Cardiac Murmur Grading: Past, Present, Future

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A heart murmur is caused by rapid, turbulent blood flow through the heart. This condition is diagnosed by an irregular audible rhythmic vibrations (sounds)- commonly described as whooshing- during auscultation. The first documented discovery of cardiac murmurs were described approximately two-hundred years ago by a physician named Jean-Nicholas Corvisart. This noted medical revelation paved way to how we describe, grade, and treat systolic or diastolic murmurs. There are three main types of heart murmurs that can occur. A systolic murmur begins during or after the first heart sound and ends before or during the second heart sound. A diastolic murmur occurs when the heart relaxes between beats (diastole) to fill up with blood. A continuous murmur is one heard during both diastole and systole. This specific murmur occurs when there is a consistent shunt between a high and low pressure blood vessel. The 6-level grading system to describe the intensity of these murmurs was designed by Samuel Levine, and has been adopted by veterinary cardiologists for the last 50 years. These grading levels have not been revised or advanced since the 1960s. In murmur grading, the 1-4 scale is used for diastolic, and a 1-6 grading scale is used to described systolic murmurs.
To describe a murmur, the intensity is considered. The intensity, or ‘grade’, refers to the loudness of a murmur. If murmur grade varies, the term "dynamic" is used and the grade is labeled as a range.[1]
The following one through six scale is described as follows:
Grade I/VI- Quiet murmur that is not immediately audible. Can be noticed only after precise auscultation in a quiet environment.
Grade II/VI- Soft murmur that is heard with careful auscultation.
Grade III/VI- Moderate murmur that is immediately audible with auscultation.
Grade IV/VI- Loud murmur characterized without a thrill (turbulent blood flow palpable on the chest wall).
Grade V/VI- Loud murmur with a noticeable, palpable thrill.
Grade VI/VI- Easily audible with or without the stethoscope positioned on the chest wall. Associated with a thrill.[2]

In present diagnosis, there is a broad margin of error when using the 1-6 grading ranges to characterize a heart murmur . Due to the broadness of this grading scale, the intensity of the murmur could be considered up to the discretion of the specific provider conducting the auscultation. Because of this, there could be discrepancies between one medical professional to the next. This could cause error in diagnosing the intensity of the murmur, which could lead to an unsuitable treatment plan. For example, the presence of hearing loss could impact the precision of murmur grading. In a study conducted by the American Academy of Audiology, it is stated that, on average, 35 percent of adults between the ages of 65 and 75 years suffer from hearing loss. More so, 50 percent of adults seventy five years and older experience hearing loss. In the case of older generations still in private practice, these statistics could pose a risk of incorrectly

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[1] M. Rishniw. *Murmur grading in humans and animals: past and present.*Journal of Veterinary Cardiology, Volume 20, Issue 4. Pages 223-233. 2018.

[2] Campbell, Fiona E. *Cardiac Disease and Examination.* World Small Animal Veterinary Association World Congress Proceedings. *2013*

grading the intensity of a specific cardiac murmur in their patients.[3] Since murmurs indicate the presence of a valvular abnormality, it is important to regularly check progression in order to be proactive and catch early signs of chronic disorders, such as Aortic Valve Stenosis.
There is a more accurate way to diagnosis, grade, and measure the progression of heart murmurs in veterinary and human medicine. In the past, the use of 2D imaging, such as echocardiograms, to analyze and grade heart murmurs once diagnosed by traditional auscultation. In both veterinary and human medicine, there is now a more comprehensive and accurate way to examine, diagnose, and treat cardiac disorders - such as murmurs. 3D heart murmur rendering is a modern technological advancement that allows one to visualize a heart murmur through a 3D lens. In the words of Dr. Pless, DVM, "this technique uses cardiac imaging to create detailed three-dimensional visualizations of the heart, allowing veterinarians to better understand and assess heart murmurs in animals"[4]. Rendering holography in heart murmur visualization makes for a very precise diagnostic tool. Medical professionals would be able to see a a three-dimensional image of any human or animal's heart murmur. This 3D visual representation would allow one to see a patients heart structure and cardiac function without use of invasive, unnecessary exploratory surgery. This 3D rendering technology can be integrated into private practice, allowing licensed DVM's a more concise diagnostic tool than just auscultation and 2D imaging alone. With 3D rendering, veterinary cardiologists can track progression of the murmur with a visual aid. This additional sensory figuration can allow medical professionals a better understanding of the anatomy, physiology, and pathology of the cardiovascular system.

[3] NIH (National Institute on Aging). *Hearing Loss: A Common Problem for Older Adults.* American Academy of Audiology. 2016.
[4] Pless, Scott DVM. *Veterinary 3D Heart Murmur Rendering*. VET XPS. 2023.