GE HealthCare

Vivid™ Magazine

Vivid Pioneer

Edition 7

Dagfinn Saetre
General Manager
Cardiovascular Ultrasound

Dear Reader,

Technology matters most when it adapts to your clinical reality. When it supports workflow instead of disrupting it. When it delivers clarity without compromise. And when it helps you move confidently from diagnosis to decision — knowing every image, every choice has a real impact on your patients.

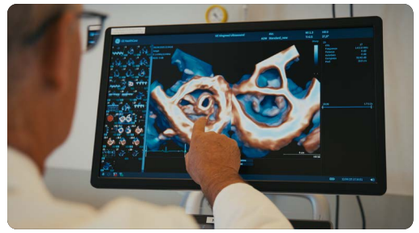
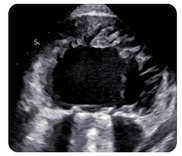
In this special Vivid™ Pioneer issue we explore how innovations in cardiovascular ultrasound are helping meet rising demands across busy echo and cath labs and pediatric departments — and most importantly what these innovations mean to your patients.

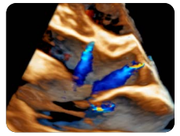
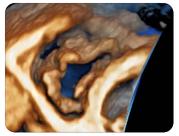
In these pages Professors Luigi Badano and Denisa Muraru in Milan share how advances in 4D TTE are reshaping expectations in the echo lab — supporting more accurate, reproducible assessment in routine practice, while Dr. Akhil Narang in Chicago highlights how improved 4D rendering is enhancing tissue visualization and spatial understanding during complex valvular interventions. In pediatric cardiology — where congenital heart disease presents some of the most delicate and variable challenges — Dr. Ferran Rosés discusses how probe innovation and advances in image quality are helping his team in Barcelona see more clearly, sooner, across patients ranging from newborns to young adults. From a sonographer perspective, Amy Dillenbeck in Cleveland, Ohio shares her experiences and from Barcelona, the team of Prof. Marta Sitges, Dr. Laura Sanchez and Dr. Xavier Frexia offer critical patient learnings, and finally Prof. Erwin Donal and the team share new possibilities for 4D transthoracic echocardiography and valve research.

We invite you to explore this issue of Vivid Magazine to see how these ideas are taking shape globally through diverse perspectives and case studies — offering a firsthand look at the next generation of cardiovascular ultrasound, Vivid Pioneer.

Dagfinn Saetre

Vivid Magazine

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Accelerating 4D imaging adoption for better cardiac care

Vivid™ Pioneer helps make a clear case for everyday use in the echo lab

As cardiovascular care becomes more precise and personalized, demand is growing for imaging that delivers real-time, volumetric, and anatomically accurate insights into cardiac function and structure. Despite the demonstrated advantages of 4D transthoracic echocardiography (TTE) over conventional 2D imaging, adoption in routine practice remains limited. Experts increasingly point to advances in ultrasound technology as a critical step toward closing the gap between potential and everyday clinical use.[1]

Research shows that 4D TTE offers significant diagnostic and procedural advantages over traditional 2D TTE,[1] particularly in evaluating structural heart diseases. Studies demonstrate improved accuracy, precision, and reproducibility[2,3] — driven in part by enhanced visualization of cardiac structures. And unlike 2D echocardiography, which relies on simplified geometric models (like an ellipsoid shape) to calculate volumes, 4D TTE captures true chamber shapes and sizes, allowing direct measurement of cardiac chamber volumes and function.

Professor Luigi Badano and Professor Denisa Muraru of the Department of Cardiology and Unit of Integrated Cardiovascular Imaging Diagnosis in Auxologico, IRCCS, in Milan, are leading proponents of 4D transthoracic echocardiography in the echo lab. It's not only part of their routine use, but also the focus of ongoing research. This includes their recent study, Clinical Impact of the Volumetric Quantification of Ventricular Secondary Mitral Regurgitation by Three Dimensional Echocardiography.[4]

In addition to transthoracic echocardiography, the team at Auxologico performs transesophageal, as well as exercise and pharmacological stress echocardiography — conducting approximately 13,000 studies annually. The institution serves a diverse patient population with both acute and chronic cardiac conditions, including valvular heart disease, genetic cardiomyopathies, heart failure, arrhythmias, and pulmonary hypertension. Auxologico also houses a large cardiac rehabilitation unit, receiving many post-cardiac surgery referrals, myocardial infarction, and structural interventions for ongoing screening and follow-up.

Professor Muraru and Professor Badano were among the first to experience the new Vivid Pioneer cardiovascular ultrasound system. In a recent discussion, they shared their perspectives on the new ultra-premium platform.

How would you describe Vivid Pioneer's image quality as a foundational tool for valve and chamber assessment?

Prof. Badano: *Image quality is one of the most significant advancements we've observed with Vivid Pioneer. Both 2D and 4D imaging — in transthoracic and transesophageal echocardiography — show impressive improvements in quality. The use of 4D echocardiography provides a highly realistic and detailed view of cardiac structures. Vivid Pioneer is also easier to use than the Vivid E95 — producing 4D echocardiographic datasets with higher spatial and temporal resolution in a single-beat acquisition.*

> *"I have found that getting images with spectacular clarity and high definition is much easier on the first attempt with Vivid Pioneer."*

Prof. Muraru: *The latest echocardiography system brings unparalleled clarity in 2D, and particularly 4D, and Color Flow imaging. For me, the game changers are truly anatomic 4D imaging and automated quantitative tools with improved border detection. I have found that getting images with spectacular clarity and high definition is much easier on the first attempt with Vivid Pioneer. These improvements have enhanced our clinical confidence.*

You touched on Color Flow. What is your experience with the new Color Flow technology, including the Radiant*flow*™ feature?

Prof. Badano: *If I had to highlight the most impressive improvement on Vivid Pioneer, it would definitely be the 4D Color Doppler — remarkable in both transthoracic and transesophageal acquisitions. The changes in the Color Flow are one of the most awaited and noticeable improvements in the Vivid Pioneer release. This has really transformed the Color Flow, which used to be a bit pixelated and difficult to assess the contour of the jet. Now the Color Flow is really smooth — I would even say pictorial — and shows the origin and the extension of the jet very nicely and in a reliable way.*

The Radiantflow is very nice to see, but also clinically useful. In complex jets — especially multiple jets — it really helps differentiate the origin and the extension of each jet. This is particularly important for tiny jets and is especially important in patients with congenital heart disease, where the flow can be really complex to assess.

> *"Radiantflow is very nice to see, but also clinically useful. In complex jets — especially multiple jets — it really helps differentiate the origin and the extension of each jet."*

You are both strong proponents of incorporating transthoracic 4D imaging into routine clinical practice, yet adoption remains somewhat limited. What do you see as the main advantages that should drive broader use?

Prof. Badano: *For many years we have advocated for the more frequent use of transthoracic 4D echocardiography in clinical routine because it allows precise morphology assessment of patients with valvular or congenital heart disease. It also provides more reliable, accurate, and reproducible quantitation of the geometry and the size of the cardiac structures.*

Actually, we've seen that with the latest technology and improvements in image quality of 4D TTE, we depend less than we used to on transesophageal echocardiography to assess the anatomy and the severity of conditions like valve diseases. This benefits patients — reducing healthcare costs and reducing the need for transesophageal echo when we've already decided to refer the patients for repair procedures.

> *“The changes in the Color Flow are one of the most awaited and noticeable improvements in the Vivid Pioneer release.”*

Prof. Muraru: *Transthoracic echocardiography remains our frontline tool — not only because of its accessibility, but also because, when performed with high image quality and the right technology, it provides comprehensive anatomical and hemodynamic information in a single, non-invasive session. It now offers a level of precision that, in the past, could only be obtained with transesophageal echocardiography.*

Building on this, the possibility to routinely apply transthoracic 4D echocardiography to measure chamber volumes — rather than just diameters — and to assess ejection fraction and quantify valve regurgitation using the 4D volumetric method will, in my opinion, significantly improve diagnostic accuracy. This approach can help avoid unnecessary additional testing and delays in treatment that prolong management of the patient, and increase costs.

In everyday practice, many decisions need to be made immediately at the patient’s bedside — particularly during the night — when the fellow may not have access to a supervisor or the support of another imaging modality. Transthoracic echocardiography needs to be able to provide that information, and it needs to be reliable. We can’t afford to make mistakes.

How has your research supported this approach, and what are the key insights that have emerged from your work?

Prof. Badano: *The Doppler PISA method, which quantifies the severity of mitral regurgitation, relies on numerous geometric and fluid dynamic assumptions — such as the shape and size of the orifice and the timing of regurgitation during cardiac systole. Unfortunately, these assumptions are rarely met in real patients.*

Our research demonstrates that transthoracic 4D echocardiography is highly accurate in measuring the volumes of the left and right ventricles. We have tested the accuracy of measuring the regurgitant volume of the mitral and tricuspid valves by calculating the difference between the 4D echocardiography stroke volumes of the right and left ventricles, or between the 4D echocardiography left ventricular stroke volumes and the left ventricular outflow tract Doppler stroke volume.

This method quantifies regurgitant volume independently of any geometric and temporal assumptions, making it particularly useful for assessing residual regurgitation after transcatheter valve repair procedures.

Prof. Muraru: *We strongly advocate for the adoption of 4D VCA (Vena contracta area) and 4D volumetric methods to obtain more reliable metrics of MR, particularly in cases of secondary MR and after TEER. The limitations of current 2D methods — for both deriving left ventricular volumes and PISA — carry significant implications for clinical trials and for their ability to demonstrate a mortality benefit following device implantation. We know and we discuss how important it is to do 4D VCA, but it is rarely adopted in routine practice.*

> *“With the latest technology improvements in image quality of 4D TTE, we depend less than we used to on transesophageal echocardiography to assess the anatomy and the severity of conditions like valve diseases. This benefits patients — reducing healthcare costs.”*

4D echocardiography enables more accurate quantification of valve stenosis and regurgitations, provides more reproducible quantification of LA and LV volumes and function.

If we focus on the tricuspid valve, how has 4D TTE impacted your approach to assessments?

Prof. Badano: *Tricuspid valve disease has been neglected and underrated for so many years, particularly because it’s very difficult to assess the anatomy of the tricuspid valve apparatus, as well as the severity of the disease, using conventional 2D and Doppler echocardiography.*

One of the major contributions of 4D is making echocardiography a reliable technique to assess right heart structures. Since we added 4D, there has been an increasing appreciation of the importance of the tricuspid valve in terms of patient outcomes, and we completely changed our approach to the tricuspid valve — both in assessing the anatomy and quantitating the severity of the disease.

Let’s delve deeper into the mitral valve. How essential has 4D echocardiography become in your daily practice?

Prof. Badano: *Even though tricuspid valve disease is gaining more attention, mitral valve disease — particularly mitral regurgitation — is still a clinically relevant and highly prevalent condition. We need to assess the anatomy of the mitral valve in order to plan the procedures effectively, and we need to evaluate the severity of the regurgitation to determine the correct treatment indications.*

In this regard, 4D echocardiography is essential for identifying the patients that should be referred to the heart team or monitored closely.

How does Vivid Pioneer perform when it comes to capturing critical anatomical details of the mitral valve and subvalvular apparatus, and how would you compare it to other systems?

Prof. Badano: *Vivid Pioneer’s transthoracic 4D images — particularly in volume rendering and Color Doppler — are superior quality compared to other echocardiography systems available on the market. I think this is one of the main breakthroughs with Vivid Pioneer. There has been so much improvement in the quality of the volume rendering and better, more precise Color Flow to assess the origin of the regurgitant jet and mechanism of the mitral regurgitation. This advantage allows us to rely less on transesophageal approaches to assess valve anatomy and regurgitation severity in our patients.*

Prof. Muraru: *Vivid Pioneer is a revolutionary scanner that allows us to obtain very detailed information about cardiac anatomy. This is fundamental because, in valvular heart disease, the issue isn't only functional, it's the underlying anatomy that causes the problem. So the surgeon or the interventionalist isn't just interested in understanding the functional significance of the anomaly, they need very in depth, granular information. It's not only about the leaflets, which we can see with 2D, but also understanding the anatomy in depth, the fine anatomic details, and the spatial relationships with surrounding structures. These precise measurements are essential for choosing the right device.*

Nowadays with the evolution of treatments with devices, we are also very interested in examining the subvalvular apparatus — like the papillary muscles, how far they are from the valve itself, and whether we can measure it. These details are crucial for choosing the right repair and replacement technique. All this information requires excellent image clarity — not just in 2D, but especially with 4D echocardiography.

> *"Vivid Pioneer is a revolutionary scanner that allows us to obtain very detailed information about cardiac anatomy. This is fundamental because, in valvular heart disease, the issue isn't only functional, it's the underlying anatomy that causes the problem."*

Hypertrophic cardiomyopathy (HCM) patients often present with complex anatomy. How does this affect your echocardiography approach, and what are some of the key challenges in assessment?

Prof. Muraru: *In HCM, the anatomy is highly variable, and the hypertrophy is often asymmetric — localized in different segments of the myocardium. But beyond the myocardium, the mitral valve apparatus plays a critical role in the symptoms experienced by many patients, particularly those with obstruction. Elongated leaflets, anterior displacement of papillary muscles, and accessory chords are frequent findings that can contribute to SAM, mitral regurgitation, or LVOT gradients.*

Many times, it's not only about the abnormal thickening of the myocardium, but also about these morphological abnormalities of the mitral valve — features that are essential to diagnose before a patient undergoes septal reduction therapy. The surgeon needs to know clearly whether there is organic involvement of the mitral valve apparatus, or if it's a functional effect due to LVOT obstruction.

The problem with hypertrophic cardiomyopathy is that, many times, it's difficult to diagnose — particularly in the early phases. You need to have a very crisp image in order to obtain reliable measurements of the thickness across all segments, not just the basal septum. That includes the apex, as well as the anterior and inferior wall. This can be challenging if the image quality isn't very good.

This is the reason why we often have to rely on CMR measurements, but we know those can also be quite variable depending on the operator. In addition, many patients are unable to undergo CMR due to implanted devices that are incompatible. So, if we're able to obtain accurate measurements from high-quality images — like those provided by Vivid Pioneer — we can better stratify risk in patients with HCM.

We know there's an added layer of complexity in diagnosing HCM — how does 4D TTE imaging help make it easier?

Prof. Muraru: *There are some forms of hypertrophic cardiomyopathy — like apical hypertrophic cardiomyopathy — where patients may develop apical aneurysms over time. Historically, we've said that 2D echocardiography often misses these apical aneurysms because they tend to be small and the images are frequently foreshortened. Another challenge is that images are often affected by artifacts at the apex, which can obscure a reliable evaluation.*

However, with a next-generation scanner like Vivid Pioneer, if you can obtain high-quality 4D echocardiographic acquisitions, you're able to reposition the planes and image the real apex. And once you know an aneurysm might be present, you can use 2D echocardiography to confirm it or switch to a different probe for better evaluation.

> *"If we're able to obtain accurate measurements from high-quality images — like those provided by Vivid Pioneer — we can better stratify risk in patients with HCM."*

How does Vivid Pioneer's new 6Sc-D probe enhance your ability to assess HCM?

Prof. Muraru: *The 6Sc-D probe improves image quality and reduces apical noise, allowing for better visualization of the LV apex. Its ability to reach higher frequencies with improved spatial resolution — specifically for the apical region or in slim patients — helps us better evaluate the presence of thickening or other morphological abnormalities suggestive of HCM.*

This can be especially useful when scanning family members of patients with HCM, as these young subjects often have a smaller body size and tight intercostal spaces. We've had several cases where the 6Sc-D probe improved the image quality of the anterior LV wall.

I had the impression when using the 6Sc-D probe in several patients — particularly women with tight intercostal spaces — that it really helped improve visualization of the more apical segments, so having the option to switch probes and use a higher frequency one can be very helpful.

> *“The 6Sc-D probe improves image quality and reduces apical noise, allowing for better visualization of the LV apex. Its ability to reach higher frequencies with improved spatial resolution helps us better evaluate the presence of thickening or other morphological abnormalities suggestive of HCM.”*

You have both made a strong case for using 4D TTE in routine clinical practice. In your view, how could Vivid Pioneer help drive broader clinician adoption of 4D TTE, particularly when it comes to image quality?

Prof. Badano: *We used to work with older 4D systems and relied heavily on multi-beat acquisition to achieve high temporal and spatial resolution. This was challenging because not all patients could hold their breath long enough for multi-beat acquisition, and a sizable number of patients with arrhythmias, like atrial fibrillation, couldn’t be examined using this technique. Vivid Pioneer, with the high temporal and spatial resolution achievable from a single-beat acquisition, makes it much easier to obtain a 4D dataset—just like we were used to doing with 2D echocardiography. If coupled with improved automation in quantitation — like the new software packages for the left ventricle, the left atrium, and also for quantifying the anatomy and leaflets of the mitral valve — it will represent a super breakthrough and make it much easier to incorporate 4D imaging into the routine assessment of every patient in the lab.*

Prof. Muraru: *It all comes down to the time required and confidence in the measurements. If a measurement takes too long to obtain, or if the operator is concerned about the reliability of the results — whether due to poor image quality or border-tracking issues — it simply won’t be used in routine practice. If we want to raise the quality of echo exams, we need to incorporate 4D and strain wherever feasible and the AI-enhanced solutions coupled with excellent image quality of Vivid Pioneer will encourage echocardiographers to adopt them in their routine examinations.*

How have improvements in Vivid Pioneer’s image quality impacted your productivity?

Prof. Badano: *The improved image quality of 2D imaging — particularly in patients with fair or poor acoustic windows — reduces the time needed to obtain diagnostic-quality images.*

Additionally, the higher spatial and temporal resolution of single-beat 4D echocardiography makes it clinically valuable for patients with atrial fibrillation or other arrythmias, where multi-beat acquisition may not be feasible due to stitching artifacts. This is a significant advantage given that approximately 30% of patients with heart failure and 60-70% of those with severe atrioventricular valve disease, have atrial fibrillation. Accurate quantification of the geometry and function of cardiac chambers is essential for effectively managing these patients.

> *“Vivid Pioneer, with the high temporal and spatial resolution achievable from a single-beat acquisition, makes it much easier to obtain a 4D dataset — just like we were used to doing with 2D echocardiography.”*

In what ways has the user experience brought more ease and efficiency to your workflow?

Prof. Muraru: *I was impressed by the system. The compact design and the simplified console make it easier to operate, as many of the redundant buttons and TGC have been moved to the touchscreen. I also appreciated the more intuitive controls, where written functions have been replaced by symbols — eliminating translation issues that can be difficult for foreign researchers or colleagues to interpret.*

Prof. Badano: *Thanks to the simplification and streamlining of the user interface — along with a reduction in buttons and controls — it’s now very easy to obtain the desired dataset using both transthoracic and transesophageal modalities.*

Also, the 4D Auto LHQ feature is user-friendly and fast, providing 4D measurements of left ventricle (LV) and left atrial (LA) volumes, as well as LV strain analysis — now faster and more reliable.

The Easy AFI feature provides immediate calculations of LV longitudinal strain and offers automated quantification of LV ejection fraction, which has proven reliable when compared to 4D echocardiography in the same patient. This is particularly useful for internal checks.

Let’s end by looking at the big picture. How would you describe the potential impact of the new Vivid Pioneer on clinical practice and patient care?

Prof. Badano: *I would say that Vivid Pioneer has changed the paradigm of 4D echocardiography, making it simpler, more reliable, and faster to be introduced into the routine of the echo lab.*

Prof. Muraru: *Vivid Pioneer is not just an update or another new scanner. It’s an evolution. It’s a transformation. We are evolving towards a patient-centered, anatomically sound assessment — with increased accuracy, streamlined workflows, and a detailed assessment of the cardiac morphology and function in real time. This allows us to improve our diagnostic capabilities for the better care of our patients.* ■

Luigi Badano, FESC, FACC, MD, PhD, is the Director of the Cardiovascular Imaging Unit at Istituto Auxologico Italiano, IRCCS, San Luca Hospital and Professor of Cardiology at the University of Milano-Bicocca, Milan, Italy. His clinical expertise includes native and prosthetic valvular heart disease, as well as right ventricular and atrial function. Professor Badano's research focuses on 3D and deformation imaging echocardiography and cardiac mechanics. A prolific academic, he has published 389 peer-reviewed articles and authored 9 books on echocardiography and cardiovascular imaging.

Denisa Muraru, FESC, FACC, MD, PhD, is a cardiologist at Istituto Auxologico Italiano, IRCCS, San Luca Hospital, and Associate Professor of Cardiology at the University of Milano-Bicocca, Milan, Italy. She is an international expert in 3D and strain echocardiography, with extensive experience in valve disease, right heart imaging, and cardiomyopathies. Her research focuses on tricuspid regurgitation, right ventricular remodeling, and advanced echocardiographic techniques. Prof. Muraru has co-authored over 270 peer-reviewed publications and 70 book chapters.

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Advancements in imaging of Hypertrophic Cardiomyopathy

Courtesy of Denisa Muraru, FESC, FACC, MD, PhD, cardiologist at Istituto Auxologico Italiano, IRCCS, San Luca Hospital, Milan

Patient history/ pathology

- 53 year-old male patient with Hypertrophic Cardiomyopathy (HCM) with apical-midventricular obstruction (MVO), past history of surgical myectomy and apical aneurysmectomy (2015) with ICD implantation (2020)
- Last CMR (2020 before ICD): no residual LV aneurysm, LVEF 55%, therefore anticoagulant treatment was stopped
- Patient followed on different institutions-echocardiograms: normal LV size, stable LV systolic function (2D LVEF = 60%), no residual intracavitary gradient, meaning an optimal outcome after the procedure
- Patient continued to complain, with Dyspnea on exertion (NYHA II) with mild impairment of functional capacity, elevated NT proBNP (643). Treatment: beta-blocker, ACEI, statin

Challenges

- Previous sternotomy
- ICD not CMR compatible

System, probe & device used

- Vivid™ Pioneer
- 4Vc-D probe
- 6Sc-D probe

Step-by-step procedure

- Comprehensive 2D and 4D Echocardiography (4Vc-D probe)
- Focused apical 2D echocardiographic imaging (6Sc-D probe)

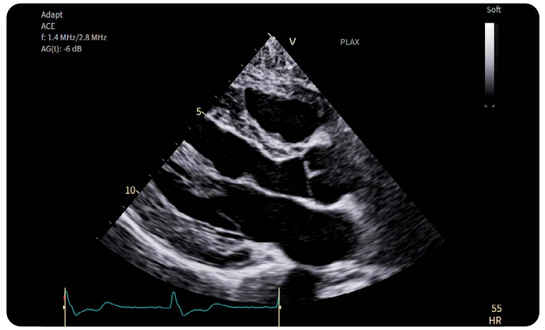
Conclusion

- HCM s/p surgical myectomy with apical aneurysm and residual dynamic obstruction at apical-midventricular level due to papillary muscles hypertrophy
- Latrogenic coronary-LV cavity fistula needs to be confirmed with second modality, typically coronary CT
- Mild LV dilation with mild systolic dysfunction
- Moderately dilated LA
- Mild MR
- Mild AR
- Mild TR associated with ICD lead (no interference) with normal RV size and function

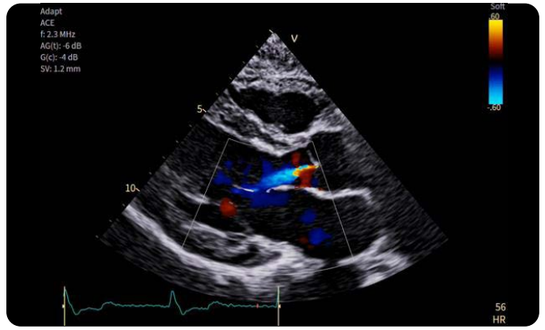
Follow-up

- NOAC was re-introduced and HF treatment was optimized
- Exercise stress echo and CPET scheduled to objectively assess the cause of symptoms and functional impairment
- Coronary CT to evaluate the coronary fistula and invasive hemodynamic assessment will be performed
- A multi-disciplinary discussion is to be held to evaluate the indication for percutaneous closure

1) 2D Echocardiography: Parasternal Long-Axis

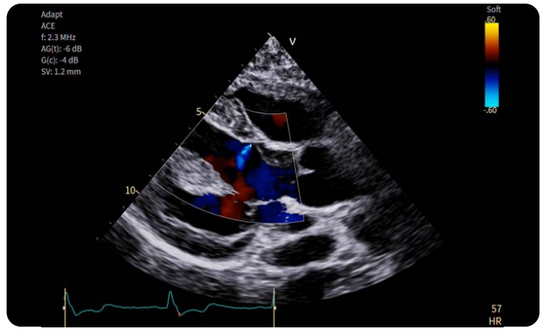


LVH with signs of septal myectomy, PM hypertrophy, no Systolic Anterior Motion (SAM)

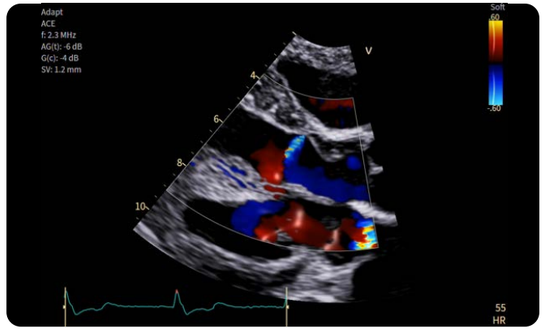


Mild central MR, mild central AR

2) 2D Echocardiography: Color Doppler and Radiant*flow*™

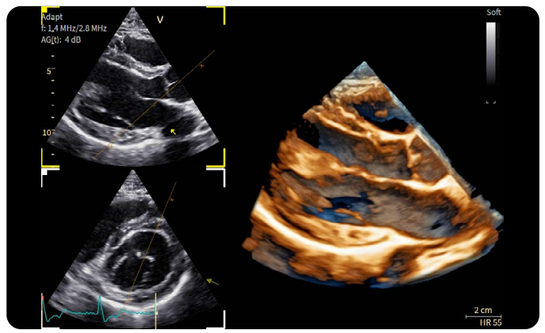


Thin diastolic jet flow between IVS and LV cavity

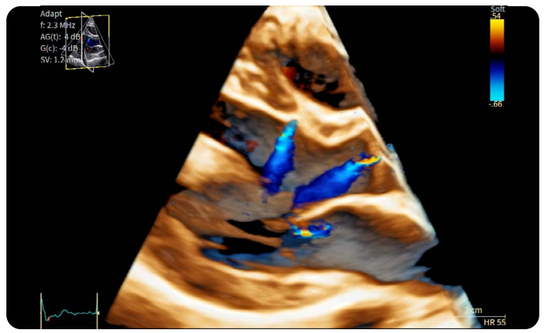


Radiant*flow* – to appreciate better the direction of the flow

3) True anatomical 4D echocardiography and Color Doppler

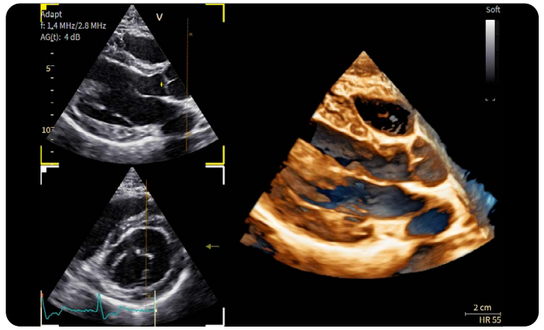


Residual thinning of the IVS after myectomy (6 mm) – No SAM – PM hypertrophy

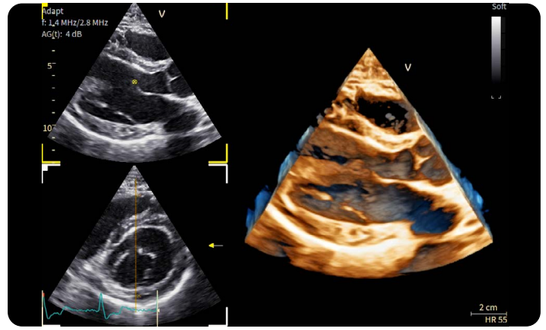


Three different lesions by Color Flow on the same image, in single-beat acquisition

4) 4D Echocardiography to better understand 2D limitations

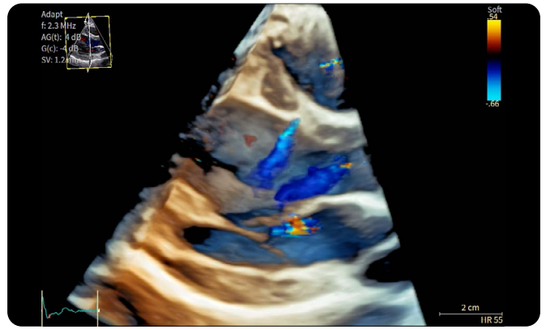


Residual thinning of the anterior IVS after myectomy

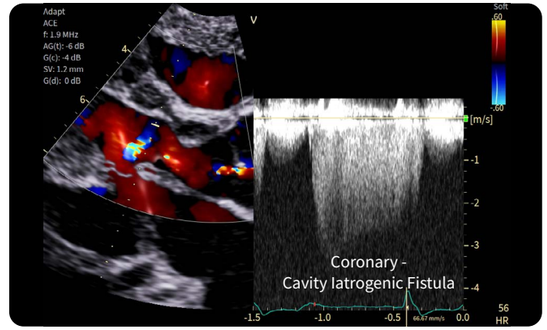


Residual thinning (and fistula origin) is missed

5) 4D Color and CW Doppler for better spatial and temporal definition

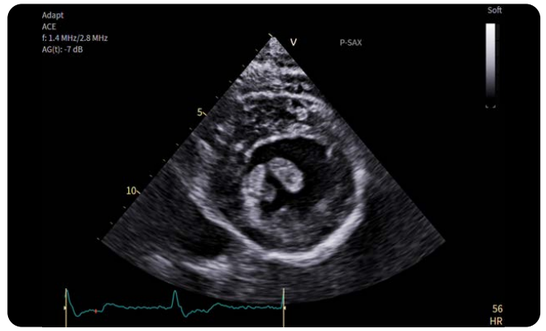


Cine rotate to better document jet localization and origin

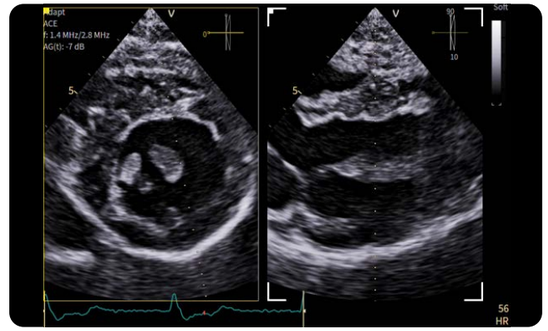


CW Doppler to better document jet direction and timing

6) 2D Echocardiography: Parasternal Short-Axis and Biplane

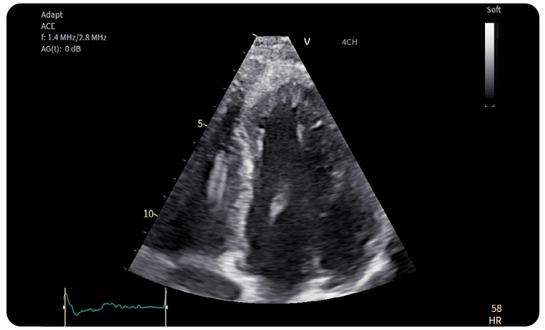


Bifid postero-medial PM – Displaced antero-lateral PM with systolic contact – No septal thinning

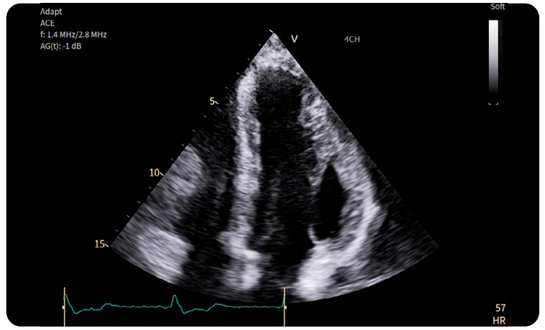


Biplane visualization of PM hypertrophy

7) 2D Echocardiography

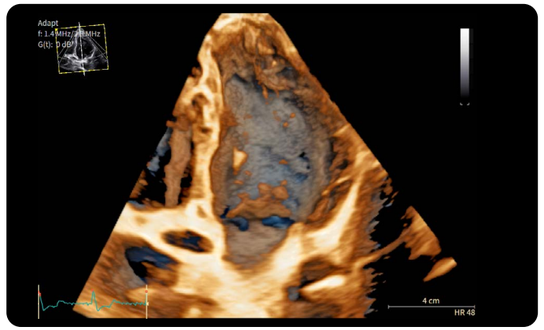


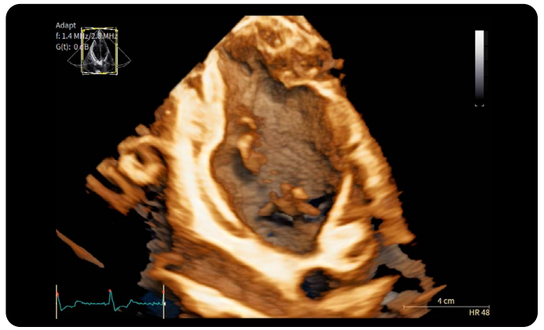
Apical – hypertrophic cardiomyopathy due to LV apical foreshortening in 2D apical 4-chamber

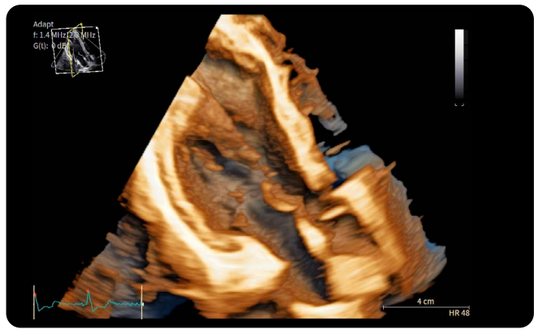


Apical aneurysm with mid-ventricular and PM hypertrophy

8) 4D Echocardiography: Apical Views

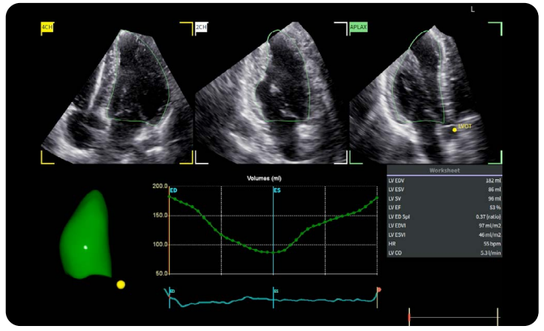


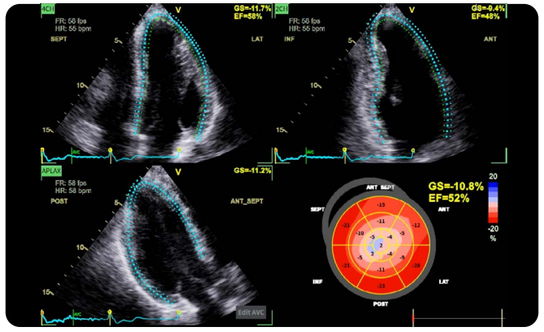




Clear visualization of the contours of the wall, extending to the farthest part of the myocardium, allows appreciation of the anatomical details and trabeculations, and helps confirm whether there is obstruction at the mid-cavity, including its location and mechanism

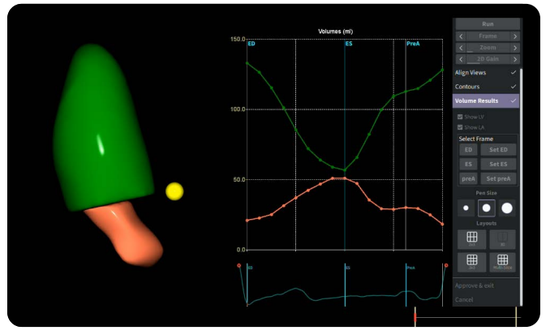
9) LV Volumes and Systolic Function





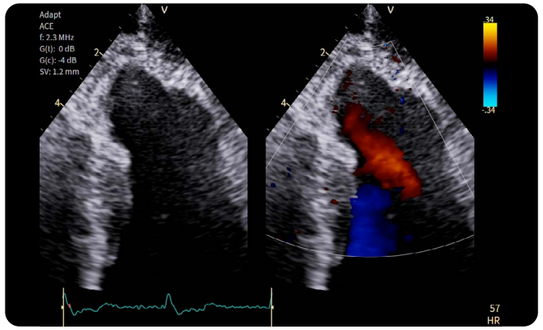
4D LHQ revealed that the patient already had left ventricular dysfunction (LV EF 53%, LV EDV 162 ml). The presence of the fistula could potentially add an additional hemodynamic burden to a ventricle already compromised by fibrosis and left ventricular hypertrophy

10) Assessment of LV – LA Coupling

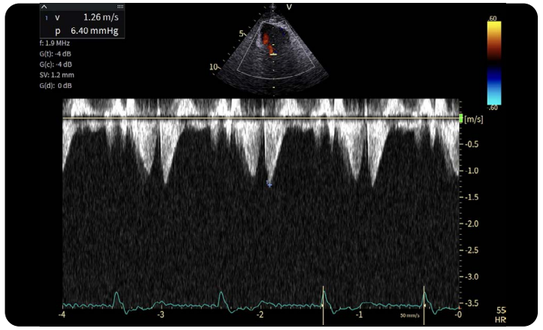


4D LHQ enables simultaneous acquisition and measurement of both the left ventricle (LV) and left atrium (LA), allowing assessment of their coupling — an important parameter for predicting the presence of atrial fibrillation in patients with hypertrophic cardiomyopathy

11) LV Apical Aneurysm

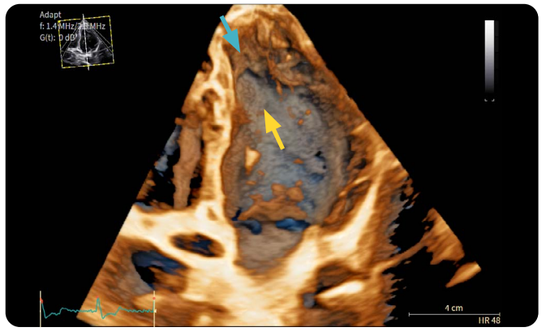


Color Doppler with biphasic flow from aneurysm

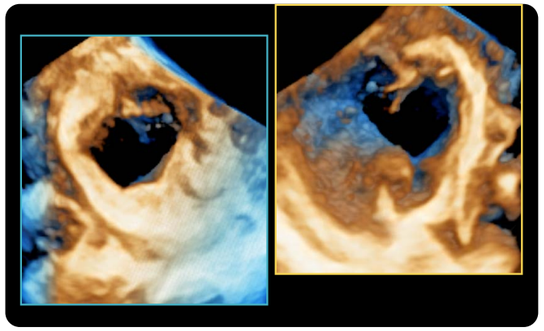


CW Doppler with “Lobster claw” sign

12) 4D anatomical assessment of LV obstruction

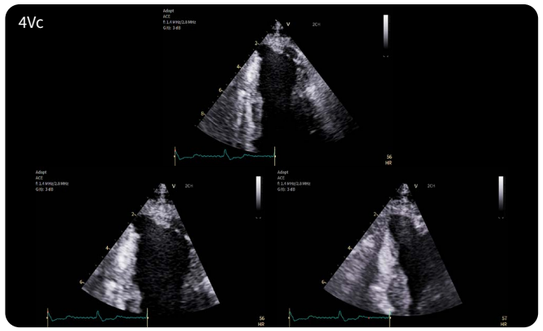


LV Dynamic Obstruction



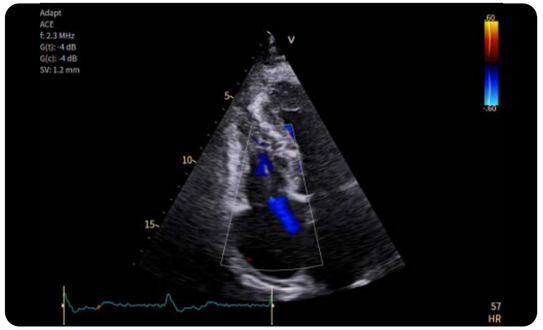
LV Dual-Crop

13) Aneurism assessment with 2D echocardiography

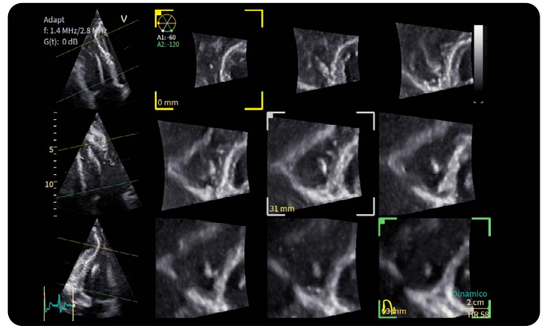


Comparison between the 4Vc-D and the 6Sc-D high-frequency probe demonstrated that the latter enabled clear apical visualization, confirming the absence of intracardiac thrombus

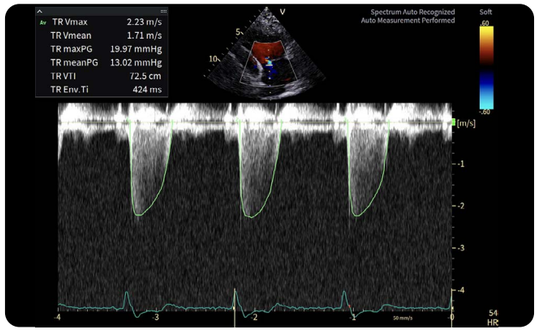
14) Assessment of TR mechanism and severity



Radiant*flow*



4D Dynamic Slices



Auto Doppler

Overall feedback

- Excellent image quality with improved spatial and temporal resolution of 4D images
- High sensitivity to detect small color jets
- Ability to appreciate fine anatomic details on intracavitary structures that are relevant for HCM diagnosis and management
- Efficient integration of 2D/4D/Doppler capabilities, transducers, echo techniques, and display modalities for in-depth anatomic and functional assessment and to address all the clinical questions

Prof. Denisa Muraru is a paid consultant for GE HealthCare and was compensated for participation in this article. The statements by Prof. Denisa Muraru described here are based on her own opinions and on results that were achieved in her unique setting. Since there is no “typical” hospital/clinical setting and many variables exist, i.e. hospital size, case mix, staff expertise, etc. there can be no guarantee that others will achieve the same results.

JB34129XX

Case study

Advanced 4D transthoracic echocardiography for accurate assessment of tricuspid regurgitation

Courtesy of Luigi Badano, FESC, FACC, MD, PhD, Director of the Cardiovascular Imaging Unit at Istituto Auxologico Italiano, IRCCS, San Luca Hospital, Milan

Patient history/ pathology

- 66-year-old man
- Unremarkable previous medical history. No cardiovascular risk factor
- On May 2025, the patient went to the E.R. presenting paroxysmal atrial fibrillation treated with amiodarone e.v.
- Systolic murmur identified at physical examination. Patient referred to echocardiography exam

Challenges

- Quantifying non-holosystolic regurgitant jets
- Utilizing the conventional PISA method to quantify tricuspid regurgitation
- Identifying the anatomy of the tricuspid valve and understanding the pathophysiology of tricuspid regurgitation

System, probe and device used

- Vivid™ Pioneer
- 4Vc-D probe
- EchoPAC™

Step-by-step procedure

1. Assess the timing of MR (holosystolic vs. non-holosystolic)
2. 4D volumetric assessment of MR severity
3. Corrected PISA method to assess severity of TR
4. Transthoracic 4D to assess the morphology of the tricuspid valve
5. Apical RV focus view to calculate RA volume
6. 4D measurement of LV and RV volumes
7. 4D volumetric assessment of TR severity
8. Identify the pathophysiology and classification of TR

Conclusion

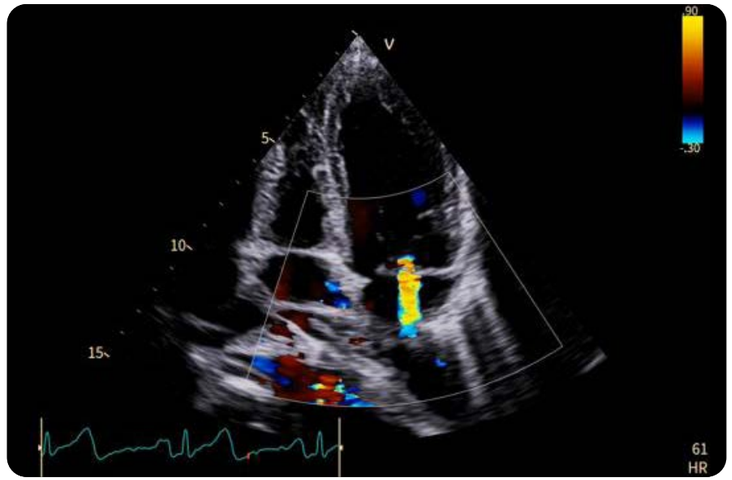
The use of quantitative 4D transthoracic echocardiography and dedicated tools (angle and jet velocity corrected PISA method) and views (RV focused apical view to measure right atrial volume) allowed to determine the correct etiology of TR and its severity to plan personalized follow-up and treatment goals.

Imaging follow-up

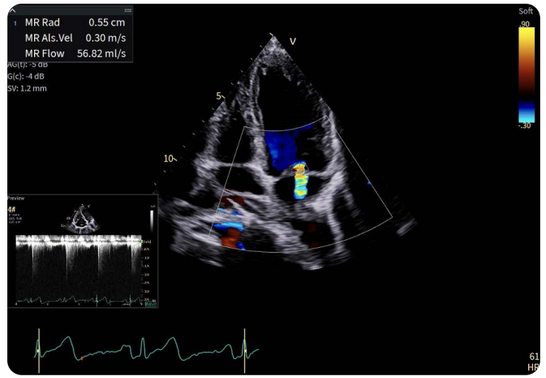
Repeat 4D transthoracic echocardiography at 6 months to check for progression of TR severity and right heart chamber remodeling.

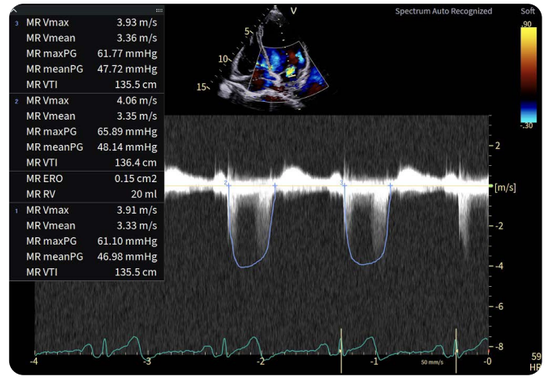
Aggressive treatment to maintain sinus rhythm.

1) Apical 4CH view – Mitral regurgitation

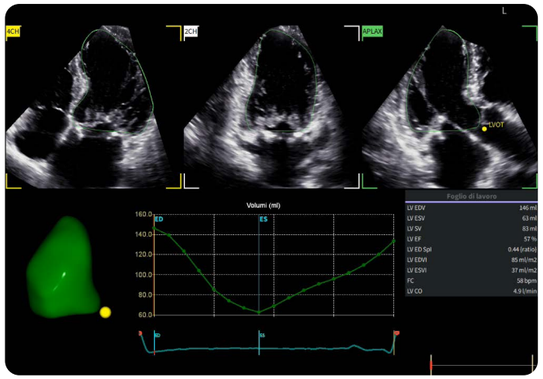


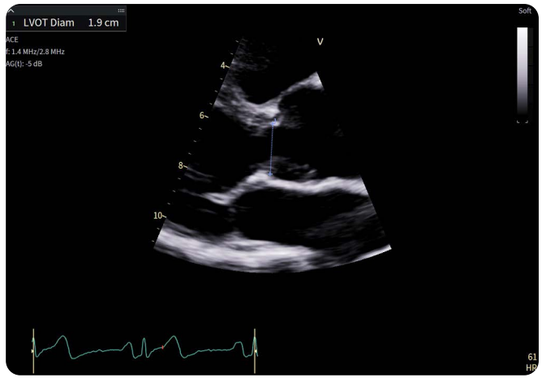
2) Mitral regurgitation quantitation using conventional PISA method



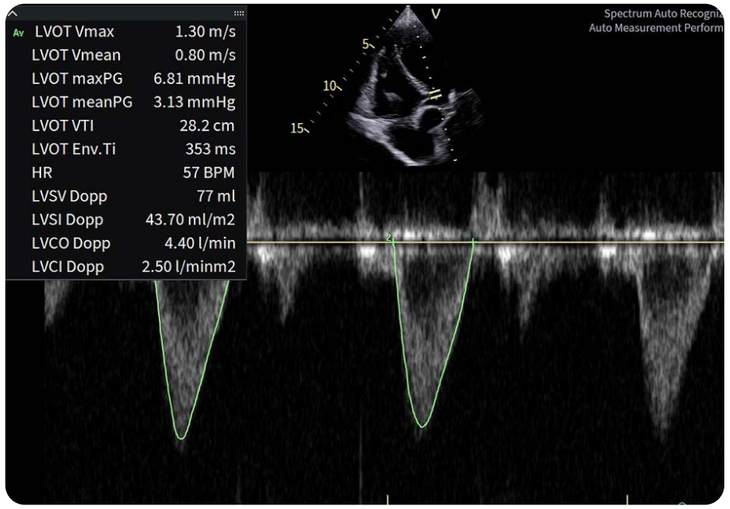


3) Mitral regurgitation 4D quantitation with 4D LHQ



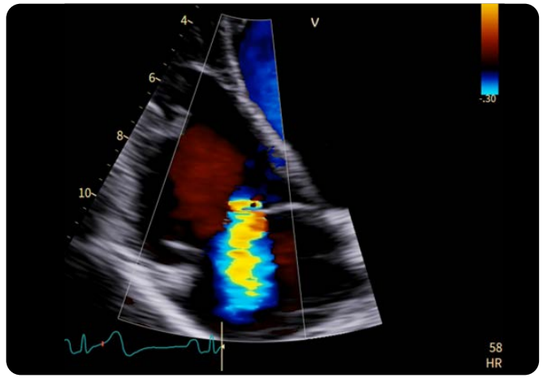


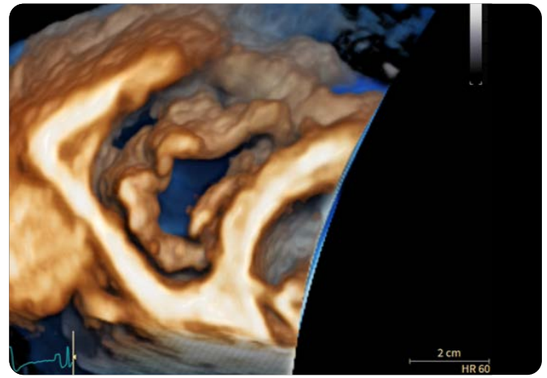
A close examination of the envelope of the regurgitant jet reveals protosystolic and telesystolic components, while no regurgitation is observed during mid-systole. In this case, the conventional PISA method is likely to overestimate the severity of MR.



Regurgitant volume = SV_{LV} - SV_{LVOT} = 83 - 77 = 6 mL. Confirms mild MR.

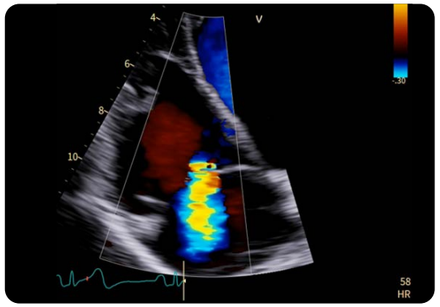
4) Tricuspid valve function and anatomy assessment

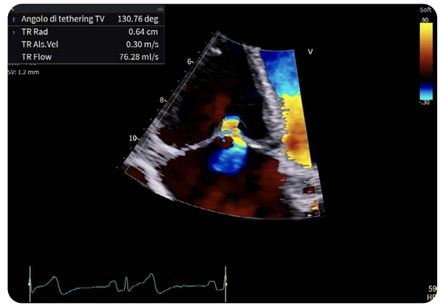




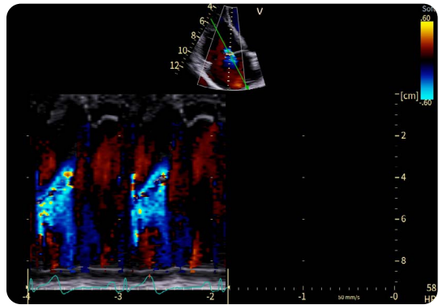
4D transthoracic – single beat acquisition. High quality anatomical images.

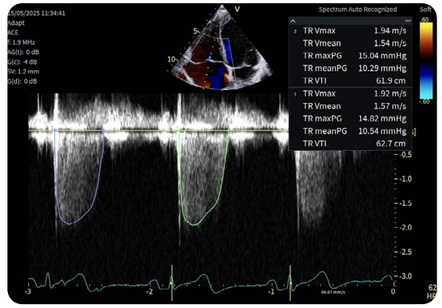
5) Tricuspid regurgitation – PISA method, challenges and considerations





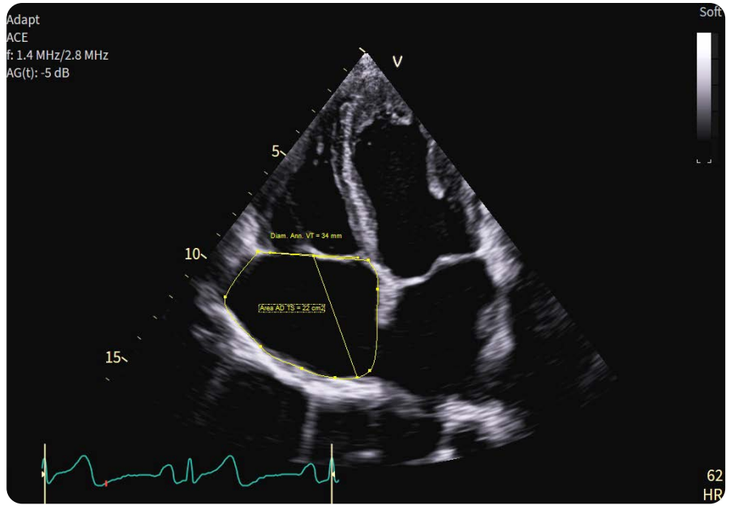
Conventional PISA method:
Regurgitant volume = 20 mL
EROA = 0.33 cm^2
Moderate TR





Corrected PISA method:
Regurgitant volume = 26 mL
EROA = 0.42 cm^2
Severe TR

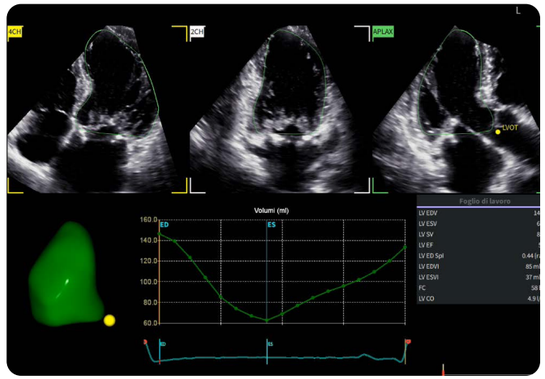
6) Etiology of tricuspid regurgitation – guideline recommended echo



- Moderate tricuspid regurgitation
- Normal LV ejection fraction (57%)
- No significant left heart disease
- Mildly dilated left atrium = 40 mL/m²
- Pulmonary artery systolic pressure = 25 mm Hg
- Mildly dilated right ventricle (ED area = 13.9 cm²)
- Normal RV function (FAC = 50%; TAPSE = 2.5 cm)
- Mildly dilated right atrium = 40 mL/m²
- Increased end-systolic RA/RV area ratio = 1.59
- Normal tricuspid annulus diameter = 34 mm
- No leaflet tenting

Conclusion: Based on the green parameters, findings are consistent with atrial secondary tricuspid regurgitation. However, the normal diameter of the tricuspid annulus is in contrast with this diagnosis.

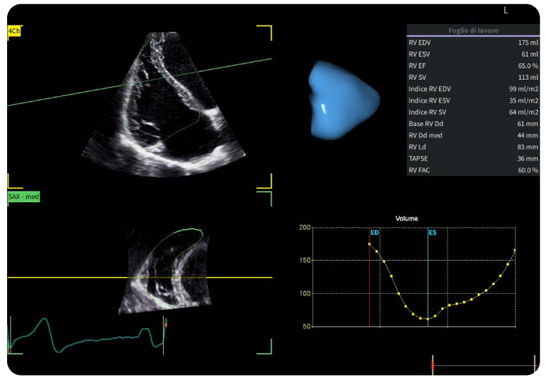
7) Tricuspid regurgitation – 4D volumetric method



Regurgitant volume = SV_{RV} - SV_{LV} = 113 - 83 = 30 mL

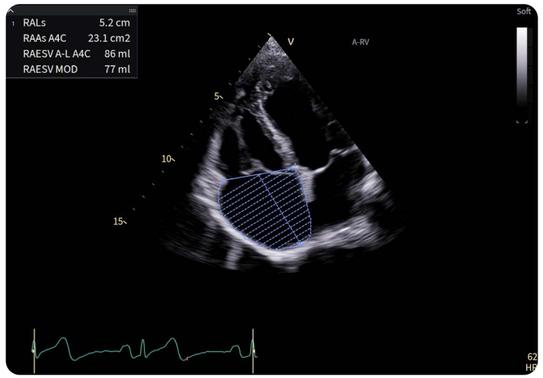
EROA = Regurgitant Volume/VTI_{TR} = 0.48 cm²

Regurgitant Fraction = Regurgitant Volume/SV_{RV} = 27%



Effective RV Ejection Fraction = 47% (increased risk if < 20%)

Forward SV_{RV}/ESV_{RV} = 1.36 (increased risk if < 0.4)



- Severe tricuspid regurgitation
- Normal LV ejection fraction (57%)
- No significant left heart disease
- Mildly dilated left atrium = 40 mL/m²
- Pulmonary artery systolic pressure = 25 mm Hg
- Mildly dilated right ventricle
- Normal RV function
- Severely dilated right atrium = 51 mL/m²
- Increased end-systolic RA/RV volume ratio = 1.45 (significant > 1.4)
- Dilated tricuspid annulus area = 17.2 cm² (normal < 13.1 cm²)
- Mild leaflet tenting – height 9 mm, volume = 4.3 mL

Conclusion: By using a 4D dataset and measuring the tricuspid annulus with Auto TVQ, the actual size of the tricuspid annulus is measured. Now all the parameters remain consistent with the diagnosis. Atrial secondary tricuspid regurgitation can be confidently confirmed.

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JB34128XX

Precision at the heart of pediatric care

Transforming complex congenital heart care through imaging

What was once a devastating diagnosis is now one of pediatric cardiology's greatest success stories. Nearly 1 in 100 newborns is affected by congenital heart defects, yet today, more than 90% survive into adulthood — a dramatic shift made possible by decades of innovation.[1,2] Advances in echocardiography — especially high-performance probes — have led to sharper imaging and greater precision across a broader range of patients, enabling earlier diagnosis and more personalized treatment.

Developing individualized care plans is essential in congenital heart disease (CHD) because each anomaly varies in anatomical structure, clinical complexity, and functional impact. Precision is particularly important in pediatric cardiology, where even small anatomical differences can significantly affect treatment strategy and a patient's overall health trajectory.

Vall d'Hebron University Hospital's Pediatric Cardiology Department, located in Barcelona, is a leading center in Spain for the care, teaching, and research of congenital heart disease — serving patients from the fetal stage to adulthood. With over 40 years of experience, the Pediatric Cardiology Department is recognized as a national reference center for complex pediatric cardiac conditions and has a renowned heart transplant program.

As Chief of Pediatric Cardiology at Vall d'Hebron University Hospital, Dr. Ferran Rosés is actively involved in CHD research and eagerly integrates new technologies to help advance the field — with high-quality imaging at its core. Among the first physicians to explore the capabilities of the new Vivid™ Pioneer ultrasound system, Dr. Rosés has performed echoes on patients ranging from newborns to young adults.

We spent time with Dr. Rosés in clinic, observing first-hand how he's using Vivid Pioneer — and asked him to share how it's shaping everyday practice.

Congenital heart disease is a key focus in your department. What are the biggest obstacles you face in understanding anatomy and determining the best treatment?

Dr. Rosés: *My challenge is helping patients with really complex congenital heart disease, particularly the ones where we really need to understand the anatomy to plan treatment. Basically every patient's heart is different, so every congenital heart disease is slightly different. You can then study each patient's heart in a very particular way, so that you can then target and design a treatment.*

Precise imaging plays a critical role in navigating complex heart cases. How would you describe the image quality?

Dr. Rosés: *The image quality of Vivid Pioneer is outstanding. It was mind blowing actually and is quite different from the Vivid E95 system. It takes just a few seconds to adjust to this new way of viewing things, and then you begin to appreciate the quality, the detail, the tissue characterization, and the Radiantflow.™ All of these make a fantastic package.*

To get real detailed anatomy — you really need a very powerful echocardiogram, and Vivid Pioneer is excellent. The 2D image quality for me is what was really striking. You can see the detail of all the structures: the tissue, the muscle, the leaflets, the valves, and that is really helpful to diagnose our patients.

> *"The image quality of Vivid Pioneer is outstanding. It was mind blowing actually."*

Every image, every insight in echocardiography starts with the probe. What are your impressions of Vivid Pioneer's new 6Sc-D probe?

Dr. Rosés: *I think the 6Sc-D probe, which is the new pediatric probe, gives us an edge because we can see things that we could not see with other probes. The accuracy of the image quality is outstanding. You can see much more detailed valves, or an aortic coarctation quantitation for example. The image quality allows you to precisely diagnose the problem, so you can then inform the surgeon or the interventionalist.*

One thing that is fantastic is that you just use Vivid Pioneer — put the probe on the patient, and the image quality is there for you. You don't have to do much tweaking because the setup is already done.

Can you talk about the design of the 6Sc-D probe and how it impacts usability, especially in pediatric patients?

Dr. Rosés: *The design is really important. It's completely new compared to the 6S on the Vivid E95. The major change is the elongated footprint. It's narrower and longer, which makes it perfect, so you can scan through the ribs and then you have a larger window. It allows you to scan patients from neonate to adults — and the image quality is wonderful.*

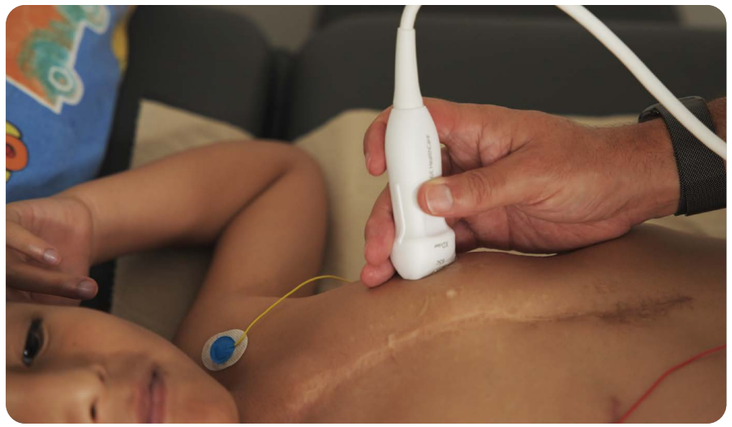
Some might believe that it's not ideal for neonates, but that's not the case. The fact that it's narrower is perfect.

> *"The 2D image quality for me is what was really striking. You can see the detail of all the structures: the tissue, the muscle, the leaflets, the valves, and that is really helpful to diagnose our patients."*

You can scan them from subcostal, from the four-chamber view, and from the long axis-view nicely. It doesn't matter that it's slightly longer. The image quality is still perfect.

How does the image quality you're seeing with the probe impact your clinical confidence in treating this broad group of patients?

Dr. Rosés: *As a pediatric cardiologist it's all about image quality. For us, it's all about seeing things. We are morphologists, so we need to understand the anatomy very well. So if you don't see well, then you won't be able to treat them well. Having an echo this powerful makes all the difference.*



> *"I think the 6Sc-D probe, which is the new pediatric probe, gives us an edge because we can see things that we could not see with other probes."*

How would you describe Vivid Pioneer's Color Flow advancements, which includes a new Radiant*flow* feature?

Dr. Rosés: *The new 'Color' is fantastic. What's really important with Vivid Pioneer is that the color differentiation between the muscle is much better. When you put the Color on, you can see the myocardium very nicely, and then the color flows through the structures — basically through the vessels or the cavity. The differentiation between the myocardial tissue and the color is perfect. You can see all the valves clearly, and it's much easier to see the ventricular septal defects (VSDs) or other defects in the heart.*

At Vall d'Hebron, we are familiar with Radiantflow from GE HealthCare's Voluson™ ultrasound systems for fetal cardiology, but it's new on Vivid Pioneer. It gives you a sense of depth — a 3D-like volume in a 2D image — which is actually very nice. But the color is very different. At first, if you're not used to it, you might think, "Oh my goodness, this is too much." But then, wait a minute — do it a couple of times, and you start loving it. So, the tool grows on you quickly.

When it comes to productivity and workflow, how would you describe Vivid Pioneer's AI and automation tools?

Dr. Rosés: *What really matters — apart from the image quality — is being able to do what you need to do, with the system helping you, instead of making things harder. The new AI tools are amazing because they speed the process and it helps you throughout the day. You can do much more because the machine is doing all the work for you.*

You can have all the patterns of your Doppler in one click, calculate the ejection fraction very quickly, and acquire 4D volumes of the right ventricle amazingly fast. The machine is helping you do all the quantification analysis. And at the end of the day, that's exactly what you need for your report.

> *"The new AI tools are amazing because they speed the process and it helps you throughout the day. You can do much more because the machine is doing all the work for you."*

It also means you can spend more time exploring the patient and talking to the family rather than doing manual calculations. I'm not focused on playing with the settings or doing the measurements because the AI tools are doing that for me. I can concentrate on paying attention to the family, making sure they understand the consultation, and really interacting with the patient.

One of the goals was to make the system more intuitive. What are your thoughts on the new interface?

Dr. Rosés: *The Vivid Pioneer is a very easy-to-use machine. The new interface is extremely user-friendly, with everything you need positioned close together, making image acquisition fast and intuitive.*

Capturing fantastic images is simple — anyone can do it. You don't have to be an expert in echo because everything is clearly laid out and easy to find. The way everything is displayed is really useful. It's all fantastic.

If you've worked with a Vivid E95, you could move to Vivid Pioneer without any training. It's very simple, but an improved version. And you will think, "Oh my goodness, this is even better."

> *"The differentiation between the myocardial tissue and the color is perfect. You can see all the valves clearly, and it's much easier to see the ventricular septal defects (VSDs) or other defects in the heart."*

A boy with a big heart

A new chance at childhood thanks to ultrasound innovation technology

Just a few months ago, 8-year-old Erik Jaldin found it difficult to keep up with everyday activities. Born with a serious congenital heart defect, even simple moments of play were exhausting. Today, he's back to doing what kids do best — being a kid. The dramatic change was made possible by specialized treatment and technology at Vall d'Hebron Hospital, under the care of Dr. Ferran Rosés.

Diagnosed with congenital heart disease in utero, Erik underwent emergency surgery as a newborn in Murcia, Spain. After several additional procedures, he was later transferred to Vall d'Hebron Hospital in Barcelona — an eight-hour drive from his home in the southeastern part of the country.

"They asked if we wanted to go to Barcelona or Madrid," his mother, Delia Jaldin, recalls. "I said, 'Wherever the best doctors are.' So they sent us here."

When Erik first arrived, he was in heart failure living with a single ventricle and a prosthetic valve in the systematic position. He also had a previous pacemaker that was contributing significantly to dyssynchrony, which only worsened his condition. Erik was referred to Dr. Rosés for both assessment and to be added to the transplant list. Diagnostics included imaging with the new Vivid Pioneer ultrasound system.

"We started evaluating Erik's case with our conventional tools, and it was a fantastic surprise when Vivid Pioneer with the 6Sc-D probe provided views that could not be achieved with other probes. The 2D image quality of the myocardium was outstanding and having the ability to capture the entire ventricle in the image also enabled dyssynchrony analysis using strain," Dr. Rosés explained. "In Erik's case, it enabled us to clearly identify a dyssynchrony pattern. With that information, we were able to plan the procedure to upgrade him to cardiac resynchronization therapy — which helped him a great deal."

For Erik's family, the experience has brought more than answers — it's brought hope.

"Thanks to Dr. Rosés and the technology here, Erik is still with us — something that might not have been possible back home. Vall d'Hebron Hospital is always innovating and finding better solutions for patients — like my nephew," says his uncle, Gustavo Rojas.

For his mother, the progress means reassurance. "It gives us peace and confidence," she added.

Erik and his family continue to navigate his healthcare journey, but the advanced care he's receiving has already made a meaningful difference in his life.

"He's feeling much better and has got much more energy to do what he wants on a day-to-day basis," Dr. Rosés explains.

"After surgery, Erik has grown more and can do daily activities he couldn't do before," Erik's uncle says, smiling. "He gets tired less, and plays football — which he loves. I see a big improvement."

> *“2D image quality is what is really amazing. We’re exploring things that are new for us because we can see it better.”*

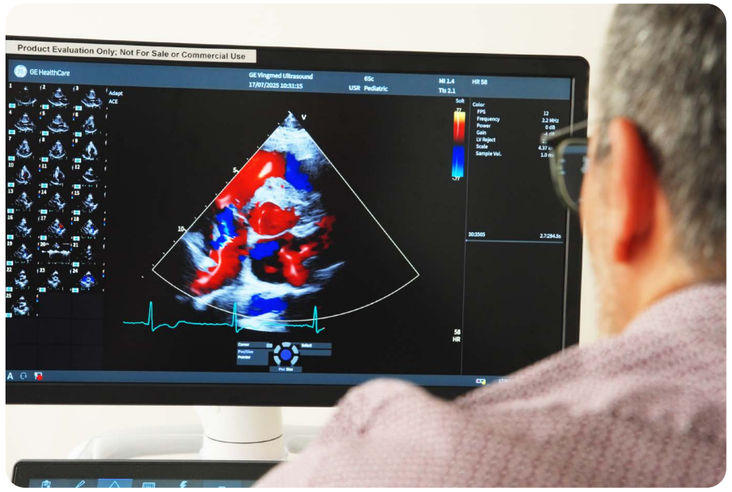
Vivid Pioneer weighs just 104 to 110 kg. How does the lightweight design affect your workflow at Vall d’Hebron University Hospital?

Dr. Rosés: *Vivid Pioneer has a new shape and design that’s much more portable, with a reduced size. That makes it easier to bring to theatres and intervention labs. One good feature is that you can move it around very easily with one hand, which makes it the perfect tool for outpatients and also the theater.*

Is there anything that surprised you about Vivid Pioneer?

Dr. Rosés: *What surprised me the most is that Vivid Pioneer comes with a color, LED light as part of the design. It’s the first thing you see with this machine and it’s perfect for kids. They can set the color and they watch it, which is perfect. They have [GE HealthCare’s] compassion purple as one option, which is a very nice color and works well too.*

We have touched on a number of topics ranging from image quality and probes to workflow and productivity. How would you best summarize Vivid Pioneer?



Dr. Rosés: Vivid Pioneer has gone back to basics because what matters is the image quality. And that is really outstanding. What really matters here is not the fancy work on top of it. What’s really amazing is that the 2D image quality is much better, and everything that you build on from there is going to be even better. But the 2D image quality is what is really amazing. We’re exploring things that are new for us because we can see it better.

With pediatric cardiology and the field of echocardiography evolving so rapidly, how meaningful is it to have innovations like Vivid Pioneer?

Dr. Rosés: *When I see one of those machines, I say, “Wow, this is perfect.” But it’s not perfect because it looks nice — it’s perfect because it will actually help someone. And that’s what’s really remarkable here.*

> *“There’s one way of talking about it, which is calling it innovative or revolutionary, and that’s fine. But what really matters to a doctor is being able to treat patients. The rewarding part, for me, is helping them.”*

So if you’re using new technology, if you’re using new tools in everyday practice — or developing new ones that might help people—that’s what’s truly rewarding as a doctor. There’s one way of talking about it, which is calling it innovative or revolutionary, and that’s fine. But what really matters to a doctor is being able to treat patients. The rewarding part, for me, is helping them. ■

Vivid Pioneer provides a clear path to early cardiac care

Advanced echocardiography enables early detection of congenital heart disease — supporting more informed planning and timely intervention. Vall d’Hebron Hospital offers a broad range of pediatric cardiac care that begins before birth and continues seamlessly into the neonatal period. We asked pediatric cardiologist Dr. Gemma Giralt to share her experience with Vivid Pioneer and treating patients during these critical stages.

Can you describe your role at Vall d’Hebron University Hospital?

Dr. Giralt: *I see patients from the prenatal stage up to 18 years old. In my position, I dedicate one day to fetal echocardiography consultations and two days to outpatient consultations. I perform advanced echocardiography, including both 2D and 4D TEE, in preoperative and perioperative settings, as well as TEE monitoring during hemodynamic procedures. Additionally, I spend two days managing patients with CHD admitted to the neonatal ICU.*

Congenital heart disease is a major focus for your team. How early can it be detected?

Dr. Giralt: *Typically, the most complex congenital heart defects can be diagnosed quite early with fetal echocardiography — as early as 16 weeks of gestation. As a referral center, we receive cases from many other hospitals.*

How do you assess the fetal heart for potential anomalies?

Dr. Giralt: *We evaluate the fetal heart using the five recommended views: assessment of visceral situs, inflow tracts (4-chamber view), aortic outflow tract (5-chamber view), pulmonary outflow tract (3-vessel view), and great vessels (arch view or “V” sign) — using both 2D imaging and color/pulsed Doppler. In select cases, we also assess myocardial function using strain imaging.*

What tools are most helpful in assessing the fetal heart?

Dr. Giralt: *I have been working with GE HealthCare’s Voluson ultrasound systems for 15 years. Our current model is the Voluson E10, and the image quality, color Doppler, and the introduction of Radiantflow are remarkable.*

As patients move from fetal diagnosis to neonatal care, cardiac imaging continues to guide decisions. How has Vivid Pioneer enhanced your clinical capabilities?

Dr. Giralt: *Vivid Pioneer’s 2D and 4D image quality are impressive. The image quality of the 6Sc-D probe is truly incredible, and it allows us to perform high-quality echocardiography even in patients with suboptimal or poor acoustic windows. Because the probe is more linear, it adapts better without the need to apply extra*

pressure, as it fits more naturally into the intercostal space. Clearly, this new probe allows me to perform much more optimal studies.

I love that Radiantflow has now been implemented in Vivid Pioneer. It defines flows very clearly, without overlap, providing a clean appearance while preserving tissue detail. It also shows a sense of volume. Additionally, AI Spectrum Recognition has improved significantly, allowing us to optimize and reduce scan time.

User experience is also important. What aspects of Vivid Pioneer’s design stand out most in your daily workflow?

Dr. Giralt: *Vivid Pioneer has a battery, which is very useful for transport and mobility within the hospital. The new control panel design is also much cleaner. Overall, the design is more user-friendly.*

Ferran Rosés, MD, MSc, is Head of the Pediatric Cardiology Department at Vall d'Hebron University Hospital in Barcelona. He specializes in congenital pediatric cardiology and electrophysiology. Dr. Rosés's research also includes an emphasis on arrhythmias and hereditary conditions, including catecholaminergic polymorphic ventricular tachycardia and long QT syndrome. He has co-authored more than 40 publications and contributes significantly to national and international journals and textbooks.

Gemma Giralt García, MD, is a specialist in Pediatric Cardiology at Vall d'Hebron University Hospital in Barcelona. Her clinical and research focus includes pediatric heart transplant rejection and genomic rearrangements in congenital heart defects. Dr. Giralt is also an active member of the Imaging Section of the Spanish Society of Pediatric Cardiology and Congenital Heart Disease, contributing to advancements in diagnostic imaging and pediatric cardiac care.

1 Thomas F. Lüscher, Congenital heart disease: some progress, but still the challenge of a lifetime!, *European Heart Journal*, Volume 38, Issue 26, 7 July 2017, Pages 2021–2023, https://doi.org/10.1093/eurheartj/ehx372.

2 Diller GP, Breithardt G, Baumgartner H. Congenital heart defects in adulthood. *Dtsch Arztebl Int*. 2011 Jul;108(26):452-9. doi: 10.3238/arztebl.2011.0452. Epub 2011 Jul 1. PMID: 21776319; PMCID: PMC3139408.

Dr. Rosés is a paid consultant for GE HealthCare and was compensated for participation in this article. The statements by Dr. Rosés described here are based on his own opinions and on results that were achieved in his unique setting. Since there is no "typical" hospital/clinical setting and many variables exist, i.e. hospital size, case mix, staff expertise, etc., there can be no guarantee that others will achieve the same results.

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Precise imaging in severe cardiomegaly with single ventricle

Courtesy of Ferran Rosés, MD, MSc, PhD, Head of the Pediatric Cardiology Department at Vall d'Hebron University Hospital in Barcelona, Spain

Patient overview

8 year-old boy, 28 kg, referred from another hospital in Barcelona

Cardiac diagnosis

- Left atrial isomerism
- Absent inferior vena cava
- Hemiazygos vein draining right superior vena cava (SVC)
- Persistent left SVC into coronary sinus (CS)
- Unbalanced atrioventricular septal defect (AVSD) – single ventricle
- Severe atrioventricular valve insufficiency
- Non-confluent pulmonary arteries
- Right sided aortic arch
- Post operative complete heart block

Interventions

- 18 days: Bilateral BT shunt
- 12 months: Bilateral Glenn
- 13 months: Mechanical mitral valve replacement
- 14 months: Single chamber epicardial VVI pacemaker

Clinical follow-up

- Patient developed severe single ventricle dysfunction
- NHYA III
- Referred for cardiac transplant evaluation

Clinical assessment and device used

- Not possible to perform CMR epicardial lead
- Severe cardiomegaly which made difficult to perform a correct deformation strain analysis
- GE HealthCare Vivid™ E95 R6 with 6S-D, M5Sc-D
- Vivid Pioneer with 6Vc-D, 4Vc-D and 6Sc-D
- EchoPAC to perform deformation analysis

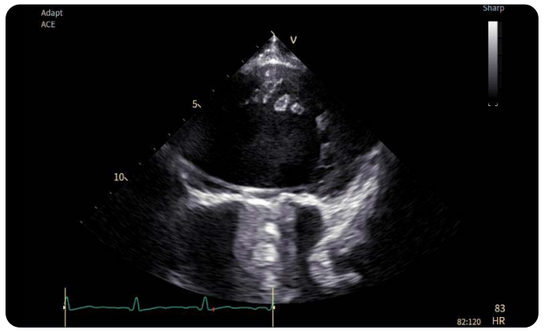
Conclusion & follow up

- Vivid Pioneer and 6Sc-D probe allowed perfect tissue visualisation in severe cardiomegaly in a single ventricle
- Reliable dyssynchrony assessment in single-ventricle cases is now possible with the 6Sc-D pediatric probe. Its ability to visualize all segments in large ventricles overcomes the limitations of traditional probes, enabling accurate 2D strain evaluation
- Strain analysis showed a clear dyssynchrony pattern induced by VVI pacing
- Findings supported the decision to upgrade to cardiac resynchronisation therapy implantable cardioverter defibrillator (CRT-D)

CT scanner showing single ventricle and pacemaker

Pre-op evaluation with Vivid Pioneer

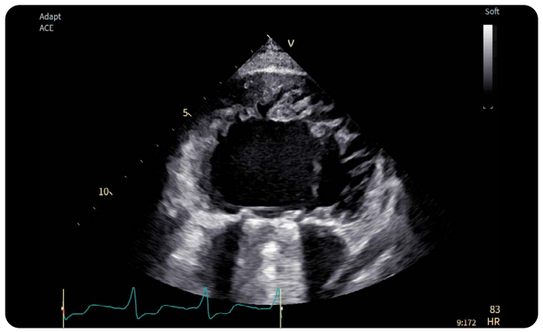
Good image quality and contrast; however, due to the complexity of the anatomy, visualization of the lateral wall remained challenging with the 6Vc-D and 4Vc-D probes



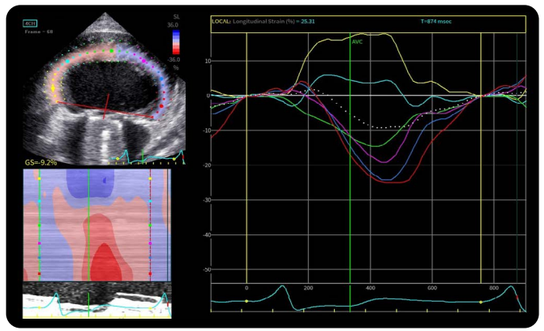
6Vc-D Probe

4Vc-D Probe

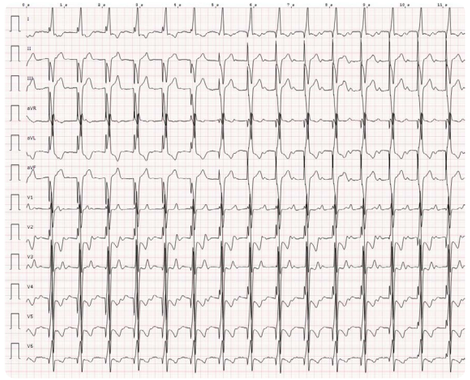
Pre-op evaluation with Vivid Pioneer and the 6Sc-D high frequency probe



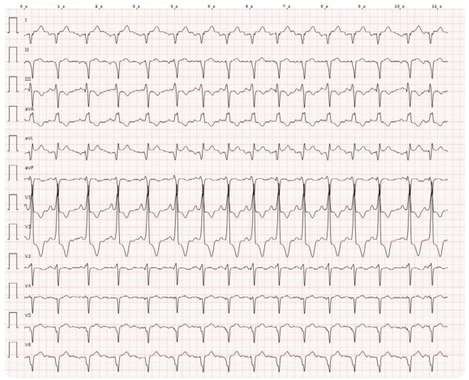
Excellent image quality, the 6Sc-D enables one single view to capture the whole image of the single ventricle while seeing the mitral valve very nicely.



Deformation 2D Strain Analysis with EchoPAC. Perfect tissue visualization of the whole single ventricle allowing reliable (and effective) 2D strain analysis.

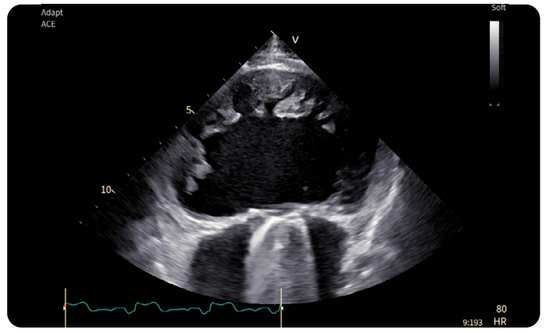


12 Lead ECG pre CRTP: QRSd 194 ms

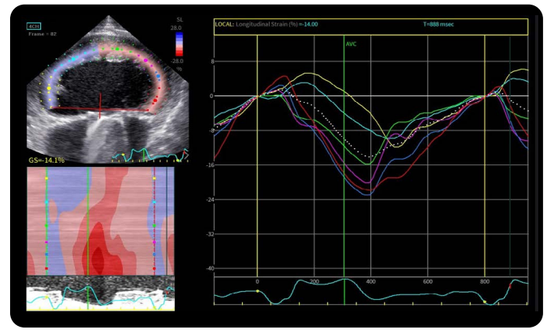


12 Lead ECG post CRTP: QRSd 151 ms

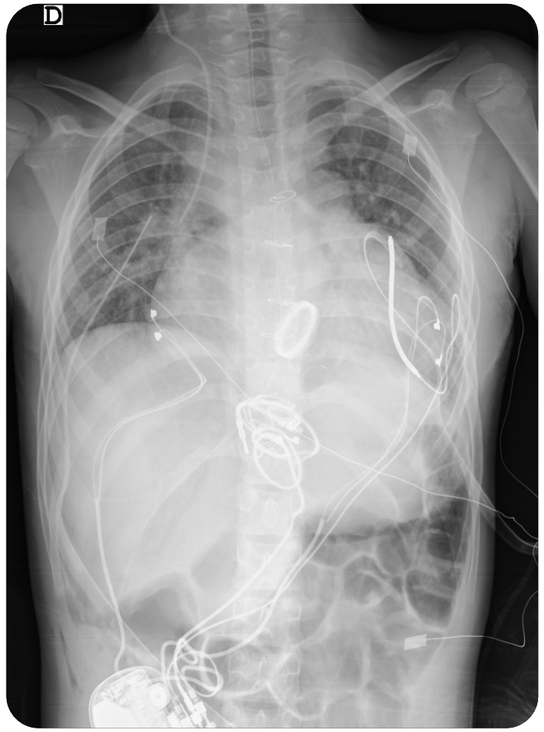
Post CRTP evaluation with Vivid Pioneer



Post CRTP



Strain post CRTP



CXR Post Op

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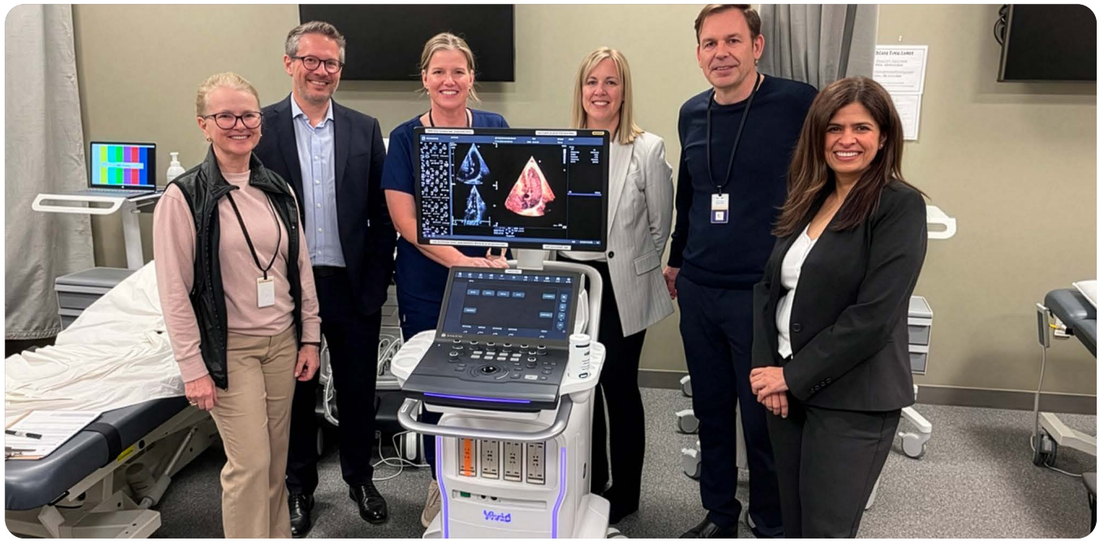
Interview: Amy Dillenbeck

Bold innovation that solves for sonographers

How Vivid™ Pioneer supports simple, efficient, and consistent scanning

Cardiac sonographers are at the heart of many diagnoses, capturing the images that can change lives. Their expertise is essential to quality care, yet the demand for skilled sonographers is increasing at unprecedented rates — leading to a shortage and strain on healthcare systems.[1] Under increasing pressure, institutions are exploring transformative technology in echocardiography. It's critical to find solutions that can ease everyday challenges by simplifying and streamlining scanning, while delivering greater consistency and confidence.



Amy Dillenbeck has spent more than 17 years on the front lines of cardiac imaging. She's the founder and Director of the School of Health Professions Cardiac Ultrasound, which is part of the Cleveland Clinic Hospital in Ohio. Dillenbeck works in a high-volume setting, with an estimated 450 exams performed daily — 15 to 20% of them conducted bedside. The hospital system operates with a fleet of 75 to 100 premium ultrasound systems, approximately half are Vivid platforms.

Dillenbeck says staffing shortages are just one of many stressors weighing on today's sonographers — pressures that need problem-solving. Faced with increasingly complex cases and technically-difficult patients, she wants technology that can help balance the need for high-quality images with heavy caseloads and the demand for faster, more efficient care. Another priority is closing the gap between new and experienced sonographers to help minimize ongoing issues like interobserver variability.

Dillenbeck is among the first to experience GE HealthCare's Vivid Pioneer ultra-premium cardiovascular ultrasound. We recently asked Dillenbeck to share her experience scanning with Vivid Pioneer and what the new technology could mean for sonographers.

What's the hardest part about being a sonographer today?

Dillenbeck: *We struggle with balancing quantity with quality and I think it's a challenge that is faced across the country. The issue is figuring out how we can find a way to make both work together. In healthcare, everyone is understaffed and overworked and there's an increasing demand for more studies, images, and advanced imaging techniques. Solving for interobserver variability is also an issue because we want our data to be accurate. The challenge is trying to meet all the expectations. I think a lot of it comes down to efficiencies and workflows. Finding ways to work smarter.*

> *"It's critical to find solutions that can ease everyday challenges by simplifying and streamlining scanning, while delivering greater consistency and confidence."*

You have a huge fleet of ultrasound systems. What are you looking for in a premium ultrasound platform?

Dillenbeck: *The number one thing is good quality imaging without having to work hard to get nice images. I've worked on systems where you need to adjust so many knobs and adapt for different variables and parameters to get a pretty image. I'd like a system where you put the transducer on the chest, find the right window, and the system optimizes the image — regardless of operator experience.*

Having a system that is intuitive is another priority. You don't want to feel like you're thinking too much, or trying to figure out where the knob is, or how to optimize. As a sonographer, you want to keep coasting, gliding, and intuitively know what to do next.

You currently work with the Vivid E95 system and have now experienced Vivid Pioneer. How would you describe the new platform in a few words?

Dillenbeck: *The technology is just getting better and better. Every version of the system is a better version because of the advancements. I'd describe Vivid Pioneer as forward-thinking innovation. I was blown away by the image quality and ease to get that quality.*

Enhancing image quality was a core focus of the new Vivid Pioneer. Can you elaborate on your experience?

Dillenbeck: *I think the image quality is really outstanding and with less effort. The Vivid E95 is a great system, and with Vivid Pioneer, you're adding a lot more technology and options for optimization — which makes a big difference.*

I'd describe it like I just got a new pair of glasses. With the Vivid E95, it was pretty nice and I could see things pretty well, but then you try Vivid Pioneer. Wow, it's like a whole other world. You put the glasses on and everything is so crisp and beautiful. I didn't realize it could be this good and what I've been missing.

> *"I'd describe Vivid Pioneer as forward-thinking innovation. I was blown away by the image quality and ease to get that quality."*

For the 2D aspect, it has better spatial resolution. For tissue characterization, the images are more crisp and more defined compared to the Vivid E95 version, and I don't need to adjust a lot of knobs. It's a benefit when you can see with less effort. The tissue really pops and you get really good definition with the endocardium and the myocardium.

In some systems, when you switch from 2D to 3D or 4D, the quality of your 2D image degrades, but that doesn't happen with Vivid Pioneer. From the start, you get high-quality images, which really helps your 3D image. That's one thing I'm really excited about — there's no degradation in image quality and the 3D is phenomenal.

> *"You put the glasses on and everything is so crisp and beautiful. I didn't realize it could be this good and what I've been missing."*

How would you describe the Color Flow and color Doppler?

Dillenbeck: *It's more precise, crisper, and trustworthy. The Color Flow now looks more saturated so you can be more confident in the results because the Color Flow is keeping up and fills the chamber and the LVOT. We are seeing precise jets that are easier to find, better defined, and more measurable.*

I think it's going to be helpful when grading severity of regurgitation. It will also make it easier to measure anatomy like the vena contracta. The width of the jet is clearer so you don't feel like you're missing anything. Having really precise, crisp, defined tissue characterization will also help when measuring patients for their LV dimensions in the parasternal.

Can you describe your experience with the 6Sc-D probe and how could it be an advantage in everyday practice?

Dillenbeck: *The 6Sc-D probe allows us to reach a depth of 15 to 20 centimeters and still have high-quality imaging. We were able to do a full study on a 200-pound patient with great tissue characterization, Color Flow, and Doppler. It's also exciting because of the smaller footprint and the ability to scan between ribs—which is helpful for pediatrics and older, petite patients. Plus, in terms of handling, it's a little lighter, so this is a good alternative to a traditional probe.*

> *"You can be more confident in the results because the Color Flow is keeping up and fills the chamber and the LVOT. We are seeing precise jets that are easier to find, better defined, and more measurable."*

Image quality is the foundation for AI-driven insights. How does Vivid Pioneer's image quality give you more confidence in AI and automated measurements?

Dillenbeck: *When you're confident in what you're seeing and the images you're getting, and you don't have to adjust all the settings, you'll feel more confident in where you're labeling and defining borders and dimensions, and when you're getting your measurements. I think it really helps with the clinical evaluation.*

> *"We were able to do a full study on a 200-pound patient with great tissue characterization, Color Flow, and Doppler."*

Solving for interobserver variability is a priority because we want to be as accurate as possible with the data. Letting the system work automatically reduces the need to modify data and I think leads to more accurate results.

You have described many enhancements. How could these added capabilities impact your everyday workflow?

Dillenbeck: *There are a few things that sonographers will notice immediately. The first is efficiency. We waste a lot of time trying to optimize images. With Vivid Pioneer, I feel like we won't need to spend 30 seconds to a minute trying to optimize each image — and that will be huge because we take 100 or more images in our study. Having a good baseline image from the start with Vivid Pioneer will be super helpful. And the system's AI and other instruments will improve workflow, too.*

I also believe it will absolutely help collaboration — the more trust the reader has in the images and seeing the sonographer's abilities, the better the relationship, and reading and interpreting. And I think this technology will be priceless for people early in their careers because the optimization will build confidence.

The last part has to do with ergonomics — the impact on the body from pushing. Our studies are getting longer and more complex. Condensing studies because images are coming up quickly and optimizing efficiently will put a lot less strain on shoulders, necks, and backs. I also think newer sonographers won't feel the need to push as hard to get a good image, which could help reduce injuries and support longer careers.

Designed with ergonomics in mind, Vivid Pioneer is lightweight, weighing just 104 to 110 kgs. What is your perspective on the portability of the system?

Dillenbeck: *The body of the Vivid Pioneer is smaller and more compact than other systems — it's really impressive. Even without touching it, Vivid Pioneer looks more ergonomic and user-friendly.*

We work in a very large hospital with multiple buildings, so traveling for bedside exams can be challenging. Sometimes, you almost need a running start just to get up the ramps. Vivid Pioneer moves easily, which is especially helpful in ICUs where you need to work around dialysis and lung machines. The system's small footprint lets you squeeze into tight spaces,

> *"It will absolutely help collaboration—the more trust the reader has in the images and seeing the sonographer's abilities, the better the relationship, and reading and interpreting."*

eliminating the need to extend your arms to reach patients during exams. That can make a big difference in protecting arms and shoulders. It really makes for a nice bedside experience while keeping the quality of the larger systems.

> *"Condensing studies because images are coming up quickly and optimizing efficiently will put a lot less strain on shoulders, necks, and backs."*

Vivid Pioneer features a battery support with standby and power interruption modes. What are the main benefits and how could it impact your practice?

Dillenbeck: *I think it's going to be a huge benefit bedside, for stat situations, cath labs, and operating rooms — anywhere you need to get in quickly, get your images, and then get out. You can save time because you don't have to boot up the system again.*

> *"Vivid Pioneer moves easily, which is especially helpful in ICUs where you need to work around dialysis and lung machines. The system's small footprint lets you squeeze into tight spaces, eliminating the need to extend your arms to reach patients."*

Vivid Pioneer offers a simplified user interface with a customizable workflow. How would you describe the user experience?

Dillenbeck: *I really like that Vivid Pioneer is so intuitive. It's similar to the Vivid E95 platform if you're used to it, but it's also improved. You have eliminated some of the buttons and most of the others now have icons instead of words, making them easy to follow. They're also located in one central location, making the Vivid Pioneer system very intuitive*

Transitioning to a new echocardiography system can bring challenges. What was the learning curve like for you?

Dillenbeck: *As a sonographer, one of the fears of trying out a new system is that you won't be as fast or it won't be as intuitive. That is not the case with Vivid Pioneer. From the day I started, within one study, I was using it without even looking.*

There will be a learning curve if you have never used a GE HealthCare system before, but the transition can definitely happen within a few studies. Vivid Pioneer has a little bit different look than other systems, but I think you could go back and forth easily.

Vivid Pioneer makes your life so much easier. I can see sonographers fighting over it. ■

> *"Vivid Pioneer makes your life so much easier."*

Amy Dillenbeck, MS, ACS, RDCS, RCS, FASE is the Director & Instructor at the School of Health Professions Cardiac Ultrasound Program at the Cleveland Clinic in Ohio. Dillenbeck, who has more than 15 years of experience in cardiac sonography, specializes in curriculum development, teaching, and driving quality improvements in cardiac ultrasound practices. She leads US training sessions and chairs educational programs, committed to fostering growth and pushing innovation in echocardiography.

1 White Paper from 2024 Consensus Committee on the Future of Medical Imaging and Radiation Therapy, *American Society of Radiologic Technologists*, last modified Oct. 30, 2024 https://www.asrt.org/docs/default-source/research/whitepapers/2024-consensus-committee-on-the-future-of-medical-imaging-and-radiation-therapy.pdf?sfvrsn=1f869819_12

The statements by Amy Dillenbeck described here are based on her own opinions and on results that were achieved in her unique setting. Since there is no "typical" hospital/clinical setting and many variables exist, i.e., hospital size, case mix, staff expertise, etc. there can be no guarantee that others will achieve the same results.

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Early experience with the new Vivid™ Pioneer ultrasound system

Assessing image quality, workflow efficiency, and usability

As cardiovascular imaging continues to evolve, today's clinicians are seeking tools that keep pace with rising clinical complexity and relentless workflow demands. With more patients and more pressure every day, true innovation must pair precise imaging with greater simplicity, consistency, and speed across all areas of echo.

Dr. Akhil Narang is the Director of the Echo Lab and a vital member of the structural heart imaging team at one of the largest Echo Labs in the US. His institution treats more than 75,000 patients annually across cardiac surgery, heart failure, interventional procedures, and cardiac rehab, performing over 2,700 cardiac surgeries per year. The echo lab is equally robust, conducting more than 2,700 echoes monthly — including TTE, TEE, and stress echoes — totaling an estimated 35,000 echoes annually.

Dr. Narang has an extensive background with Vivid E95 ultrasound systems and recently experienced the next-generation Vivid Pioneer platform. We sat down with Dr. Narang to get his perspective on the new Vivid Pioneer and what it might mean for cardiovascular care.

As a leader of a high-capacity echo lab, how does a heavy caseload impact your workflow and technology needs?

Dr. Narang: *We are the biggest and busiest echo lab in the Chicagoland area and one of the largest in the country with a robust team of dedicated cardiac imagers. We also have one of the busiest structural heart programs in the country in both surgical volumes and transcatheter volumes.*

High volume necessitates operational efficiency. From the echo lab standpoint, that means we are pretty regimented in terms of the amount of time we schedule for an echocardiogram, the sonographer to complete the exam, and do the report. We are specific in terms of the metrics we want sonographers to achieve so we don't fall too far behind.

We also face staffing limitations. We are well staffed when it comes to physicians, but sonographer staffing has been a bigger challenge. We rely on different agencies to help fill the gaps, with many sonographers coming in on several-month assignments and some contracts extended for a year. That's why it's critical for us to have an ultrasound system that reduces variability and improves reproducibility across users to effectively scale across all areas of echo.

You are among the first to experience the new Vivid Pioneer. How would you describe the overall image quality?

Dr. Narang: *I think the new Vivid Pioneer platform has made significant strides in improving image quality compared to the Vivid E95 — particularly in 2D, Color Doppler, and 4D imaging. There have also been notable improvements in respect to tissue and blood pool differentiation, and contrast resolution. I found the grayscale to be crisper with sharper borders and less noise. The color imaging was improved as well, with less bleed and speckling noted. I think the advances allow for greater accuracy when evaluating valve disease, especially in a complex setting.*

What is your impression of Vivid Pioneer's 2D image quality in the context of structural and valvular assessment?

Dr. Narang: *The 2D image quality was very impressive, with finer delineation of structures — particularly native valves and implanted devices. You could really see subtle features. When it comes to valvular anatomy, like the subvalvular apparatus and chordal structures, the leaflets appeared much cleaner. It was also easier to see the endocardial border definition, which improved assessment of LV and RV function. Overall, there was less bleeding of the grayscale. I thought it was all really outstanding and preserved across single plane and biplane imaging as well.*

How would you describe the probe technology: both the 4Vc-D probe and the new 6Sc-D probe?

Dr. Narang: *From my initial experience with the 4Vc-D probe, I thought the 2D imaging was great — there was no question about that. There was enhanced differentiation between blood pool and tissues, particularly with 2D imaging, and the Color Doppler was definitely superb. I thought the Color Flow was also very smooth with better spatial resolution — fewer blooming artifacts. This is really a step in the right direction in terms of image quality.*

With the 6Sc-D probe, the image quality was excellent with great near and far field resolution. I didn't perform any exams with the probe, but I held it and it felt very ergonomic. Overall, the Vivid Pioneer felt like a premium system, and I think it will also give you a lot of confidence in imaging.

> *"The 2D image quality was very impressive, with finer delineation of structures — particularly native valves and implanted devices. You could really see subtle features."*

You mentioned some enhancements to the Color Flow technology — could you please share what improvements you've noticed?

Dr. Narang: *In the new Vivid Pioneer, the Color Flow is clean and you are able to focus on the localization of the jets. The rendering is completely different in how the imaging is displayed, and overall, it's quite good.*

I only observed a few demonstrations of the Radiantflow™ feature. It offers a sort of three-dimensional rendering of what the jet will look like in Color Flow. Theoretically it could be very helpful for jet localization.

Shifting to 4D imaging — how would you describe the quality and your experience with Vivid Pioneer?

Dr. Narang: *I think the 4D rendering — especially of valves — is improved compared to the prior Vivid E95 platform. It was outstanding for the aortic valve. Depth perception was noticeably better, and the surface detail of the valve leaflets was more nuanced. That's especially important for valve interventions — whether it's mitral, tricuspid, aortic, or left atrial appendage — because it really enhances how you visualize the tissue and understand the spatial relationships in four dimensions.*

High-quality imaging is the cornerstone for trustworthy AI-powered analysis. Do you think improvements in Vivid Pioneer's image quality can enhance confidence in its smart tools?

Dr. Narang: *There's no doubt that precise imaging and excellent image quality allow for the rest of the smart tools. Automation, measurement, multiplanar reconstruction — it all rests on good 2D image quality and builds on that foundation. Image quality and resolution are always the underpinnings of ultrasound accuracy.*

One of those smart tools is AI Cardiac Auto Doppler. How useful is the feature in everyday practice, particularly for regurgitant measurements?

Dr. Narang: *When you get a Doppler measurement, the sonographer or cardiologist typically has to measure all the Doppler tracings, which can be very time consuming when done manually.*

> *"Depth perception was noticeably better, and the surface detail of the valve leaflets was more nuanced. That's especially important for valve interventions — because it really enhances how you visualize the tissue and understand the spatial relationships in four dimensions."*

The AI Cardiac Auto Doppler tool is really good because it automatically measures, averages results, and you can select specific beats to interpret, so it really saves time and improves workflow.

By standardizing measurements, the AI Cardiac Auto Doppler in many ways takes the human variability out of the equation — which is really important. The nice thing about the system is that the person acquiring and interpreting the images can still decide whether or not to accept the auto tracings. But from my experience, Vivid Pioneer does an excellent job, and there's very little changes that need to be made.

The AI Cardiac Auto Doppler helps in valve disease because it can trace VTIs and trace the continuous Doppler signal. It aids in the assessment of diastolic function because it traces the deceleration time, measures the E, the A wave, the E primes — all the elements required for assessment of valve disease. If those measurements are inaccurate or there's variability in interpretation, your assessment of disease severity is going to be incorrect.

The structural heart space is rapidly evolving, and GE HealthCare is working to push the boundaries in this area — with Vivid Pioneer representing the next step forward. How do you think it delivers on image quality and workflow?

Dr. Narang: *The first thing that stood out was the assessment of valve lesions and color imaging. Previously, this area was lagging behind, but Vivid Pioneer shows clear improvement. I felt Vivid Pioneer offered a more precise evaluation of valve regurgitation, which in turn gives you greater confidence during procedural steps, post-procedure, assessing valve, residual valve disease or residual regurgitation.*

Additionally, some of the smart tools built into the system also make it a competitive product. It automates many steps, particularly measurements.

> *"By standardizing measurements, the AI Cardiac Auto Doppler in many ways takes the human variability out of the equation — which is really important. The nice thing about the system is that the person acquiring and interpreting the images can still decide whether or not to accept the auto tracings. But from my experience, Vivid Pioneer does an excellent job, and there's very little changes that need to be made."*

> *"I felt Vivid Pioneer offered a more precise evaluation of valve regurgitation, which in turn gives you greater confidence during procedural steps, post-procedure, assessing valve, residual valve disease or residual regurgitation."*

Standard measurements typically performed by sonographers or echocardiographers can now be completed on the cart system with just the click of a button.

Improvements in features like FlexiSlice, 2-Click-Align, and the LAA Workflow Suite, along with updates to existing quantification tools and mitral valve visualization tools — make this a better system. It simplifies operations and leads to efficiency across the entire echocardiography workflow — from image acquisition to interpretation. The better the workflow, the easier it is to adopt and integrate into day-to-day practice. I think Vivid Pioneer does that, and it really helps improve imaging.

The bottom line: Improved image quality is the first step in feeling confident about using Vivid Pioneer in structural heart, and I think that's been accomplished here. Vivid Pioneer will be a game changer in structural heart — and the fact that GE HealthCare invests in workflow improvements makes a big impact.

Expanding on workflow — which new interventional tools made the biggest impression on you in this area?

Dr. Narang: *I was particularly impressed by the LAA workflow tools [AI FlexiViews LAA, LAA sizing, and device compression tools]. They are helpful for sizing, measurement, procedural planning, and guidance. It's really as simple as acquiring the image. As long as the left atrial appendage is in the field of view in 3D, you are good to go. I found it to be both practical and valuable for implanters and imagers during cases.*

> *"The bottom line: Improved image quality is the first step in feeling confident about using Vivid Pioneer in structural heart, and I think that's been accomplished here. Vivid Pioneer will be a game changer in structural heart—and the fact that GE HealthCare invests in workflow improvements makes a big impact ."*

I also had a chance to observe the workflow of the LAA sizing and compression tools. The tools support a structured, repeatable workflow that can be standardized, which is especially valuable for newer users. The standardization can help with consistency and reduce variability.

Could leveraging AI in image acquisition benefit newer users who are trying to master multiplanar reconstruction (MPR)?

Dr. Narang: *MPR takes some time to learn. Part of the battle is just setting up the views and clicking through the right buttons before you can even start doing any useful measurements or guidance. So the fact that it can now be done automatically for the left atrial appendage is a big help, especially for those still learning the process. It removes one step they'd potentially have to master during a procedure or a screening case.*

> *"I was particularly impressed by the LAA workflow tools. They are helpful for sizing, measurement, procedural planning, and guidance. It's really as simple as acquiring the image."*

With images automatically generated with AI FlexiViews LAA, users can focus more on understanding the anatomy and morphology of the LAA. Then, as they gain experience, they can start thinking more about how to further optimize things manually. In a busy echo lab, this kind of automation can really help novice users feel more confident using tools like FlexiSlice.

Vivid Pioneer also introduces a new TSP Height Tool, designed to help identify the ideal transseptal puncture location in just two clicks. What were your impressions and thoughts on its potential impact?

Dr. Narang: *A critical step in transcatheter mitral valve intervention is ensuring you have adequate left atrial height or transseptal puncture height. There's definitely a science to this, but also an art. Helping users optimize their height for a transseptal puncture is critical. Without taking the time to get it right — which many tend to rush — you can end up with suboptimal height, making the transcatheter procedure significantly more challenging.*

Any quick tool that can provide a precise measurement is extremely helpful — especially when the interventional cardiologist is asking, 'What's the height at this particular location?' Having that readily available would definitely support the procedure. No question about it.

Did you observe any meaningful updates to tools you've used in the past?

Dr. Narang: *I think the FlexiSlice feature has improved. It really goes hand in hand with the 4D imaging — the better the 4D rendering, the better the visualization you get from the FlexiSlice tool.*

The important thing about the FlexiSlice tool is that it provides 2D reconstructions from a 4D image, and I found those 2D images to be quite good — noticeably improved from previous versions. They felt comparable to what we're seeing from standard 2D images, even without doing a 3D acquisition and post-processing. That can be especially helpful in valve interventions — enhancing confidence for transcatheter interventions.

> *"The important thing about the FlexiSlice tool is that it provides 2D reconstructions from a 4D image, and I found those 2D images to be quite good. They felt comparable to what we're seeing from standard 2D images."*

The new Vivid Pioneer is lightweight, weighing just 104 to 110 kgs. What are your thoughts on the system's portability and role in day-to-day workflow?

Dr. Narang: *The footprint of the machine is smaller, feels more compact and streamlined than the Vivid E95, which improves portability. I actually moved it around myself, and that was great. The Vivid E95 is bigger and a bit more difficult to maneuver in a hospital setting. Sometimes you've got to squeeze into tight spaces — whether it's an OR, a cath lab, an emergency room, or an ICU filled with equipment. So having a system that's easy to move around is definitely important.*

New perspective: exploring Vivid Pioneer in the cath lab

Another important way to evaluate Vivid Pioneer's impact is by assessing its performance in real-world clinical settings. Dr. Narang gained deeper insight into the system's capabilities by reviewing a percutaneous tricuspid annuloplasty case study by Professor Marta Sitges. He also observed its use during a complex mitral edge-to-edge repair performed by Dr. Laura Sanchis at Hospital Clinic Barcelona, Spain.

Tricuspid valve case study

You reviewed a case report on a tricuspid annuloplasty procedure utilizing Vivid Pioneer. How would you describe the system's performance in terms of image quality?

Dr. Narang: *Tricuspid annuloplasty in Europe is done very well with a lot of high level expertise and I recall seeing one case completed in under an hour. This procedure is typically performed with 2D imaging, but in this case, 4D imaging was used as well, and the image quality was excellent.*

The clarity of the annular structure and adjacent valve tissue allowed for a better assessment of device and tissue interaction — which is the key step in this procedure. You want to make sure your anchors are inserted into the annulus and not the leaflet tissue. The 4D rendering that they used during the procedure was actually quite good as well. It gave a lot of confidence in the accuracy of device positioning and implantation, so it was very impressive.

Are there any specific capabilities that would enhance the procedure?

Dr. Narang: *I think it's really the 2D imaging that plays the most important role in tricuspid annuloplasty procedures. While 4D can be a helpful adjunct, the strength lies in high-quality 2D with biplane imaging, which allows you to clearly visualize the annular structure and differentiate tissue. I think that's what facilitates easier implantation.*

Mitral valve procedure

You observed a mitral valve edge-to-edge repair procedure with Vivid Pioneer. How would you evaluate the system's performance in terms of image quality?

Dr. Narang: *It was good and Dr. Laura Sanchis did a wonderful job imaging the valve throughout all the procedural steps — from the baseline assessment, the transeptal puncture, clip positioning, to leaflet grasping. Everything went smoothly, despite it being a challenging case and having to redo the transeptal puncture.*

She used FlexiSlice throughout the procedure, which helped in terms of streamlining the procedure by eliminating the need to go in and out of 2D and 4D imaging, and expedited decision making.

You mentioned that it was a challenging case. How so?

Dr. Narang: *The challenge was attributed to the patient's anatomy, not any limitations in image quality. With the enhanced resolution of the TEE —in my opinion, if I was doing the procedure — I can see how it may really help and improve my confidence with the transseptal puncture, assessing leaflet anatomy, and device orientation. If the image quality was challenging, this could have been a much more difficult case.*

Through this lens, how would you compare Vivid Pioneer to the prior system?

Dr. Narang: *The Vivid E95 platforms have obviously been a great workhorse for GE HealthCare, but there's noticeable improvement in the imaging quality with Vivid Pioneer for sure.*

Vivid Pioneer features a simplified user interface, digital TGCs, and customizable options. How would you describe the user experience?

Dr. Narang: *The interface is definitely cleaner and it feels more intuitive than previous iterations. It has a nice big screen, the button layout is nice, and the navigation feels easier and more customizable. Overall, it really gives the impression of a high-end product.*

For the TGCs — I know it's a little controversial, and I went back and forth on it myself. Initially, I didn't think I'd like it, but honestly, it wasn't a big deal. There are fewer physical buttons on the screen, and to me, that's fine. I know some users really value the tactile feedback because it's familiar and allows them to navigate using both hands more instinctively. But as we shift into a more digital, touchscreen-driven era, I was comfortable with the new setup. Plus, there were some nice presets — including customizable TGC contouring — which I think will help ease the transition for others as well.

> *"I think customization is really important — especially from a cardiologist's perspective. A lot of people want the ability to build their own workflows into the system. From what I've observed, everyone has slightly different approaches, so having that flexibility can be incredibly helpful."*

I think customization is really important — especially from a cardiologist's perspective. A lot of people want the ability to build their own workflows into the system. From what I've observed, everyone has slightly different approaches, so having that flexibility can be incredibly helpful.

Vivid Pioneer includes a power interruption mode—in the event of accidental disconnection or power loss, the system continues scanning up to 5 minutes. What's the value of this feature in your clinical settings?

Dr. Narang: *It's a very helpful feature. In the cath lab or tight spaces, cords can easily get pulled or tripped over — it's happened to all of us, and it's very disruptive. It can take us 10 or more minutes to recover and get back to where we were, and can also create safety concerns. So having a power interruption mode is definitely valuable. And being able to unplug the system and still have 5 minutes of battery life is really helpful — especially for someone who needs to move quickly from one area to another.*

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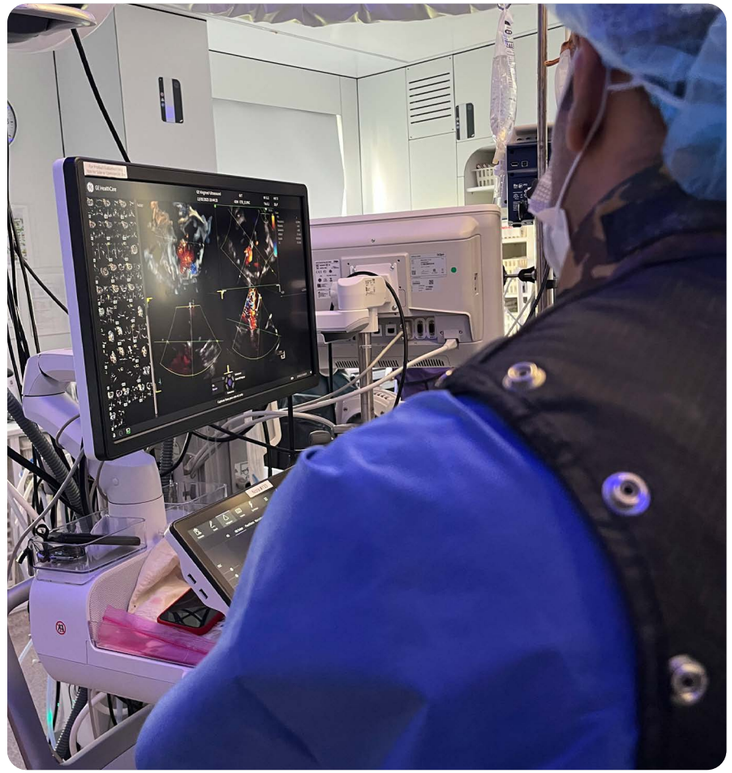
Bringing everything into focus, how would you best describe Vivid Pioneer to your peers?

Dr. Narang: *I think Vivid Pioneer is a combination of comprehensive improvement in image quality and post-processing tools, coupled with enhanced workflow via automation and artificial intelligence.*

For sonographers, I would mention that it's a premium system with enhanced tools and advanced post-processing software that will allow for improved workflow, enhanced imaging quality, and an enjoyable scanning experience.

For physicians, Vivid Pioneer offers substantial improvements in image quality, particularly for TEE. The enhancements in valve assessment will allow for greater confidence in all aspects of transesophageal echocardiography, including structural heart evaluation. ■



Akhil Narang, MD, FACC, FASE, FSCMR, is a cardiologist and expert in advanced cardiovascular imaging at Northwestern Medicine and an Assistant Professor of Medicine at Northwestern University Feinberg School of Medicine in Chicago. He serves as Director of the Echocardiography Laboratory and plays a key role in the structural heart imaging team, collaborating closely with interventional cardiology and cardiothoracic surgery. Dr. Narang specializes in echocardiography, cardiac MRI, CT, and structural and valvular heart disease imaging. He is actively involved in clinical research, including trials on emerging imaging technologies and structural heart interventions, and has authored numerous peer-reviewed articles, book chapters, and papers.

Dr. Akhil Narang is a paid consultant for GE HealthCare and was compensated for participation in this article. The statements by Dr. Akhil Narang described here are based on his own opinions and on results that were achieved in his unique setting. Since there is no "typical" hospital/clinical setting and many variables exist, i.e., hospital size, case mix, staff expertise, etc., there can be no guarantee that others will achieve the same results.

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Precision and performance under pressure

How Vivid™ Pioneer powers confidence in complex structural heart interventions

Thanks to breakthroughs in transcatheter therapies, cardiac patients once thought untreatable can now receive life-saving care. As the number and complexity of these interventional procedures continue to grow, so does the demand for clear, immediate, and precise imaging. At the core of it all is cardiovascular ultrasound — foundational for dependable planning and confident intraprocedural guidance.

For the team at Hospital Clínic de Barcelona in Spain, today's innovations must provide real-time answers in a dynamic, real-world setting. It's not enough to be right — echocardiographers also need to be fast. From high-stakes interventions to the seemingly routine, Professor Marta Sitges and Dr. Laura Sanchis emphasize the ongoing importance of tools that deliver both accuracy and speed.

The innovation mindset is deeply rooted in their hospital's emphasis on clinical research and its role as a testing site for new technologies.

The Cardiovascular Institute at Hospital Clínic serves as a tertiary care center for all types of cardiovascular diseases for a 2-million-inhabitant population and as a national referral center for heart transplantation, mitral valve repair, pulmonary hypertension, inherited heart disease, and adult congenital heart disease. The department manages more than 40,000 patient visits and performs 1,400 vascular surgery interventions, 900 cardiac surgeries and 2,900 percutaneous procedures annually — including TAVI, mitral, and tricuspid valve repair. Echocardiography is a cornerstone of care, with an estimated 19,000 echo exams performed each year.

The team at Hospital Clínic was among the first to explore the capabilities of the new Vivid Pioneer ultrasound system. We joined Professor Sitges and Dr. Sanchis for a busy day of cases to see the ultrasound system in action — and hear how it's impacting their clinical care.

How does working in a high-pressure cath lab setting shape your workflow and imaging needs?

Prof. Sitges: *Having higher precision and higher image quality gives you more details about cardiac anatomy and function, which is crucial in the cath lab. We need that level of detail because this is a very dynamic process. We might have a perfect idea of what's going on from the initial echo, but once we're in the cath lab, everything can change. We are working on a living heart, so we really need to understand all the details — and what's happening at every moment.*

The other important thing is that we need those details fast. In the echo lab, you can be very precise — getting great images with post-processing, but that can take 10 minutes. In the cath lab, you have 10 seconds. The interventionalist needs immediate answers.

Dr. Sanchis: *It's very important for our patients that we are efficient — especially in the cath lab, where you need to quickly change views to locate a device or wire. It's essential we can achieve all the images we want very fast without post-processing — just live.*

Given the demands of interventional cardiology — especially around precision and speed — what were your initial thoughts on Vivid Pioneer?

Prof. Sitges: *Our first impression was, 'Wow, this is even better than the Vivid E95.' Vivid Pioneer is a step further in improving image quality and gaining speed — with faster, easier tools, and a more user-friendly interface. We were also happy to have this high-quality image in a compact system that was easier to move.*

Dr. Sanchis: *For me, Vivid Pioneer has higher image quality and faster tools. There are enhancements — the 2D and 4D are nice, and the Color is better — but the main difference is improved imaging with the FlexiSlice tool (MPR).*

> *"Our first impression was, 'Wow, this is even better than the Vivid E95.' Vivid Pioneer is a step further in improving image quality and gaining speed — with faster, easier tools, and a more user-friendly interface. We were also happy to have this high-quality standard in a compact system that was easier to move."*

Prof. Sitges: *I also think with Vivid Pioneer, we gain a lot of simplicity in the workflow, without sacrificing the tools, robustness, or precision of the system. So, it's getting simpler, but with the very high standards of image quality and very supportive tools for the cath lab. It's really focused on making the user's life much easier.*

Building on what you've already shared, what are your thoughts on the overall image quality and the 6VT-D probe?

Prof. Sitges: *We were used to very good image quality with the Vivid E95 system and we were really happy to see that this was even better. I was astonished when I could see the precision on some images — the different parts of some devices in the cath lab. So there was really precise imaging, which I had never seen before.*

We were really impressed by the detailed and precise imaging of the 6VT-D probe, especially during complex structural heart cases. For example, in several edge-to-edge repair cases and tricuspid valve replacement procedures

— where precision is critical — we really need to clearly see the valve leaflets. Sometimes that's challenging, but with the 6VT-D, the imaging was very precise. What was more astonishing was the ability to clearly distinguish the different parts of the delivery system, which is crucial for some complex procedures like tricuspid valve replacement and annuloplasty.

We performed a tricuspid annuloplasty procedure where we could perfectly distinguish the differences between the guiding catheter, the spool, and other parts of the device — to ensure the procedure was fast, fluid, and ultimately successful. The main challenge of this procedure is placing different anchors in the annulus of the tricuspid valve. With Vivid Pioneer, there was a significant step forward in evaluating the different parts of the device. It was good with Vivid E95, but this was much better. Vivid Pioneer is really a step further and something we haven't seen before — so really a breakthrough.

> *"I also think with Vivid Pioneer, we gain a lot of simplicity in the workflow, without sacrificing the tools, robustness, or precision of the system. So, it's getting simpler, but with the very high standards of image quality and very supportive tools for the cath lab. It's really focused on making the user's life much easier."*

> *"With Vivid Pioneer, there was a significant step forward in evaluating the different parts of the device. It was good with Vivid E95, but this was much better. Vivid Pioneer is really a step further and something we haven't seen before — so really a breakthrough."*

Dr. Sanchis: *With Vivid Pioneer, we can really have a very nice understanding of the anatomy. You can be very precise looking at the subvalvular apparatus for example. Whether there is indentation, endocarditis, or a hole, now it's something that you can understand from the very beginning of the echo. Now you can see it, so it's great.*

With the 6VT-D probe, the 2D visualization and the 4D are very good. With 4D Color, you can see the location of the jets precisely. You can also use FlexiSlice in real-time and you don't have to worry about the probe overheating. I think it's very important that you don't need to stop using the probe or freeze the image to reduce the temperature of the probe, and the quality of the imaging stays reliable during the entire intervention. So, I think the imaging has improved a lot, especially 2D and FlexiSlice.

I'd also point out that visualizing heart valves in echocardiography can sometimes be challenging, especially the tricuspid valve, due to its location in the far field. With the new tools, we now have improved visualization of this area.

How would you describe the improvements in Color Flow with Vivid Pioneer? What stood out most to you during your cases?

Dr. Sanchis: *The Color in 2D is better than the Vivid E95. With Vivid Pioneer, you can see the jets better and you don't see any splash, so I really like the changes in the color. The 4D is better now than the Vivid E95 and also the 4D Color is quite precise when you put it in 4D. You can really narrow the areas of the regurgitant jet and the orifice, so I think the visualization of the jets is especially nice. I really like that you can isolate the color indicating flow toward or away from you because you can see the complete jet, especially when they are eccentric.*

Prof. Sitges: *Color Flow is better than before because we have a denser image of the flow, and now 4D Color Flow offers high-quality imaging combined with a higher frame rate than before. I think this is another step forward in the visualization of residual leaks.*

We also have the new feature Radiantflow.™ The image looks gorgeous, but we still need to figure out the overall benefits of this type of rendering. It seems promising to distinguish concomitant flows or close flows like mitral and aortic in the outflow. For example, in patients where you have concomitant flows, like in the case of LVOT obstruction, and you have two close flows. I think that it will also be helpful on residual leaks, but we need more experience.

How would you describe your experience with our new feature Silhouette?

Dr. Sanchis: *Silhouette is a new feature we started playing with and I think the main use may be in visualizing the morphology of the appendage. It's not so important to see the distal part, but sometimes you need to determine the anatomical classification of the appendage, or you want to understand a bit more about what you're seeing in monoplane. And for that, I think it's quite useful.*

You mentioned improvements to FlexiSlice — Vivid Pioneer's multiplanar reconstruction tool. How has it made a difference in interventions?

Prof. Sitges: *FlexiSlice is becoming an essential tool in the cath lab. Currently we are performing more and more complex procedures in structural heart interventions, and we need to align and visualize structures that we are not used to. Examples include using devices for annuloplasty or transcatheter valve replacement where it's critical to see the engagement of all leaflets — or even simple edge-to-edge repair when there's distortion of the heart's anatomy and it's not aligned with the scanning ultrasound beam.*

Also, because the image quality of FlexiSlice has improved so much, guiding the procedure is easier for us because everything is in one shot — the 4D enface view, the short axis, the long intercommissural view, and the LVOT, for example, in mitral valve repair. So we have everything on one screen and we can all speak the same language.

Dr. Sanchis: *FlexiSlice is extremely helpful for visualizing the valve's surroundings and for achieving precise positioning within the valve. This allows us to work with 4D and the different planes at the same time for the right placement. It's something we need to do very fast and it needs to be reliable. The Vivid E95 version was fast, but with Vivid Pioneer there is a difference in image quality so some procedures can be performed faster. For me, this is the biggest step forward with the new system.*

I think this can also help for communication with interventionalists because they can have 4D and the biplanes at the same time. They can have all the information together, so it's now very easy with 4D to know the catheter position and movement.

> *"Color Flow is better than before because we have a denser image of the flow, and now 4D Color Flow offers high-quality imaging combined with a higher frame rate than before. I think this is another step forward in the visualization of residual leaks."*

While FlexiSlice is something that most people are not using — especially during live interventions — I would recommend trying it because it's easier than it looks. It's something you can start applying offline at the beginning and then try during interventions. Several years ago, it was quite difficult to understand, but now the learning curve is easier, and it's becoming simple to use in everyday practice.

> *"2-Click Align is another tool that helps us perform really fast alignment during FlexiSlice. You can follow the catheter or any structure you want, and with just two clicks, all the views in FlexiSlice align concomitantly. It's super fast and makes your life easier as a user."*

When it comes to performance and productivity, what are some other features that could help improve efficiencies during procedures?

Prof. Sitges: *2-Click Align is another tool that helps us perform really fast alignment during FlexiSlice. You can follow the catheter or any structure you want, and with just two clicks, all the views in FlexiSlice align concomitantly. It's super fast and makes your life easier as a user.*

The TSP tool — the transeptal puncture tool — also allows us to automatically measure the height of the transseptal puncture, which is crucial in many procedures, particularly in edge-to-edge mitral valve repair. With just three clicks, it's easier and faster to do the measurements and makes it easier to communicate with the rest of the team. Everybody can see it, everybody can understand, and we are all on the same page.

Dr. Sanchis: *When I started using the TSP tool, I thought maybe this is difficult or not so useful. Then you realize its value because you already have your two lines aligned with your plane. It's very easy to perform and it saves you time.*

Vivid Pioneer also has a LAA Workflow Suite. How are some of these tools and other features of the system supporting you in left atrial appendage procedures?

Prof. Sitges: *The LAA Workflow Suite helps with procedures for LAA occlusion. AI FlexiViews LAA automatically aligns the left atrial appendage with FlexiSlice — so all the planes are already aligned for measurement and guidance.*

The LAA Sizing Tool includes magnetic tracing that goes to the boundaries of the LAA to measure the landing zone. It's a really useful tool that gives you the precision and speed to perform tasks we used to do manually — things that took time to both perform and understand. Now, everything becomes more automatic and is supported by the machine.

Dr. Sanchis: *Vivid Pioneer also has new QuickApps, which could be interesting for left atrial appendage procedures. Just push one button and you have direct visualization in 4D of the left atrial appendage in an accorded and anatomical position — with the mitral on the bottom and the pulmonary ridge on the upper part.*

From a usability standpoint, how would you describe your experience with Vivid Pioneer?

Prof. Sitges: *From the user's perspective, there have been a lot of improvements. We are experienced users, but I can tell you the learning curve is easier because the workflow is much more straightforward and flexible. There are less buttons on the platform, the TGCs are digitized, and you have presets on your left screen.*

Also, the design is very nice. The system is compact and smaller, so it's easier to transport, and there have been improvements to the brakes.

Sometimes you need to take the machine out to clean the room, then change the setup and then rebuild everything for a second case. With the transportation mode, you don't need to turn the system off and reboot it every time, so that's really nice. Plus, there are standalone batteries.

And if you work in a place with a lot of people — like anesthesiologists, interventionalists, and nurses — you're grateful to have a compact machine with the same image quality and faster tools.

From an ergonomic standpoint, I like that the new platform has hand rests. We often have long procedure times, so you really need a place to rest your hands with the probe. Having that space is really, really useful and appreciated by users.

> *"FlexiSlice is extremely helpful for visualizing the valve's surroundings and for achieving precise positioning within the valve. This allows us to work with 4D and the different planes at the same time for the right placement. It's something we need to do very fast and it needs to be reliable. The Vivid E95 version was fast, but with Vivid Pioneer there is a difference in image quality so some procedures can be performed faster. For me, this is the biggest step forward with the new system."*

In a busy cath lab environment, how are these advancements helping enhance communication with the rest of team?

Prof. Sitges: *There are very experienced echocardiographers who can understand the image, but it's not just about one person — the whole team needs to see and understand it. For interventionalists, the image is their eyes — their guide to move the catheters. If the image quality isn't good or available quickly, they're not going to feel confident and the procedure isn't going to work.*

Dr. Sanchis: *If you have good image quality, you can be more confident when you are guiding interventions and screenings because you can understand the anatomy better. This allows you to communicate better with your peers, the surgeon, or with interventionalists — just to describe the anatomy and decide the best strategy for your patient.*

With interventional cardiology advancing so rapidly, how do innovations like Vivid Pioneer shape the future of the field — and what does it mean to be at the forefront of this transformation?

Dr. Sanchis: *It's exciting. In the field of valve disease and structural intervention, we're continuously adding more and more technology. It would be impossible to do the kind of interventions we do now with the echo systems of 15 to 20 years ago. The reason we're able to perform more complex interventions now is because we have better imaging.*

Prof. Sitges: *We are very enthusiastic about imaging — that's why we are so devoted to it. When we see high-quality images like with Vivid Pioneer, we're happy — but we're even more satisfied these images are easy and straightforward to obtain. This is why we work in this rapidly growing field, and Vivid Pioneer is the next step.* ■

A new edge for interventionalists

Advanced echo for everyday guidance

As the complexity and scope of structural heart interventions continue to expand, successful outcomes increasingly depend on the seamless collaboration between interventionalists and echocardiographers. Procedures are challenging, anatomy is variable, and the clinical landscape can shift in an instant — making high-quality, real-time imaging guidance essential.

Dr. Xavier Freixa is Director of Interventional Cardiology at the Cardiovascular Institute at Hospital Clínic de Barcelona. He recently experienced Vivid Pioneer firsthand in the cath lab and shared his insights as an interventionalist.

What are your biggest challenges as an interventional cardiologist?

Dr. Freixa: *One of the biggest challenges is the variety of interventions. In the past, we used to do very similar procedures, but now every intervention is completely different. You need to constantly change from one measurement to another, one plane to another, one approach to the next. The procedures are more complex and we need more support from an imaging perspective, but we're now capable of doing things that, even five years ago, would have seemed completely impossible.*

In the face of complex cases, how would you describe Vivid Pioneer's image quality?

Dr. Freixa: *With Vivid Pioneer, my feeling is — if you can't get good imaging with this system, you're not going to get it. The system provides the tools to have the best experience in terms of echo imaging, anatomical visualization, and Color Flow.*

We're doing interventions that require high image quality, like tricuspid valve repair and tricuspid valve replacement. With Vivid Pioneer, the overall image quality is improved. You get the sense that you're getting more information and details — like pathways, leaks, and jets. I think now you have better accuracy.

How have recent updates to the Color Flow impacted interventions?

Dr. Freixa: *The Color Flow is clearly improved — especially in the 4D environment. It's really high quality, particularly for paravalvular leaks or edge-to-edge repairs when you have a residual leak or residual jet. Now we can identify the point precisely and deliver the solution.*

Another big update involves FlexiSlice. How would you describe the changes?

Dr. Freixa: *I'm very impressed by FlexiSlice — it's one of the most important tools of Vivid Pioneer. FlexiSlice is not new, but the improved image quality and real-time automatic alignment are. It's powerful because it provides a simultaneous display of up to four high-resolution 2D planes — extracted from a 4D volume — on a single screen. It's incredible because, in a single shot on one screen, you have all the information you need to proceed with the intervention. You don't need to wait for a specific plane.*

For example, in edge-to-edge repair, you have everything necessary to move forward with the grasping. Sometimes they even need to stop me so I don't keep going!

The FlexiSlice experience is much better now because you have accuracy, speed, and information all at the same time. You have everything you need to be precise — and for us, that's the most important thing.

How else does Vivid Pioneer simplify and streamline your workflow?

Dr. Freixa: *With the new system, you can get automative measurements and images with little manipulation. It's really important because that makes procedures easier and faster. And if everything goes faster, you're able to do more procedures in one morning or in one day. It makes our life easier.*

Vivid Pioneer has another feature called 4D Markers — can you describe the benefits?

Dr. Freixa: *4D Markers helps with communication between the echocardiographer and the interventional cardiologist. It's an important feature to direct interventions and localize different points. I believe it's probably intended for people with less experience — teams that are building their experience. Having these different markers and the ability to speak the same language is very important.*

Vivid Pioneer is equipped with a power interruption feature that maintains scanning capabilities for up to five minutes during accidental power outages or disconnections. What is the potential impact on your interventions?

Dr. Freixa: *In the past, we had an interruption during a case, and we were lucky because nothing serious happened. But if you were in a delicate stage of an intervention, it could definitely be a problem. I see this as a safety issue, and I believe this feature and the standalone battery are necessary.*

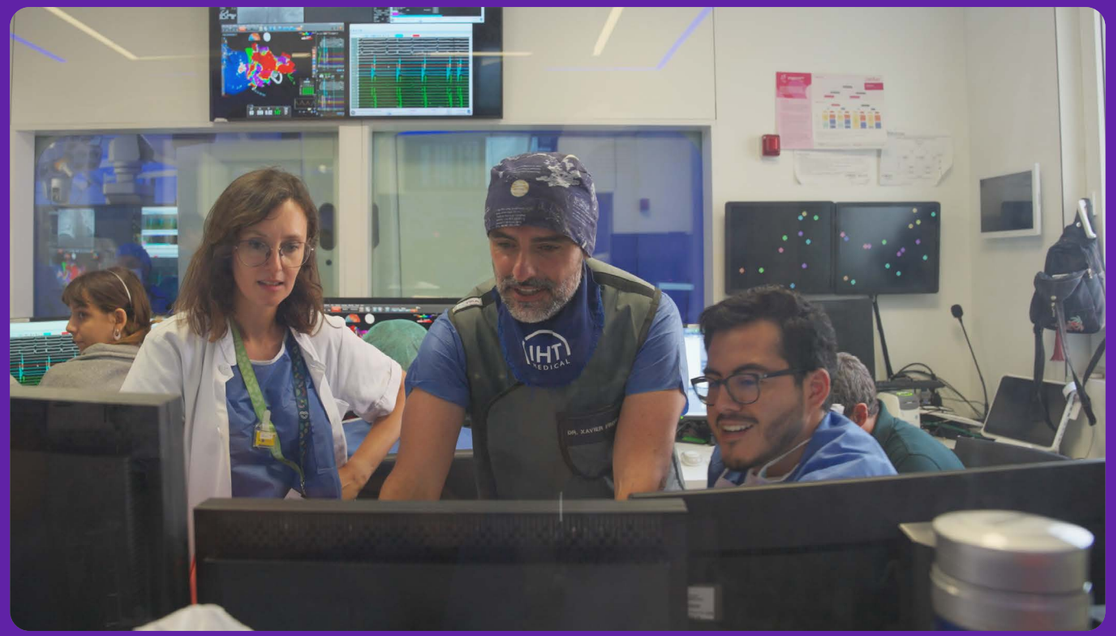
Vivid Pioneer is the latest technology to complement Allia™ IGS 7 — GE HealthCare's interventional image-guided platform. What is the value of having these systems operating together in the cath lab?

Dr. Freixa: *We have worked with GE HealthCare echo systems for a decade and added the X-ray solution in the last few years. Having the latest technology with the Allia platform and now Vivid Pioneer makes everything easier — integration, image quality. We are also experienced with the technology, so when it comes to workflow, preparation, and setup — it really simplifies everything.*

In closing, how would you summarize your experience with Vivid Pioneer?

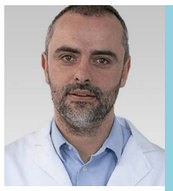
Dr. Freixa: *The main potential of Vivid Pioneer is its image quality, especially the powerful Color Flow. Second is the consistent image quality with a stable probe that does not overheat, which is crucial during long interventions. And finally, I love FlexiSlice. I think it's very powerful to have so much information on a single screen. The quality is really a step forward.*

For me, having Vivid Pioneer is like having a Ferrari — it is the best technology available currently. If you're not getting better image quality, it's because it's not possible.



Marta Sitges, MD, PhD is a senior consultant non-invasive cardiologist at the Cardiovascular Institute at Hospital Clínic de Barcelona and Professor of Medicine at the University of Barcelona. Her main clinical practice is related to clinical and interventional echocardiography, sports cardiology, and heart valve disease. She has published more than 450 peer reviewed papers and presented more than 300 lectures in national and international meetings. Professor Sitges has been the Director of the Cardiovascular Institute since 2015.

Laura Sanchis, MD, PhD specializes in noninvasive cardiac imaging at the Cardiovascular Institute at Hospital Clínic de Barcelona. She is part of the Valve Team and performs echocardiography and advanced echocardiography techniques, as well as echo-guidance of structural interventions in the catheterization lab. Her main research currently focuses on the application of cardiac imaging to understand the pathophysiology of heart valve disease, its clinical management, and the structural heart interventions planification. Dr. Sanchis is credited with more than 100 research publications.



Xavier Freixa, MD, PhD is Director of the Interventional Cardiology Department at the Cardiovascular Institute of Hospital Clínic de Barcelona. Dr. Freixa is recognized for his clinical excellence and contributions to advancing minimally invasive cardiovascular procedures. He specializes in complex coronary interventions and leading-edge structural heart procedures, including transcatheter valve therapies and congenital defect closures. Dr. Freixa's research includes more than 100 scientific publications, multiple clinical trials, and principal investigator roles in many international studies.

Prof. Marta Sitges, Dr. Laura Sanchis and Dr. Xavier Freixa are paid consultants for GE HealthCare and were compensated for their participation in this article. The statements by Prof. Marta Sitges, Dr. Laura Sanchis and Dr. Xavier Freixa described here are based on their own opinions and on results that were achieved in their unique setting. Since there is no "typical" hospital/clinical setting and many variables exist, i.e., hospital size, case mix, staff expertise, etc., there can be no guarantee that others will achieve the same results.

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Quality, quantified.

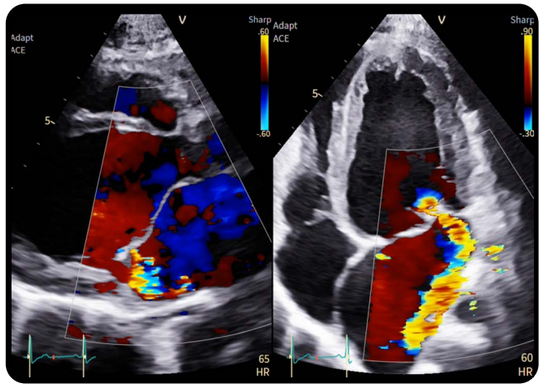
Driving productivity in the echo lab with Vivid™ Pioneer

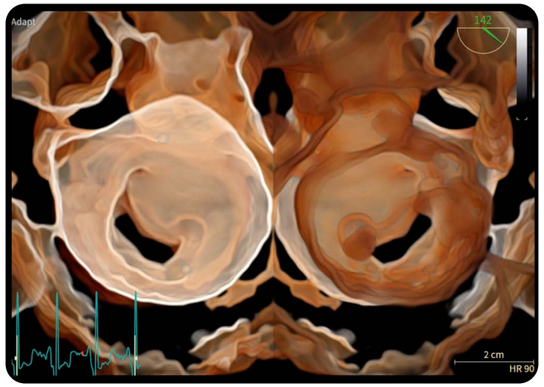
In the echo lab, there's little room for compromise. As patient volumes rise and cases become more complex, balancing efficiency with confidence and consistency is a daily challenge. Image quality is foundational. Clearer images can mean faster measurements, more reliable quantification, and greater diagnostic certainty. AI and automation further streamline workflows, saving valuable time and effort under constant clinical pressure.

These realities shape everyday practice for Professor Erwan Donal and his team at Rennes University Hospital in western France. The Cardiology and Vascular Disease Department provides advanced cardiac imaging, including echocardiography, with a focus on valvular disease, cardiomyopathies, and heart failure. Prof. Donal leads the department's demanding echo lab, which conducts approximately 23,000 studies annually, while the interventional cardiology team also performs an estimated 150 mitral and tricuspid valve interventions each year.

Prof. Donal also oversees efforts that combine leading-edge research with clinical innovation at Rennes University Hospital where he is as Director of the echo lab and leads the Core Imaging Lab, which provides echocardiography expertise and data analysis for large, multicenter clinical trials and research projects across Europe. The dynamic environment supports a high-volume echo practice where innovations in Transthoracic Echocardiography (TTE) and AI-assisted quantification are integrated into daily workflows.

One of those innovations is the Vivid Pioneer ultra-premium ultrasound system. As one of the first to experience the new cardiovascular ultrasound platform, Prof. Donal shares how he feels the system is changing workflow and opening new possibilities for 4D transthoracic echocardiography.





Given your demanding and fast-paced environment, what do you need most from a premium ultrasound system?

Prof. Donal: *The challenge for the echo lab is that we have more and more patients every year. These patients are diverse and complex, often with comorbidities, and in some cases, they're extremely severe. So we need the most efficient workflow possible to make sure we can assess these patients while having them comfortable. From the beginning to the end of the day, we need an ultrasound system that is robust, easy to use, and rapid for everybody. It should be intuitive and reproducible.*

> *"The images are impressive, which improves the ability to quantify more accurately. So, it's not only a question of beauty — it's a question of how we analyze the data."*

Your team also performs a significant number of mitral and tricuspid valve interventions. How does this add to the complexity and reinforce the need for precise imaging?

Prof. Donal: *These two valves are the most demanding for imagers — especially the tricuspid valve. In Rennes, we're doing research for the Evaluation of Tricuspid Valve Percutaneous Repair System in the Treatment of Severe Secondary Tricuspid Disorders trial, so we are doing a lot of interventions on the tricuspid side. We believe in the value of the treatment for our patients, but it's also very demanding because the quality of the imaging is fundamental. We need to see the tricuspid valve perfectly and to assess the right ventricle and the right atrium. Having access to percutaneous repairs treatment is nice for the patients and good for the institution, but it's also very challenging.*

Considering the importance of image quality — how would you describe your experience with the new Vivid Pioneer system?

> *"With this new generation of Color Doppler, we can see the regurgitation and quantify it much better, not only on the mitral side, but also on the tricuspid side, and the aortic side. So we have the capability to see things that maybe we didn't see before."*

Prof. Donal: *The previous Vivid E95 was very good, but with the Vivid Pioneer it's better and much easier to get nice images. It means you don't have to change the settings from one exam to the next. The images are impressive, which improves the ability to quantify more accurately. So, it's not only a question of beauty — it's a question of how we analyze the data.*

The Color Flow is also beautiful. With this new generation of Color Doppler, we can see the regurgitation and quantify it much better, not only on the mitral side, but also on the tricuspid side, and the aortic side. So we have the capability to see things that maybe we didn't see before.

Innovation at the core of valve research

Rennes University Hospital hosts a dedicated Core Imaging Lab that delivers advanced echocardiographic expertise and centralized data analysis for large-scale, multicenter clinical trials and collaborative research programs across Europe. The Core Lab supports standardized image acquisition, rigorous quantitative analysis, and high-quality imaging endpoints for academic and industry-sponsored studies.

For image assessment, the Core Lab uses GE HealthCare's EchoPAC™ for advanced cardiac post-processing and quantitative echocardiographic analysis. The software supports multi-vendor compatibility, enabling standardized analysis of DICOM® images acquired from different ultrasound systems. With its advanced quantification tools, EchoPAC enables reproducible analysis of echo data supporting consistent, high-quality results across study sites.

How would you describe the Core Lab?

Prof. Donal: *The Core Lab is accredited and the key words to describe it are quality, robustness, and efficiency. The Core Lab is dedicated to assessing mitral and tricuspid valve images from around the world. With images coming from a range of machines and places, we need a system that can quantify data from different sources.*

How does EchoPAC facilitate assessment?

Prof. Donal: *EchoPAC is fundamental for the Core Lab activities. The fact that we have EchoPAC, we can quantify every exam — and we use only DICOM data, so we can quantify valvular heart disease, the LV and RV function.*

Prayuth Rasmeehirun: *EchoPAC is an amazing software for reading echoes because it can be used offline. You can go back to your workbench and measure things offline, which saves you time with the patient and helps if you forget to measure something while scanning. You can also shift your color and increase or reduce the gain, which makes post treatment easier.*

What are the advantages of EchoPAC in this research setting?

Marina Saadi: *EchoPAC gives us the ability to perform offline analysis, which really helps the Core Lab function. We receive exams from other places and analyze them all in one location. It allows us to perform blind analysis for clinical trials without access to the patient or the machine that performed the exam. With EchoPAC, we are able to perform advanced measurements, such as strain, calmly, efficiently, and productively.*

Prayuth Rasmeehirun: *EchoPAC can perform measurements automatically, so you won't have to rely on manual calculations. This makes your life easier, especially when performing many measurements, and working on multiple research projects. Plus, EchoPAC is also important because it allows us to perform all measurements on DICOM images. For example, strain analysis can be performed directly on DICOM data.*

How would you describe the learning curve?

Marina Saadi: *It's a program that's easy to learn and greatly helps with offline analysis, while the system can continue functioning and attending other patients.*

Prayuth Rasmeehirun: *EchoPAC has the same user interface as Vivid Pioneer so, in my opinion, there's zero learning curve to use it.*

Prof. Donal: *It's very rapid, robust, easy-to-use, and every single fellow can use the solution. Everybody understands how it works and it's convenient. There are many people who come into our Core Lab, so we can teach them how to use the new EchoPAC very rapidly.*

Prayuth Rasmeehirun, MD, Fellow Corelab Echo, CHU Rennes

Marina Saadi, MD, PhD, Fellow Corelab Echo, CHU Rennes

How has Vivid Pioneer impacted your transthoracic imaging and why do you think it's important for other clinicians?

Prof. Donal: *Vivid Pioneer delivers outstanding 2D image quality, which remains essential in everyday practice. At the same time, we have been discussing the value of 4D echocardiography for many years, particularly in Transesophageal Echocardiography (TEE), and increasingly in Transthoracic Echocardiography (TTE). The fact is that most physicians are still not using 4D echo in TTE. With the new Vivid Pioneer platform, you can acquire 4D in both left and right ventricles in almost every patient. This means we can hope for all cardiologists to routinely adopt 4D images in TTE.*

> *"Today, we have a platform that provides 4D imaging not only to visualize structures such as the veins, valves, ventricles, papillary muscles, and the right ventricle, but also to perform robust and reproducible quantification."*

For example, I had a patient who had dilated cardiomyopathy with severe mitral regurgitation. In just a few minutes I captured all the images, including the 4D of the LV. The images are impressive, but what I care about is being able to quantify left ventricular size in systole and diastole, which lets me quantify mitral regurgitation very precisely using a volumetric approach.

Today, we have a platform that provides 4D imaging not only to visualize structures such as the veins, valves, ventricles, papillary muscles, and the right ventricle, but also to perform robust and reproducible quantification. The better the image quality — particularly in terms of resolution and volume rate — the more robust and accurate the quantification will be. With Vivid Pioneer, it's feasible — whereas in the past, it was perhaps more challenging. This is why 4D echocardiography should be adopted more widely in daily clinical practice.

The new system features 4D Auto LHQ, which simultaneously performs 4D quantification of both chambers in fewer clicks. What is the impact of the tool in your clinical practice?

Prof. Donal: *We are doing a 4D acquisition for every single exam that we do in TTE. The goal is quantification, and Vivid Pioneer makes it easy for LV size and LV ejection fraction. On top of that, the assessment of the LA is also robust. So in just a few seconds, we can quantify everything on the left side, and of course, we have a tool that we can use on the right side.*

I think it's useful to have images dedicated to the LV and LA, and separate images dedicated to the RV, because it's very difficult to record everything accurately in a single acquisition. Capturing the LA/LV together with precise quality is challenging. However with Vivid Pioneer, the LA and LV can be quantified quite easily thanks to a 4D acquisition on the left side, and we can apply the same approach to the right side afterward.

Exceptional image quality is foundational for AI-driven insights you can trust. How does Vivid Pioneer translate this into reliable and reproducible results?

Prof. Donal: *The echo lab is very busy and we need to perform exams as fast as we can. We sometimes need AI tools to speed up the process and get quantitative measurements in a small period of time. Vivid Pioneer has a new AI software for automatic Doppler measurements expanding it capabilities. AI Cardiac Auto Doppler works for every type of Doppler, is more robust than the Vivid E95, and allows us to clearly see what the system is doing. We can obtain excellent quantitative Doppler Tissue Imaging (DTI) assessments and quantify valvular heart disease, including stenosis, very nicely.*

> *"We have many echo machines in the echo lab, with different physicians, fellows, and nurses practicing echoes every day. It's important that everyone feels comfortable with the platforms. Vivid Pioneer is really easy to use."*

It's easy to obtain a high-quality Doppler and have the quantification done by AI. Whether it's performed by me or by a fellow, the result is essentially the same, making it reproducible. Beyond image quality, this tool speeds up the workflow, allowing us to see patients more rapidly and efficiently. I really hope the community will adopt this because it's rapid, robust, and works extremely well.

What features are particularly valuable in improving visualization and workflow for your echo lab and structural heart interventions?

Prof. Donal: *We perform a significant number of interventions and use many tools. Of course, we can quantify the mitral valve annulus and tricuspid valve annulus using 4D Auto MVQ or TVQ, but the visualization of the valves is much better.*

We perform a lot of 4D acquisitions that can be displayed nicely thanks to Flexi-Slice (MPR). Flexi-Slice was already good with the Vivid E95 system, but with Vivid Pioneer it's much better — and actually faster. We can navigate through the volume to make sure there are no issues with the chordae, indentations, or unusual anatomies. We also have 2-Click Align, for instance, that allows us to align with the mitral valve and the tricuspid valve perfectly in 2 clicks.

> *"I need a machine that moves with me. Vivid Pioneer is beautiful, very convenient to use, but also lighter."*

These tools improve the way we display images in the echo lab, but they're even more important in the cath lab, where FlexiSlice and 2-Click-Align are ready to use in a few seconds.

Why is portability essential for you, and what sets Vivid Pioneer apart?

Prof. Donal: *I'm using the system in the echo lab and the cath lab, so I need a machine that moves with me. Vivid Pioneer is beautiful, very convenient to use, but also lighter than the Vivid E95. There is a battery, and also a transportation mode, which means we don't have to turn the system off when moving rapidly between places. This is very convenient because in just a few seconds I can be efficient and acquire images if needed. This is really a new capability of the system that was not possible before.*

Ease and simplicity have come up repeatedly in our conversation. Can you comment on the learning curve given your wide range of users?

Prof. Donal: *We have many echo machines in the echo lab, with different physicians, fellows, and nurses practicing echoes every day. It's important that everyone feels comfortable with the platforms. Vivid Pioneer is really easy to use — features are easy to find and everything is obvious. We don't have to think, "Where is this button?" or "How can I do 4D?"*

And it's not just for me — it's the same for the fellows. For example, I observed a fellow who was able to perform a TTE perfectly including 4D. Vivid Pioneer is easy to understand and there aren't too many buttons, so it's something we can really adopt — from the youngest to the most experienced staff.

How is the new ultrasound system changed the way you work, and what do you see as its true value?

Prof. Donal: *Vivid Pioneer is really providing something new. Thanks to this platform, we now use 4D in every single TTE exam, which is very convenient and been a goal for a while. It's clearly improving the robustness of our assessments.*

On top of that, the Color Doppler is really amazing and much better than what we had before. We can visualize valvular leaks and quantify everything much better than in the past. Vivid Pioneer is also designed for the cath lab. Overall, the image quality, the improvements on Color Doppler, and the ease in obtaining high-quality images make communication with the interventionalist much easier. ■

Professor Erwan Donal, MD, PhD, is a Professor of Cardiology at the University of Rennes and a senior cardiologist at Rennes University Hospital (CHU Rennes), where he serves as Director of the echo lab and leads the Core (Core Imaging) Lab. His clinical and academic work focuses on advanced cardiovascular imaging, with particular expertise in echocardiography, valvular heart disease, heart failure, and structural heart disease assessment. Prof. Donal specializes in quantitative and multimodality imaging, standardization of imaging measurements, and the use of imaging in clinical trials. His research interests include myocardial function analysis, imaging biomarkers, deformation imaging, myocardial work, and the application of echocardiography and cardiac imaging to improve diagnosis, risk stratification, and outcomes in cardiovascular disease.

Prof. Donal is a paid consultant for GE HealthCare. The statements by Prof. Donal described here are based on his own opinions and on results that were achieved in his unique setting. Since there is no "typical" hospital/clinical setting and many variables exist, i.e., hospital size, case mix, staff expertise, etc. there can be no guarantee that others will achieve the same results.

The statements by Dr. Rasmeehirun and Dr. Saadi are based on their own opinions and on results that were achieved in their unique setting. Since there is no "typical" hospital/clinical setting and many variables exist, i.e., hospital size, case mix, staff expertise, etc. there can be no guarantee that others will achieve the same results.

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