



Introducing the world's first mini 4D TEE probe: Early experiences in structural heart interventions

Research and innovation that advance patient care are driving forces behind the century-old Hospital Clinic de Barcelona in Spain. Recognized as a center of excellence around the world, the public university hospital continues to push for progress. Most recently, its state-of-the-art Cardiovascular Institute was one of the test sites for the new 9VT-D mini 4D TEE probe. Dr. Marta Sitges, MD, Ph.D., who is the director of the Cardiovascular Institute, and Dr. Laura Sanchis, MD, Ph.D. shared their initial experiences with the novel probe.

The Cardiovascular Institute is a referral center for all of Spain for heart transplantation, mitral valve repair, pulmonary hypertension, inherited heart disease and adult congenital heart disease. With specialists in cardiology, cardiac surgery and vascular surgery, the Cardiovascular Institute at the Hospital Clinic reported an estimated twenty-two thousand patient visits, fourteen thousand echocardiograms, and nine hundred cardiac surgeries during 2022. The staff includes more than 60 medical professionals, along with three hundred nursing and administrative support professionals.

The Institute's structural heart interventions program began in 2009 with TAVI and expanded to include edge-to-edge procedures in 2011, followed by tricuspid interventions in 2018. In 2021, the operatory area was completely redesigned to modernize all technologies, including the two existing angiography suites. A new hybrid interventional room was also created to support an ever-growing number of structural heart procedures. Today, the Cardiovascular Institute remains focused on exploring new ways to keep up with the growing demand for diagnosis and treatment.

"The number of patients is rising. We need to know how to do more patients in less time with less beds," says Dr. Laura Sanchis.

Easing workload challenges by improving efficiencies continues to be a driver for the entire healthcare community. Institutions are moving towards advanced technology that provides wider access to minimally invasive therapies that increase the

number of patients treated per day and enable same day discharge. Procedures that negate the need for general anesthesia allow for faster interventions, fewer staff, and can reduce overall hospital costs (inpatient vs. outpatient).

"An important challenge is the need for anesthesia, and that's a universal problem everywhere. It may increase the risk and the complexity of the intervention, so we are going towards less invasive procedures with the same safety. Without general anesthesia and without the need of a conventional probe, it makes everything go faster and quicker," says Dr. Marta Sitges.

A Small Solution

A recent innovation in probe technology, first released for pediatrics, could address these challenges, and provide opportunities to treat more patients. For certain indications, the 9VD-T mini 4D TEE could be a potential option for older and clinically fragile patients not suited for general anesthesia or those who can't tolerate 4D TEE adult probes.

Some of the latest research on the mini 4D TEE comes from the structural heart team at the Cardiovascular Institute at Hospital Clinic. Dr. Laura Sanchis and Dr. Marta Sitges explored the capabilities and potential benefits of the mini 4D TEE performing percutaneous left atrial appendage occlusion (LAAO) procedures on adult patients. Their paper, 'First Experience of left atrial appendage occlusion using 3D mini transesophageal echocardiographic probe with conscious sedation¹, was published in *EuroIntervention* in January 2023.

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Background

Percutaneous left atrial appendage occlusion procedures rely heavily on transesophageal echocardiography (TEE) or computed tomography (CT). 4D TEE is typically used for intraprocedural guidance and requires general anesthesia in most centers¹.

The Cardiovascular Institute utilizes the standard 4D TEE adult probe (6VT-D) with the Vivid E95 ultrasound system for most complex LAAO cases. For simpler procedures, the team trusts the 2D micro TEE probe (10T-D) in conjunction with the Vivid S70N ultrasound system.

For their research, Dr. Sanchis and Professor Sitges utilized the new mini 4D TEE with conscious sedation to help guide LAAO procedures on four patients treated consecutively on the same day. According to their paper, 'The initial experience showed good tolerance (despite minimal sedation and the supine position of the patient) with excellent image quality of the LAA that allowed an effective and safe LAAO guidance¹.



The experts shared more about their experience with the world's first mini 4D TEE probe, along with some insights about the potential for future interventions.

The Cardiovascular Institute was one of the test sites for the new mini 4D TEE probe. In your experience, what are some of the advantages of the mini 4D probe?

Dr. Sitges: *Compared to the micro TEE, I think we should highlight the 3D and good quality images. Probably for LAAO procedures, the image quality is as good as the conventional 3D TEE probe.*

Dr. Sanchis: *The 3D is very nice for me and is the same that we can get with the standard probe. When we were doing the left atrial appendage occlusion—closing it with the mini TEE was super easy and you are super relaxed because you have all the control.*

Dr. Sitges: *Laura and our team have extensive experience in this type of interventions, but for less experienced echocardiographers and interventionalists in the learning part or the initial experience, I think the 3D is really useful because you have this smaller probe with the same capabilities as the conventional one.*

Dr. Sanchis: *To do it without 3D is risky if you are not very skilled in left atrial appendage occlusion. It's always better to do it with biplane than*

monoplane because you have more control. So, it's another point for the mini 4D TEE probe.

I also want to bring up that many people are not using the micro TEE because it's difficult to manipulate and you need to be very skilled. I think it's easier with the mini because it's a little thicker and it's easier to use.

How did the mini 4D TEE probe impact your workflow?

Dr. Sitges: *The advantage of the mini is that we can optimize the process by making it quicker. The mini TEE probe has 3D so the planning can be performed during the procedure. With the micro, it's only 2D so we need to do another 3D screening echo before the procedure day to do all the measurements for planification.*

Dr. Sanchis: For me, the main benefit is for the left atrial appendage occlusion because with the mini TEE we may simplify the patient pathway because we can do all the measurements in the cath lab.

Does the mini 4D TEE probe enable other opportunities to increase efficiencies when performing LAAO procedures?

Dr. Sitges: With the mini TEE, you can avoid general anesthesia and you are reducing or avoiding hospital stays. So that's a big impact.

Dr. Sanchis: We tested the mini TEE

and you can also make many patients in one morning and the tolerance was nice.

Along with simple LAAO cases, do you think the mini 4D TEE probe could be beneficial in other structural heart interventions?

Dr. Sanchis: The thing is that when we have a new technology, we start exploring how it can be used and try to apply it to different procedures.

Dr. Sitges: We have limited experience with the probe, but I am sure we will discover new indications. We didn't have time to test it, but maybe in some

very simple, straightforward cases of functional MR, for example. These cases are usually very easy to treat with an edge-to-edge repair and it typically gets us less than an hour.

Dr. Sanchis: If we have this probe, we will of course use it for the left atrial appendage occlusion. I think that is the main value of this probe. PFO is simple and you can do it without 3D, but some cases are difficult, and I think it's great if you can use 3D and biplane. We could use it also for percutaneous valvuloplasty of the mitral valve. As Marta said, I think that for functional mitral regurgitation in patients where we think it will be easy, it could be also an option.

Dr. Sitges: Choosing the 4D mini probe will not depend on the tolerance of the probe. It will depend on the quality of the image that you need to do the procedure. If it's an easy procedure, we can do it. If it's a very complex and long procedure, probably not. Taking that into account, ASD and PFO are indeed a possibility in the experienced hands as Dr. Sanchis and our interventional team.

In addition to the mini 4D probe, what other ultrasound features or applications are useful in your structural heart procedures?

Dr. Sanchis: If they are complex intervention, I really like Vivid's FlexiSlice, the Live MPR feature. I really like that, for example, for MitraClip, as you can guide it all with 3D and MPR at the same time. With the new Ultra Edition release, the quality of 3D and MPR is much better, so it is very nice.



Dr. Sitges: Dr. Sanchis explained very nicely the advantages of MPR, which I completely agree with. Then there is the CT-Echo fusion that is getting better and better, but still need to work on it to add it to more procedures.

Looking ahead, what advances would you like to see in technology, and how do you envision the cath lab of the future?

Dr. Sitges: For the cath lab of the future, we should have a robot that would allow remote manipulation of catheters, but also of the mini TEE probe with all the 3D capabilities. We would have tools that would help get rid of anesthesia, of course.

Dr. Sanchis: We will make more things than now. I think it's increasing exponentially.



Dr. Marta Sitges, MD, PhD. is a senior consultant non-invasive cardiologist at the Cardiovascular Institute in Hospital Clinic 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 280 peer reviewed papers and presented more than three hundred lectures in national and international meetings. Professor Sitges has been Director of the Cardiovascular Department since 2015.



Dr. Laura Sanchis, MD, PhD. specializes in noninvasive cardiac imaging at the Cardiovascular Institute. 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 one hundred research publications.

1 Sanchis L, Regueiro A, Cepas-Guillen P, Sitges M, Freixa X, First experience of left atrial appendage occlusion using a 3D mini transoesophageal echocardiographic probe with conscious sedation. EuroIntervention. 2023 Jan.; DOI: 10.4244/EIJ-D-22-00921
9VT-D probe is exclusively available for Vivid E95 and Vivid E90 systems. Vivid Ultra Edition is released as of 25th August 2022 Ultra Edition is not a product name, it refers to the 2022 release of the Vivid portfolio.
Doctors are paid consultants for GEHC and were compensated for participation in this article. The statements described here are based on their own opinions and on results that were achieved in their unique setting. Since there is no "typical" hospital and many variables exist, i.e. hospital size, case mix, etc.. there can be no guarantee that other customers will achieve the same results.
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Left Atrial Appendage Closure with 9VT-D, mini 4D TEE probe

Courtesy of Dr. Marta Sitges and Dr. Laura Sanchis, Hospital Clinic Barcelona, Spain

Patient History/ Pathology

68-year-old man was admitted due to heart failure after new-onset rapid atrial fibrillation (AF). Despite having a previous episode of paroxysmal AF, oral anticoagulation had been suspended after recurrent hematuria (chronic cystitis resulting from a previous radiotherapy treatment for prostate carcinoma). A transesophageal echocardiography (TEE) was performed to rule out thrombus before electric cardioversion. The patient was discharged with low-dose subcutaneous heparin and, after another episode of hematuria, percutaneous left atrial appendage (LAA) occlusion (LAAO) was proposed.

Challenges

Percutaneous LAAO needs planning with a 3D imaging technique (CT or TEE). Our patient had a previous TEE but without 3D measurements of the LAA and dedicated evaluation. Performing a new imaging test would have implied a delay in treatment as well as additional cost and risk (radiation, esophageal intubation). Alternatively, LAAO with general anesthesia and 3D TEE guiding had to be performed to evaluate the LAA and guide the procedure.

System, probe & device used

As we had available the 9VT-D mini TEE probe with 3D capabilities with the Vivid E95 (206 release) echocardiographic system, we decided to perform LAAO under conscious sedation and on an ambulatory basis with same day hospital discharge. The patient was admitted in the morning, LAAO was performed under conscious sedation and after 6 hours monitoring and a transthoracic echocardiography to rule out pericardial effusion and device embolization, the patient was discharged from the hospital.

Step-by-step procedure

The tolerance of the probe was excellent with only pharyngeal topic lidocaine and conscious sedation (fentanyl 0.05 mg and midazolam 2 mg). 3D measurements of the LAA (ostium 14x23 mm and landing zone 16x21 mm) were performed during LAAO with live MPR and an Amplatzer Amulet 25-mm device was chosen for closure. Transseptal puncture and device implantation were guided with biplane 3D imaging with a successful implantation.

Conclusion

The use of a mini TEE probe with 3D capabilities (9VT-D) allowed us to directly perform a safe and effective LAAO with

conscious sedation and same day hospital discharge. Without this probe it would have been necessary to do a previous 3D imaging technique (TEE or CT) or to perform LAAO with general anesthesia and 3D TEE guiding with the standard probe.

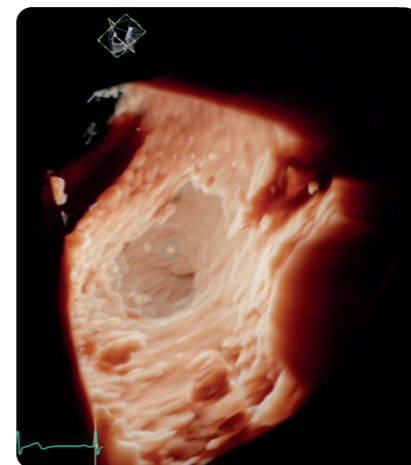
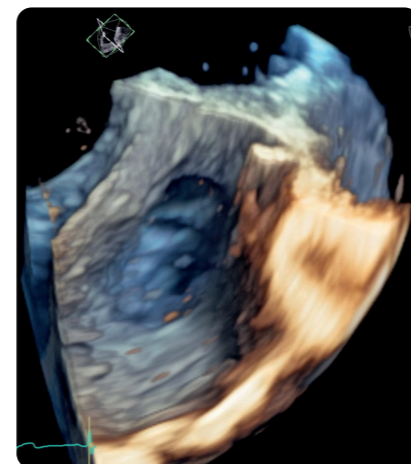


Figure 1. 3D visualization of the LAA ostium.

3D measurement of LAA

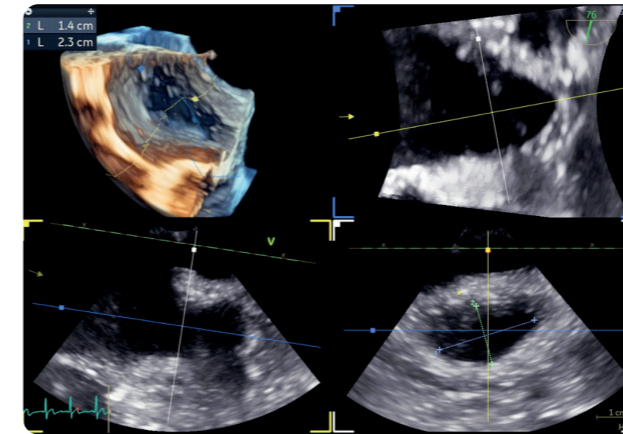


Figure 2. Ostium.

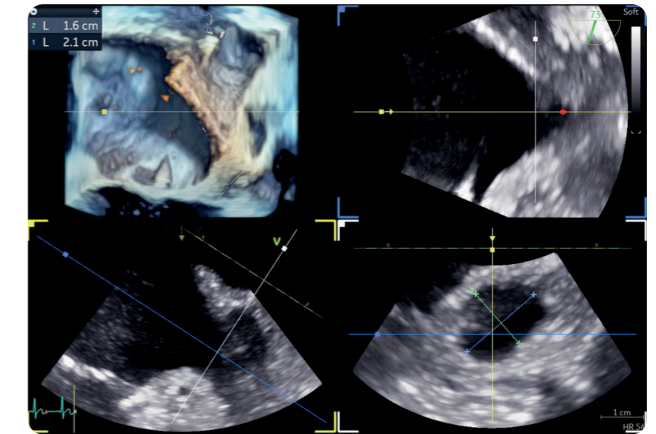


Figure 3. Landing zone.

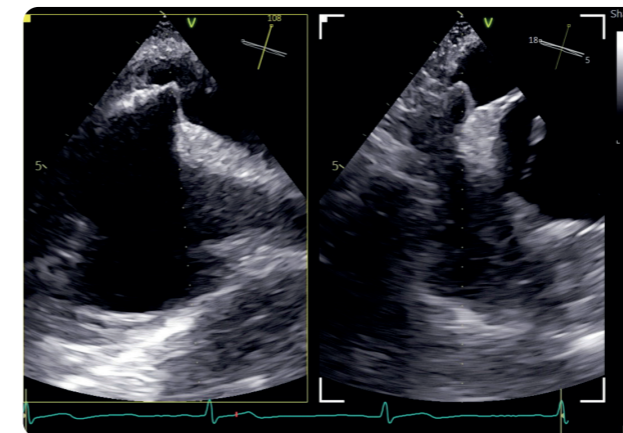


Figure 4. Transseptal puncture.

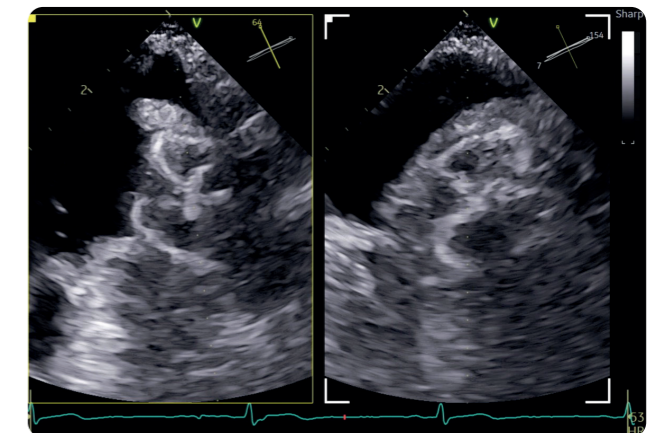


Figure 5. Lobe opening.

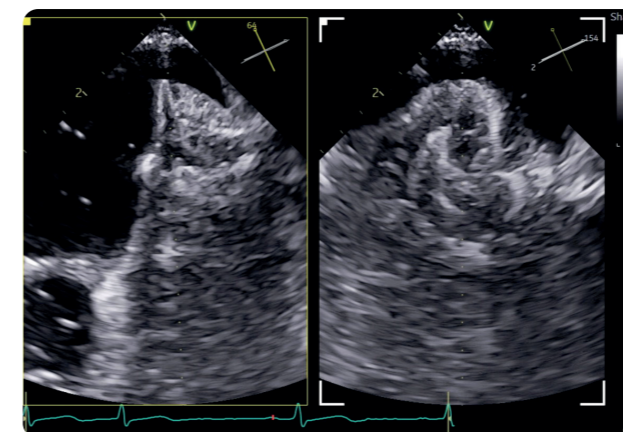


Figure 6. Disc opening.

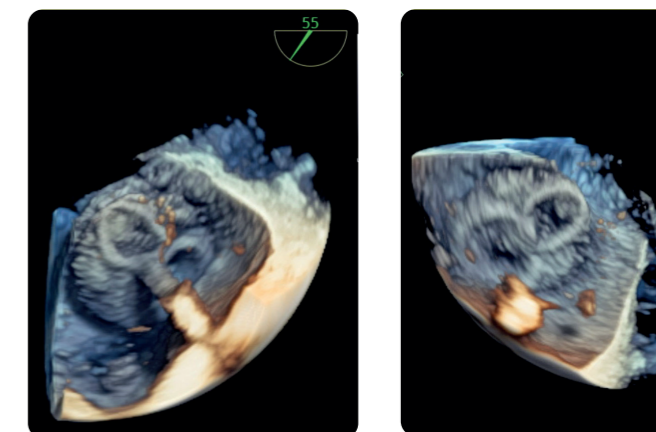


Figure 7. 3D evaluation of leaks before release.

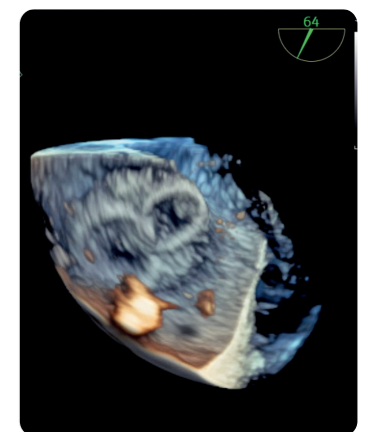


Figure 8. Final result.

9VT-D probe is exclusively available for Vivid E95 and Vivid E90 systems. Vivid Ultra Edition is released as of 25th August 2022. Ultra Edition is not a product name, it refers to the 2022 release of the Vivid portfolio.

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