

Using Echocardiography for the Assessment of Heart Valve Diseases

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Introduction

Analogous to an echocardiogram, a Doppler ultrasound (or Doppler echocardiography) is an examination that combines very high-frequency sound waves that get recoiled from the patient's heart and blood vessels. In this procedure, echoes are chosen and rotated into images that display the flow of blood via arteries or the heart. It then permits doctors to have a clear perceptibility of how the blood flows in a specified patient's heart and blood vessels.

This also permits doctors to acknowledge the obstacles in arteries and calculate the degree of tightening or seepage of heart valves. It allows the assessment of blood flow in coronary, carotid, and other major arteries. Thus, it is recommended for atherosclerosis or [coronary artery disease](#) patients.

Echocardiography uses high-frequency ultrasound to study the human heart for diagnosis of valvular heart disease. This technique provides valuable real-time quantitative information about the different dimensions of cardiac structures. This technique is used to obtain information regarding ventricular volumes and myocardial wall thickness. This also provides information related to blood and tissue velocities. MRI is also a recognized diagnostic modality for the assessment of valvular stenosis, but the preferred investigative modality is echocardiography. This comparatively new noninvasive system has some imperative practices in patients with valvular heart disease. It provides direct hemodynamic data that assists in patient recovery. In patients, with heart failure echocardiography, being low-cost and versatile is an indispensable test. It can be performed in hospitals during regular procedures or in an intensive care environment (Marwick, 2015). It assesses myocardial [structure and function](#), valvular illness, and hemodynamics. This research paper will discuss echocardiography (use of Doppler ultrasound) for the assessment of heart valve diseases.

Literature Review

Echocardiography is an authentic method compared to other percutaneous or transcatheter interventions, which need widespread multi-modality imaging. It provides the precise prediction of the pressure gradient crossways the valve by measuring peak flow velocity. This also provides data related to pressure gradient and mitral orifice area. Thus, this method can be used to deliver direct indication for or against the occurrence of valvular spewing out. Also, this is used to assess the veracity of the second valve in patients who have identified a disease of one cardiac valve.

Noninvasive evaluation of valvular cuts with Doppler echocardiography is founded on resolving the velocities of blood flow in the area of the cardiac valve. These are contiguous cardiac chambers and are present in the large vessels. When there are barriers in the vessels, it leads to an increase in the speed of flow in the area of stenosis. This can be diagnosed with the help of the Doppler technique. It is possible to have the value of speed with the help of Bernoulli equation. According to the equation, pressure gets reduced at the valves when there is more velocity. Moreover, the harshness of the stenosis is mirrored in the chronological route of the velocity arc at the stenosed valve.

In cardiology, currently Echocardiography has taken the form of a major diagnostic imaging technique. During the last five decades, its diagnostic ability has sharply increased, and it can capture images from M-mode and two-dimensional (2D) imaging. There are now many advancements in computer technology and ultrasound instrumentation, making it possible to have three-dimensional (3D) echocardiography (Gabriel, Kamp & Visser, 2005). With this, there is now a new period in cardiovascular imaging. This new 3D echocardiography has the potential for setting up operations and evaluating interventional or surgical consequences.

Thus, Cardiac Output Doppler echocardiography is practical for calculating cardiac output. The cardiac output equals the volume of blood for implementation of the left ventricle every minute. This output is shown in cardiology as liters per minute. The volume of blood expelled at each systolic beat is known as stroke volume. This calculation is based on the postulation that the aorta is a tube throughout each systolic beat. This cylindrical surge volume will possibly be calculated if one knows the value of the area along with the length.

Echocardiography is also a preferred method as it is three-dimensional (3D) imaging and provides better results than other interventions (Hahn, 2015). It was originally familiarized in 2000, and the sustained upgrading of 3D technology has directed its prevalent obtainability and its rising effectiveness, predominantly for valvular heart diseases. Two techniques can be used in Doppler ultrasound or Echocardiography. One is the continuous-wave and the other is the pulsed wave Doppler (Lancellotti et al., 2013). Continuous-wave Doppler makes use of a transducer that consists of two ultrasonic crystals. One uninterruptedly produces ultrasound, and the other uninterruptedly takes the backscattered ultrasound indication. The results of this continuous-wave Doppler in the form of frequency shifts are the combination of all signals received by the ultrasound beam. On the other hand, Pulsed Doppler delivers range resolution, and time-gating is used for this purpose.

Blood flow calculations in echocardiography depend upon the Doppler principle, according to which the calculated shift in frequency between a conveyer and a received ultrasound wave is connected to the speed at which the scatterers (red blood cells) inside the sample volume are changing (Moran, Thomson, RogZielinska, & Gray, 2013). This practice and blood flow calculation is also capable of investigating tissue movement. Doppler echocardiography not only perceives the incidence of regurgitation but also authorizes the realization of methods of regurgitation (Lancellotti et al., 2013). In clinical practice, the organization of patients having valvular regurgitation mainly puts together the consequences of echocardiography. It is consequently vital to give principles that plan at setting up a

baseline catalog of capacity to be executed when charging regurgitation.

Echocardiography is the main non-invasive imaging technique for valve stenosis evaluation (Baumgartner et al., 2009). Clinical decision-making is founded on echocardiography today. Appraisal of the harshness of valve stenosis is necessary for standards to uphold correctness and consistency across echocardiographic laboratories. It is done when there are assessments and exposure valve stenosis. Echocardiography has become the standard way to appraise aortic stenosis (AS) sternness. Cardiac catheterization is not further suggested except in uncommon cases when echocardiography becomes non-diagnostic with clinical data.

Methodology:

Research methodology is principally a procedure of how research is being carried out. It includes different tools and methods for carrying out particular research or judgment. Consequently, choosing a precise technique to assess research purposes is significant. Here the methodology used is case studies that are included in the literature review as a qualitative study. Thus, secondary sources, mostly scholarly articles from the last few years, are used to draw results.

Findings and Discussion:

The principle of reflection and scattering is used in ultrasound, which makes it possible to use an area of cardiology. Fundamentally, all ultrasound imaging is done by producing a pulse, which is in part reflected from a border between two tissue arrangements and in part broadcasted. The difference in impedance of the two tissue structures is responsible for reflection. Basic imaging by ultrasound only uses the amplitude material within the reflected indication. When there is the production of one pulse, then the reflected signal, on the other hand, is sampled further or less incessantly. Because there is quite an invariable velocity of sound in tissue, the time between the release of a pulse and the greeting of a reflected signal relies on the distance. This refers to the deepness of the reflecting structure. The reflected pulses are, therefore sampled at multiple periods that relate to multiple depths and are shown in the image as deepness. Different quantities of energy are emitted by different configurations. Therefore, the reflected signal from different pits will have diverse amplitudes. The period before a new pulse is flung out. This period is associated with the maximum preferred depth required for the image.

Thus, this principle is the Doppler Effect's base due to the ultrasound's reflection from stirring blood or tissue. This is seen in response to a change in the frequency of the reproduced ultrasound within the incident ultrasound. This Doppler shift has been extensively employed in clinical practice as a resource for calculating blood velocity. Two types of Doppler Imaging are used in cardiology. These are Colour Doppler Velocity Imaging and Power Doppler Imaging.

Conclusion

Doppler echocardiography is a comparatively new noninvasive method that is used as a substitute technique for assessing patients who have valvular heart disease. It is the primary imaging modality for the analysis and organization of patients who suffer from valvular heart disease. Development in surgical conclusion and proceeding in the interventional method need additional modification in echocardiographic imaging (Hahn, 2015). All imaging methods can give an ejection fraction, but the adaptability of echocardiography makes it exclusive in the stipulation of volume, diastolic purpose, right ventricular purpose, hemodynamics, and valvular regurgitation. Also, advancements in 3D ultrasound imaging have permitted the superior qualitative estimation of valvular construction. The addition of color flow Doppler to the 3D imaging has granted the benefit of having enhanced images of regurgitant lesions and grasp great assurance for a better quantitative appraisal of these types of cuts. The continuing smallness of transducers and development in hardware and software parts of ultrasound systems will surely improve both the effortlessness of image attainment and image excellence, which should result in additional exact quantitation of valvular dysfunction. However, clinical paybacks of 3D echocardiography have up till now been established incorrectly in clinical examinations. These are required for the extensive acceptance of this technique.

Doppler echocardiography should be a customary element of the noninvasive appraisal of patients with known or supposed valvular heart disease. It is an essential portion of the cardiovascular echocardiographic assessment. This results in the specific hemodynamic assessment of the heart. Both systolic and diastolic roles are possible to be quantitated using blood collection and tissue Doppler. This makes it possible to investigate pressure gradients, intracardiac forces, valve region, regurgitant degree, and shunt volume noninvasively and unfailingly. Support on Doppler hemodynamics In addition to 2D echocardiography, the majority of hemodynamic circumstances can be controlled surgically and medically with no invasive hemodynamic calculations.

Limitations:

There are certain limitations of this qualitative study. This only discusses the effects of the specified number of patients in case studies. As this is not an original study, it is difficult to specify the legal and ethical issues, in this study. This is not making use of any inferential statistics technique. The results are only based on subjective judgments.

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