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REVIEW

Usefulness of echocardiographic-fluoroscopic fusion imaging in adult structural heart disease

Apport de l'imagerie de fusion entre échocardiographie et fluoroscopie dans le traitement des cardiopathies structurelles de l'adulte

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EchoNavigator®

Summary Percutaneous approaches to treat structural heart diseases are growing in number and complexity. Multimodality imaging is essential for planning and monitoring such interventions. The combination of three-dimensional transoesophageal echocardiography with fluoroscopy is the cornerstone of interventional imaging. However, these two modalities are displayed on separate screens, and are handled by different physicians, which requires a complex mental reconstruction for the interventional team. To overcome this issue, echocardiographic-fluoroscopic fusion imaging has been introduced recently in clinical practice. This system

Abbreviations: 2D, two-dimensional; 3D, three-dimensional; echo, echocardiography; LAA, left atrial appendage; PVL, paravalvular leak; TOE, transoesophageal echocardiography.

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combines, in a single view, the precise visualization of catheter and devices provided by fluoroscopy with the continuous soft tissue information provided by echocardiography. In addition, the procedure may be guided using a marker-tracking mode. However, there are few data on how this new technology can have an impact on our routine clinical practice and patient outcomes. In this review, we provide a user manual for the system, discuss its potential clinical applications in adult structural heart diseases and consider future perspectives.

MOTS CLÉS
Cardiopathies structurelles ;
Échocardiographie ;
Fluoroscopie ;
Imagerie de fusion ;
Intervention ;
EchoNavigator®

Résumé Les solutions percutanées pour traiter les cardiopathies structurelles de l'adulte sont en constante augmentation mais leur complexité également. L'imagerie multimodale est indispensable pour la planification et le monitorage de ce type d'intervention. L'association de l'échocardiographie tridimensionnelle par voie œsophagienne et de la fluoroscopie constitue la pierre angulaire de l'imagerie interventionnelle. Cependant, ces deux modalités sont affichées sur des écrans séparés et sont chacune manipulées par des médecins différents, ce qui nécessite une reconstruction mentale complexe de la part de l'équipe interventionnelle. Afin de contourner ce problème, l'imagerie de fusion entre l'échocardiographie et la fluoroscopie a récemment été introduite en pratique clinique. Ce système permet de combiner sur un seul écran la précision de la fluoroscopie pour visualiser les cathéters et les dispositifs intracardiaques, à l'information tissulaire continue apportée par l'échocardiographie. De plus, la procédure peut être guidée par une fonction de marquage de zone d'intérêt. Cependant, il existe peu de données sur l'intérêt que peut avoir cette nouvelle technologie dans notre pratique clinique. Dans cette revue de la littérature, les auteurs détaillent le fonctionnement du système de fusion d'image, ses potentielles applications cliniques chez l'adulte, et les domaines qui restent à explorer.

Background

The success of transcatheter aortic valve replacement has opened the door to the development of numerous percutaneous approaches to treat structural heart diseases [1]. Exponential numbers of devices are in development for mitral and tricuspid valve repair or replacement, especially in patients at high risk of operative mortality and complications [2]. These complex procedures are increasingly challenging, with a prolonged learning curve, and requires the combination of different imaging modalities (fluoroscopy, echocardiography [echo] and computed tomography) for optimal sizing and monitoring, and to minimize procedure-related risks. A dedicated interventional team, involving cardiologists who cooperate and have a perfect mastery of multimodality imaging, is essential.

Structural heart disease procedures require real-time monitoring of cardiac structures by two-dimensional (2D) and three-dimensional (3D) transoesophageal echocardiography (TOE), and the accurate localization of catheters and devices by fluoroscopy. However, these two imaging modalities are handled by two different cardiologists, and are displayed side-by-side on different screens with different orientations. A mental reconstruction and fusion of the information delivered by the two imaging modalities is necessary, but not intuitive, and may complicate the procedure. To overcome this issue, echocardiographic-fluoroscopic fusion imaging (EchoNavigator® system; Philips Healthcare, Best, The Netherlands) has been introduced recently as a novel software solution to optimize guidance in acquired and congenital [3,4] structural heart interventions.

In this review, we focus on this new modality and its potential clinical applications for structural heart procedures in adults.

How to use the EchoNavigator® system

This software requires a full echocardiographic and fluoroscopic Philips system. The ultrasound system must include the 3D modality, using a standard TOE probe (X7-2t; Philips Healthcare) combined with a recent fluoroscopic system (Allura Xper FD10; Philips Healthcare). The central control unit of the fusion imaging software is housed in the catheterization control room, but can be controlled remotely in the procedure room using a wireless mouse. During the procedure, the software can be handled by both the interventional cardiologist and the echocardiographer, but usually by the latter. This real-time and user-friendly software requires no additional hardware to merge and synchronize the echocardiographic and fluoroscopic modalities. Data from the EchoNavigator® can be stored throughout the procedure, but only in AVI or JPEG format, without the possibility of postprocessing analysis.

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