen in inferior myocardial infarction. Acute excessive volume load in the left ventricle and left atrium can lead to pulmonary congestion and decreased cardiac output. Early diagnosis and prompt management can often save lives [2]. The chordal and mitral valve leaflets are typically normal or slightly thickened in chronic secondary mitral regurgitation. As a result of coronary atherosclerotic heart disease (ischemic chronic secondary MR) or idiopathic myocardial illness, MR is linked to significant left ventricular dysfunction (non-ischemic chronic secondary MR) [1]. The papillary muscle is displaced as a result of abnormal left ventricular enlargement, which hinders leaflet closure by displacing the leaflets and enlarging the annulus. Secondary MR can result from left atrial expansion and mitral annulus enlargement when they are combined with AF and other cardiomyopathies. In some circumstances, there is both primary and secondary MR [3]. Atypical left ventricular expansion causes the papillary muscle to move, which prevents leaflet closure by moving the leaflets and widening the annulus. When AF and other cardiomyopathies are present, secondary MR might be caused by left atrial expansion and mitral annulus enlargement. There may be both primary and secondary MR in some situations. The severity of secondary MR may increase over time due to left ventricular or mitral annulus remodeling; because the reflux port becomes a crescent, the effective reflux port calculated by Doppler color flow fusion will underestimate the severity of MR [2].

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2. Dog mitral regurgitation

2.1. Location of the dog heart

Because the long axis of the dog heart is larger, the bottom of the heart is mainly opposed to the anterior mouth of the chest. The heart is located within the thorax, and the projection is located between the 3rd and 7th ribs. The apex of the heart is posterior and slightly to the 6th to 7th costal cartilage, and even the 8th costal cartilage. Most of the thoracic costal surface of the heart is opposite to the lower thoracic wall, and there is a certain distance between the 5th thoracic costal joint and the lower thoracic wall. The left margin of the heart is in contact with the left chest wall at the 4th to 6th ribs, and the right margin contacts the right chest wall at the 5th rib. The cranial side of the heart is connected to the large vessels, and the rest is free within the pericardium. Large blood vessels in and out of the heart: the big blood vessels in and out of the heart are basically similar to people. Canine mitral regurgitation is very common in older small dogs, with an incidence of up to 20 – 30%. The occurrence of the disease has a certain relationship with breed, age and sex. The age of sick dogs is mostly distributed between 5 and 16 years old, and the disease rate increases with the growth of age, more often in small dogs and male dogs. Dog mitral valve insufficiency will have characteristic night cough, night asthma, weakness, exercise intolerance or fatigue after exercise, excitement, prolonged recovery time, severe tongue purple color will appear syncope and other phenomena. Dogs with severe mitral reflux disease survive for only 3 – 6 months. The basic control effect of conventional medications is that they can only treat the symptoms; they cannot cure the condition, which will continue to progressively get worse. The average monthly prescription expenditure is between 2000 and 4000 yuan. or a procedure to replace the valve. The procedure is expensive, dangerous, and demanding with a high fatality rate. Only a few teams worldwide have finished individual cases as of yet, thus they cannot be widely disseminated. A 2-3 cm incision is made in the precardiac area, the heart is punctured into the device to complete mitral valve repair, reduce mitral valve regurgitation, and speed recovery. This minimally invasive procedure from Shanghai Hong Yu Medical offers a new technical approach to the treatment of mitral valve regurgitation.

2.2. Daily intervention

Dog's exercise should be controlled and the amount of time spent exercising should be minimized. Don't make them do anything strenuous, like long, long training sessions. Taking your dog for a walk when it is quiet. Daily diet management. When dog has heart disease, watch their diet and don't give them too many foods high in sodium, such as salty snacks and ham sausages. Don't scare a dog with a heart condition. This kind of behavior is fatal to them. The weight of dogs should be controlled well, obese dogs will increase the load of the heart, will accelerate the deterioration of the disease, cannot let the heart bad dogs eat too fat.

3. Differences between human and canine mitral regurgitation

3.1. Heart structure

The heart color ultrasound images of dogs are different from humans, and there are some differences. First, the dog's heart is smaller than the human, so the color ultrasound image is smaller than the human. Secondly, there is no aorta in the dog heart image, while the human heart has an aorta in the image. Dogs are not as clear as humans, so it is difficult to get more in-depth information. In short, dog heart color ultrasound is different from people, they have significant differences. However, despite this, this does not affect the diagnosis and treatment of heart lesions in dogs, and it is still an effective examination method.

3.2. Diagnosis of mitral regurgitation

For dog: The first method is auscultation: Cardiac auscultation is usually to examine the sound of the heart beating, judge and understand the state of the heart. Cardiac auscultation is generally an

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indispensable and important means in the examination of the heart. Cardiac auscultation includes the number of beats per minute of the heart, and whether there are symptoms of sinus arrhythmia in the rhythm of the heart. Auscultation can also reflect changes in cardiovascular blood flow. For some cardiovascular diseases, it is generally possible to make early diagnosis. In addition, it can also examine heart sounds and murmurs, as well as pericardial fricatives. The second method is the physical examination of the heart. It is to check the mitral valve, tricuspid valve, atrial septum, size, shape, atrium, ventricle, ventricular septum for abnormalities, to check for cardiac hypertrophy, and to check for cardiac hypofunction. The third is the chest X-ray: preliminary observation of the heart shape, estimate the size of each room, evaluate the amount of lung blood, and indirectly reflect the heart function, so as to determine whether there is a problem with the heart, to a certain extent to help the diagnosis of heart disease. For patients with heart disease. The fourth method: electrocardiogram (ECG): Measures the electrical activity of the heart and can accurately determine heart rate. Any abnormal rhythm can be measured. Ecg monitoring is needed for severe diseases with unstable hemodynamics, such as shock, severe infection and serious surgery, as well as severe cardiac diseases, such as acute myocardial infarction, heart failure, fulminant myocarditis, ventricular tachycardia and other diseases. Meanwhile, blood pressure monitoring and oxygen monitoring are used to judge cardiopulmonary function and hemodynamics. The presence of abnormal heart rhythms helps determine the prognosis of a pet's condition. The fifth is a blood and urine test that compares the concentration of the urine to the blood index to see if the body has other diseases. Normally, dogs with heart disease such as MR Usually have weakened liver and kidney function. For human: In patients with acute MR, TTE is the preferred imaging method for assessing left ventricular function, right ventricular function, pulmonary artery pressure, and mitral valve function. In patients who may result from severe MR due to chronic chordal rupture, it is often accompanied by dyspnea due to hemodynamic abnormalities. The sudden high left ventricular load increases the left atrial and pulmonary vein pressure, which leads to pulmonary congestion and hypoxia. At the same time, low blood perfusion of the tissue and reduced left ventricular systolic pressure resulted in reduced transvalue pressure difference, resulting in premature mitral valve closure. Therefore, the murmur of mitral valve insufficiency may be short and not obvious, and the blood flow signal under ultrasound is not obvious. When MI is accompanied by acute hemodynamic instability, but TTE confirms left ventricular hyperdynamic and eliminates new functional deterioration caused by other degenerative factors, it is necessary for TTE to further explore the papillary muscle, chords tendon rupture, valve vegetation, perivalvular abscess, and other emergency operations [4]. In evaluating patients with chronic mitral insufficiency, it is important to distinguish between chronic primary (degenerative) mitral insufficiency and chronic secondary (functional) mitral insufficiency, because the two conditions vary widely. Primary mitral insufficiency is caused by mitral valve lesions, while secondary mitral insufficiency is caused by atrial or ventricular lesions. In primary mitral insufficiency, lesions of more than one leaflet component (lobules, chordinosus, papillary muscle, annulus) lead to mitral insufficiency and thus to blood regurgitation from the systolic ventricle to the atrium. In developed countries, mitral valve prolapse is the main cause of chronic primary MR, with a more extensive etiology and manifestations. Young adults mainly showed severe myxoid degeneration and prolapse in the anterior lobe, posterior lobe and spinal cord tenuous (Barlow's valve). Some patients had ventricular arrhythmia, mitral ring rupture and left ventricular dilatation. In addition, older patients develop a disease of elastic fiber deficiency, which causes rupture due to the lack of connective tissue in the tenordiculum. Two different etiologies have some impact on the surgery. Other uncommon etiologies of chronic primary MR include infective endocarditis, connective tissue disease, rheumatic heart disease, mitral valve fissure, and radiation heart disease. If the high volume load caused by chronic primary MR is long and severe, it can cause myocardial damage, heart failure and even eventually death. Correcting mitral regurgitation before irreversible changes can allow recovery of the injured myocardium [5].

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3.3. Therapeutic regimen

For dog, major treatment is Medicine-wise treatment: including Angiotensin, converting enzyme (ACE) inhibitors, Diuretics, Nitroglycerin, Vasodilators, Beta-blockers, and Inotrope. Delaying the progress, provide the ability to keeping patient's normal life [6-7]. 2.Clinical surgery: open-heart surgical procedure & minimally invasive procedure. Mitral valve repair / Mitral valve replacement / Balloon valvuloplasty / Transcatheter valve repair [8-10]. For human, 1. Use of vasodilators can improve the hemodynamics in acute MR. The purpose of using vasodilators in acute MR is to reduce aortic resistance, thereby reducing regurgitation of the left ventricle to the left atrium, reducing mitral regurgitation, and increasing forward flow output from the left ventricle to the aorta. Usually performed with easy intravenous drugs, such as nitroprunna and nicardipine. Vasodilators should contraindicate hypotension because it is further aggravated by antihypertensive drugs when vascular tone is reduced. Intra-aortic balloon inversion (IABP) is helpful in the treatment of acute MR. IABP reduces systolic BP, thereby reducing left ventricular afterload, increasing output while reducing reflux. Furthermore, IABP can increase diastolic and mean arterial pressure, thereby contributing to the systemic circulation. The use of ECMO can reduce the damage caused by the hemodynamic instability prior to emergency surgery. 2. MR and left ventricular dysfunction lead to myocardial damage and heart failure. Surgical treatment is usually required when left ventricular systolic insufficiency occurs. However, medications for systolic dysfunction in those patients without surgery (or transcatheter repair) or who will delay surgery may help treat left ventricular dysfunction. Despite little data on MR patients with left ventricular dysfunction, such patients should include heart failure treatment options, including β blockers, ACEI or ARB, and possible aldosterone antagonists. Left ventricular dysfunction was reversed by the administration of β -blockers. Patients receiving β -blockers may have better surgical outcomes and later left ventricular dysfunction than those not taking these drugs. ACEI did not have a significant effect on mitral regurgitation in the presence of left ventricular dysfunction. As aldosterone antagonists are thought to inhibit fibrosis, their role in MR patients who rarely develop fibrosis is unknown. 3. Since vasodilator therapy is effective in acute severe symptomatic MR, it seems reasonable to delay surgery by reducing the afterload in MR patients who are chronically asymptomatic and with normal left ventricular function. However, the number of studies on this therapy was limited and not satisfactory, showing little or little clinical benefit with this treatment modality. Conversely, due to vasodilators reducing the left ventricular size and the strength of the mitral valve closure, it increases the severity of MR. Therefore, the above treatment is not applicable for patients with complicated hypertension. It is well known that hypertension is associated with complication rates and mortality, and elevated left ventricular systolic BP increases the systolic valve pressure difference of the mitral valve and aggravates MR severity. Therefore, hypertension must be treated. 4.The stage of MR, the stage of chronic primary MR in humans is divided into four major stages, and the reflux severity of these stages in these stages is not suitable for each patient. Specific cases can be evaluated according to the data and quality of severity and other clinical evidence. Stage A: The MR risk period mainly includes mild mitral valve prolapse, normal leaflet closure, mild valve thickening and slight limitation in leaflet activity. Stage B: Progressive MR stage, moderate or severe mitral valve prolapse, and normal leaflet closure. Stage C: asymptomatic severe MR, severe mitral valve prolapse, limited leaflet closure or leaflet fusion, radiation heart disease causing leaflet thickening. Stage D has severe symptomatic MR, severe mitral valve loss, limited leaflet closure or leaflet fusion, and radiation heart disease leading to leaflet thickening. The phase of chronic primary MR in dogs is also divided into four stages: Stage A dogs at high risk for heart disease had no clinical symptoms Stage B is a heart murmur without heart failure symptoms which are divided into two stages: B1 without heart hypertrophy and B2 with heart hypertrophy Stage C heart failure and must be treated Stage D heart failure can't be controlled by medication in half.

4. Conclusion

This paper mainly introduces the comparison of mitral regurgitation between human and canine. The structure of the bicapical organ consists of four parts: the lobe, the ring, the chordae tendinae, and the

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papillary muscle. The normal function of the bicapical organ depends on the structural and functional integrity of these four parts as well as the left ventricle. Structural abnormalities or dysfunction of any one or more parts can lead to incomplete closure of the bicapical organ. When the left ventricle contracts, blood flows backward into the left atrium, forming a bicuspid reflux. MR Can be divided into acute bicuspid insufficiency and chronic mitral insufficiency according to the progression of the disease. Acute mitral insufficiency: mild cases can only slight labor dyspnea, severe cases can quickly develop acute left heart failure, even acute pulmonary edema, cardiogenic shock. Chronic mitral insufficiency. The severity of clinical symptoms in patients with chronic mitral insufficiency depends on the severity of mitral regurgitation and the rate of progression of mitral insufficiency, the level of left atrial and pulmonary venous pressure, the level of pulmonary artery pressure, and the combination of other membrane damage and coronary artery disease. Patients with acute mitral regurgitation should seek medical attention as soon as possible when symptoms such as dyspnea and palpitation occur due to the rapid progression of the disease, regardless of the severity of the symptoms. Patients with chronic mitral regurgitation and those with bicuspid regurgitation during pregnancy should seek medical attention as soon as possible when exertive dyspnea, paroxysmal dyspnea at night, palpitation and other symptoms occur if they are asymptomatic at ordinary times. If the symptoms are stable under the control of drugs, you should also seek medical attention as soon as possible when symptoms worsen or new symptoms appear. Heart structure, routine interventions, diagnosis, treatment, and MR Phases were analyzed. Through comparative analysis, this paper can better let people understand and pay attention to the disease of mitral regurgitation in dogs. In fact, dogs are old people just like people. They are not as young as people in all aspects. Breeders should pay more attention to the health of dogs. Even at a later stage, follow doctor's advice to make reasonable arrangements and controls. Although the treatment may be expensive, since decided to get a pet, it is responsible for to be responsible and treat them like family. Hopefully, in the future, there will be more ways to treat mitral regurgitation in humans and dogs at a much cheaper and more sophisticated technique.

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