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Live 3D Ultrasound Solutions

Accuracy Key for Improved Heart Failure Management

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Heart failure, the inability of the heart to pump sufficient blood to meet the metabolic demand of the body, impacts millions worldwide every year. Implications of heart failure are broad and have become a tremendous economic burden. Worldwide, heart failure affects nearly 23 million patients. In Europe, nearly 14 million people suffer from heart failure, a number that is expected to reach 30 million by 2020, according to the European Society of Cardiology.

Addressing the increased scope and severity of heart failure, the American College of Cardiology (ACC) and the American Heart Association (AHA) issued updated heart failure management guidelines in 2005. The defacto paper helps physicians diagnose and treat patients, as recommended by ACC and AHA's panel of experts. Guidelines recommend use of the term heart failure instead of congestive heart failure, and recognise the value that cardiac resynchronisation therapy (CRT) brings in improving quality of life and exercise capacity in patients who respond to CRT. Revised guidelines recognise diastolic heart failure as clinical heart failure, even with normal ejection fraction (EF). Guidelines also expand the number of patients eligible for implantable cardioverter defribrilators (ICD) based on low ejection fraction (EF) of 30%.

However, worthy to note in the revised guidelines is use of Live 3D Echocardiography in diagnosing the variety of conditions that contribute to heart failure, with recommendations on use of Live 3D Echo in diagnoses.

The primary role of Live 3D Echo in clinical practice is to provide minimally invasive, cost-effective answers to the clinical questions of structure, function and risk. Measurement of cardiac function anatomy can be a time-consuming, costly task often relegated to the research department, which typically uses expensive offline systems to evaluate cardiac function. Live 3D Echo, a faster, less expensive method, has the capability to accurately measure cardiac anatomy and function to improve quality of care and diagnostic confidence.

Accuracy Critical in Improving Patient Management

Obtaining accurate images of a patient's ventricular size and measuring a patient's EF is critical in improving management of patients with heart failure and reduced liability since the greater the accuracy, the greater the chance for a physician to make an educated diagnosis. Besides EF, understanding LV remodelling as with LV size of diastolic and systolic volume and wall thickness is important. Many patients with heart failure have coexisting valvular disease. In fact, some patients who have a dilated heart can actually have leaking through the mitral valve, known as mitral regurgitation, which can adversely affect valvular function. Additionally, the use of CRT, or use of a pacemaker to improve synchronous timing of LV contraction, is an emerging medical therapy being used to treat heart failure patients.

The role of Live 3D Echo in treating heart failure patients is critical in enabling physicians to obtain accurate images. In the past, the role of ultrasound in obtaining an accurate EF was a challenge using 2D ultrasound, which previously provided only single dimensional views. 2D views cause foreshortening of the image, meaning the true view through the apex is not possible. As a result, even the most seasoned physician or sonographer can never be completely sure they are obtaining a true view. Technological advancements in ultrasound technology enables accuracy by reducing apical foreshortening errors, and helps avoid geometric assumptions because it uses all the voxels in the data set. This is critical in providing accurate quantification in a semi-automated fashion by providing an EF in a matter of seconds leading to potentially greater accuracy in diagnosing a condition, faster exam times, and improved patient care.

Live 3D Echo in Cardiac Resynchronisation Therapy

While obtaining EF volumes for ventricular modelling is important, Live 3D Echo for use in CRT is gaining more attention in certain heart failure patients. As a result, a variety of echo solutions are under development for more advanced CRT assessment. One such advancement is Live 3D Echo's role in assessing the regional LV wall motion in CRT patients. CRT is a treatment option for certain patients with heart failure, specifically patients who exhibit conduction abnormalities and have a reduced ejection fraction as well as symptoms of HF. Cardiomyopathy and heart failure in moderate to severe patients are caused by an abnormality of the heart's electrical system, resulting in an uncoordinated contraction of the heart muscle. The most common abnormality is a delay in electrical conduction through the left bundle branch. Since this delays the electrical signal in traversing the LV, the right ventricle may contract before the left instead of simultaneously as it should in a normal cardiac rhythm. Another relevant aspect is the LV needs to contract simultaneously. It may have delayed contractile segments and this may lead to pumping inefficiency and adverse remodelling and dilatation of the left ventricle. The result is an uncoordinated contraction of the heart muscle, reducing the pumping ability of the weakened heart muscle.

Improving LV Function

CRT based on biventricular pacing may improve the LV function in patients with heart failure and left bundle branch block (LBBB) and may restore normal coordinated pumping action by overcoming the delay in electrical conduction caused by LBBB. This occurs with a unique type of cardiac pacemaker that continuously monitors the patient's heartbeat and delivers a tiny electrical charge to stimulate the heartbeat when necessary. While the response to CRT may vary, studies have demonstrated modest improvements in exercise tolerance, heart failure class, and quality of life. It is still a significant goal in cardiac imaging to identify definitively the best patient candidates who will be responders to CRT.

2D echo provides images of the LV. Its advantages are ease of use during a conventional 2D examination, high frame rate and availability of quantitative tools for analysis of wall motion patterns. However, it does not assess the LV in its entirety.

2D Doppler techniques allow wall motion analysis at high frame rates. This is useful in assessing for example, transmural patterns of thickening. Nonetheless, only motion in the direction of the Doppler ultrasound interrogation is part of the analysis. The spectrum of cardiac mechanical function is more complex. While 2D and Doppler echocardiography allow the direct evaluation of the mechanical dysynchrony, it is nearly impossible for either of these devices to examine all 17 segments of the LV. MRI, long considered the gold standard for assessing LV, cannot be used due to the metal found in the special pacing device and issues regarding potential magnetic inductance of leads. In this case, the use of Live 3D Echo in combination with semi-automated contour tracing algorithms can be an ideal tool for analysing regional LV wall motion in CRT patients.

Live 3D Echo allows a comprehensive analysis of LV wall motion before and during CRT and, in contrast to conventional 2D echo, the comparison of all LV segments. Live 3D Echo also helps obtain quantifiable data and acquire images more rapidly.

Conclusion

In summary, advances in ultrasound technology are making it possible for physicians to obtain more accurate images of the heart than ever before, a critical factor in accurate diagnosis, and provide appropriate treatment for heart failure patients. From a business perspective, Live 3D Echo is enabling hospitals and clinics to improve workflow through faster exam times and improved patient management by being able to provide a timely, more accurate diagnosis. New ultrasound capabilities are providing many healthcare facilities the opportunity to expand services without major capital expenditures.

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