Editorial

What does the navigator system in interventional procedures in the hybrid room?

O que o sistema navegador agrega aos procedimentos intervencionistas na sala híbrida?

Denisse Guzman Ramirez[1]; *Jose Maria Hernandez Hernandez*[2,3]

Hospital de Cardiología Unidad Medica de Alta Especialidad No. 34, Instituto Mexicano del Seguro Social[1], *Monterrey, México. Doctors Hospital*[2], *Monterrey, México. SISIAC*[3], *Santiago, Chile.*

What does the navigator system add to interventional procedures in the hybrid room?

The usefulness of two-dimensional fixed projection fluoroscopic imaging in the characterization of soft tissues and complex cardiac anatomy is limited. Moreover, it is currently insufficient for cardiac structural interventionism. Including recent three-dimensional cardiac ultrasound imaging techniques is necessary to improve anatomical images and spatial resolution.[1]

Fusion or hybrid imaging using two-dimensional fluoroscopy in combination with static or dynamic imaging obtained from cardiac computed tomography angiography (CCT), cardiac magnetic resonance (CMR), and transesophageal echocardiography (TEE) have been successfully used for structural cardiac interventions.[2] A fusion image is the superimposition of images acquired from different modalities within the same spatial coordinate. This image mapping process is called co-registration or image registration.

As the echocardiography/fluoroscopy fusion image arises in the catheterization laboratory, we must understand the need to obtain adequate-quality three-dimensional moving images since the use of static pre-procedural images such as CMR/CCT cannot improve the intraprocedural situation. With emerging technologies constantly improving TEE resolution, this imaging modality is considered ideal for guiding structural cardiac interventions. The first published proposal, provided by Gao et al. in 2010, merged echocardiographic and fluoroscopic images using specialized software.[3]

Concept

This method uses an image based on a two-/three-dimensional registration algorithm to locate the transesophageal probe; in this way, it is possible to follow its movement and superimpose the echocardiographic image on the fluoroscopic image when the C-arc moves. The fluoroscopic image is transferred together with the echocardiographic image; the initial clinical precision in the tissue was 1.5–4 mm. This technology was FDA approved for use in 2013 for the EchoNavigator (Philips Healthcare, Best, The Netherlands) and in 2017 for the TrueFusion (Siemens Healthineers, Erlangen, Germany).[2] The first study of the software prototype, published in 2013 in Switzerland, compared two groups of non-randomized patients who received mitral clips.[4]

Strengths

Using this technology, the TEE field of view is displayed as an outline to provide an additional point of reference by showing both fused images in motion. The TEE image provides critical perspectives on soft tissue anatomy. This fusion technology allows the use of markers placed on the echo image and automatically appears on the image fused with a fluoroscopic image. Finally, on the screen, three simultaneous viewing perspectives can be changed at the operator's convenience, which favors the intervention work's fluidity. (Table 1)

Disadvantages

Availability and cost are the most important factors influencing its routine use. Limited evidence-based information is currently available; in fact, experiences of some medical centers and publications of clinical cases are the primary data sources.

New Formats

Clinical cases have been published explaining echocardiographic fusion using CCT and fluoroscopy. Fusion with CCT allows the superimposing of images taken on previous days with fluoroscopy in real time. The information obtained from both imaging modalities is synergistic during structural cardiac interventions in which immediate feedback and precision are essential.[2,5] The preload conditions may vary between the timing of the tomographic acquisition and the timing of the intervention, causing some anatomical variability. Another limitation of CCT fusion is that the correlation with thoracic anatomy may become inconsistent after catheters and wires invade the thorax.

New TEE/fluoroscopic fusion versions have optimized this technology by adding a touch screen to the echocardiographic equipment to introduce markers and automatic reconstruction

Keywords

Echocardiography; Fluoroscopy; Cardiac Surgical Procedures.

Mailing Address: Jose Maria Hernandez •
Doctor's Hospital, Ecuador 2331, Balcones de Galerias Monterrey, Mexico.
E-mail: drchemahdez@gmail.com
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plans for the aortic, mitral valve, and left atrial appendage (Figure 1). Both technologies feature these characteristics in which one-click valve modeling provides automated landmarks for live fusion.

The EchoNavigator added Truevue glass technology with Doppler color to evaluate the valvular regurgitation site in the fused image. Moreover, cavities such as the ventricle and atrium can be traced by the echocardiography equipment and the relevant images transmitted to the main screen (Figure 2).

Conclusions

Fusion echocardiography fluoroscopy is a valuable tool that can guide structural cardiovascular interventional procedures. This technology facilitates teamwork and potentially contributes to reducing the time, amount of radiation, and amount of intravenous contrast. It continues to be modernized, most recently with the advent of specific protocols for structural interventionism.

Authors' contributions

Guzman-Ramirez D and Hernandez-Hernandez JM: main ideas, selection of images; Guzman-Ramirez D: writing of the article, selection of articles; Hernandez-Hernandez JM: organization of the manuscript.

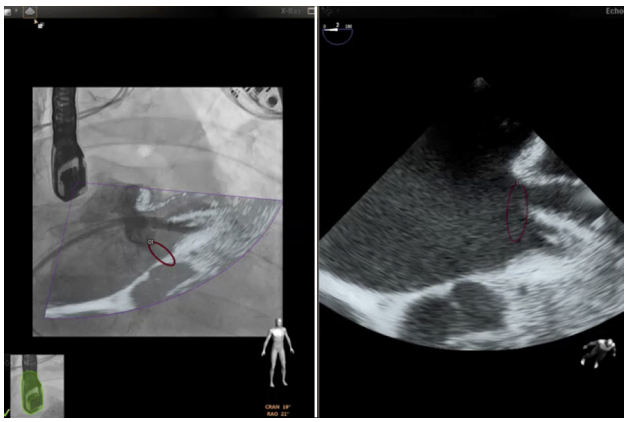
Conflict of interest

The author declares that he has no conflict of interest

Table 1 - Echocardiography/fluoroscopy fusion utility procedures.

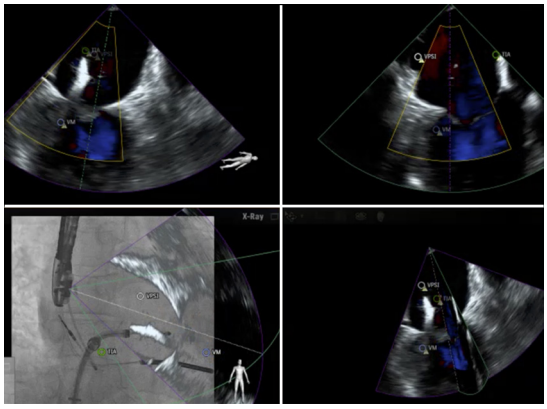
Procedure	Radiation reduction	Contrast agent reduction	Time reduction	Catheters, guidelines, and device visualization	Landmarks during procedure	Safety and feasibility
Transeptal punction	88 p; retrospective[2]		88 p; retrospective[2]		88 p; retrospective[2]	88 p; retrospective[2]
Paravalvular leak closure				Sometimes can obscure guides and catheters[2]	Small paravalvular defects or retrograde approach[2]	
Transcatheter mitral valve repair	21 p vs 21 p; non-randomized[4]	21 p vs 21 p; non-randomized[4]	21 vs 21 p;[4] in more than one implanted clip, a clinical reduction in time was noted		Can be useful in suboptimal image quality or shadowing from the guide catheter[2]	21 p vs 21 p; non-randomized[4]
Left atrial appendage closure			Theoretically[2]	Facilitate LAA cannulation[2]	Facilitate device implantation[2]	Theoretically[2]
Transcatheter aortic valve replacement		Theoretic reduction in CKD non-suitable for CCT[2]		Theoretically better evaluation of wire and device position[2]		
Congenital heart disease in adults					51 p;[6] improved confidence	51 p[6]

CCT, cardiac computed tomography; CKD, chronic kidney disease; LAA, left atrial appendage. p: patients; Green: advantages obtained in the study; Orange: some advantages and disadvantages observed in the study; Red: no benefits observed in the study.



Source: Dr. Jose Maria Hernandez, Monterrey, México.

Figure 1 – *Left atrial appendage closure guidance. Note the oval mark is showing the site of the left atrial appendage ostium.*



Source: Dr. Jose Maria Hernandez, Monterrey, México.

Figure 2 – *Fusion echocardiography/fluoroscopy in mitral clip guidance. Notice the three landmarks that provide safety during device implantation.*

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