

Contribution of Three-Dimensional Echocardiography Xplane Mode in the Evaluation of Semilunar Cusps: Two Different Case Reports

Üç Boyutlu Ekokardiyografi X Düzlem Yönteminin Semilunar Tüberküllerin Değerlendirilmesine Katkısı: İki Farklı Olgu Sunumu

ABSTRACT

Orthogonal-biplane imaging (X-plane) is relatively a new tool and provides comprehensive information about mitral valve and left atrial appendage evaluation. On the other hand, X-plane method is a promising method in the diagnosis of semilunar valve pathologies. Below, we report 2 cases, in which X-plane method was used, in order to clarify diagnosis.

Case 1: Case 1 was a 63-year-old male patient who was admitted to our clinic with dyspnea. Right ventricular dilatation and hypertrophy were assessed. In order to determine the exact reason for right ventricular pressure overload, the pulmonary valve was evaluated by X-plane, and a bicuspid pulmonary valve was represented. This patient underwent pulmonary valve percutaneous valvuloplasty.

Case 2: Case 2 was a 48-year-old male patient who was admitted to our hospital with a history of cerebrovascular event. His initial transthoracic and transesophageal echocardiography showed a hyperechoic mobile mass on the non-coronary cusp. However, after X-plane was used to detect the aortic valve, it was the prolapsed part of the non-coronary cusp adjacent to the commissure. These 2 case reports demonstrated the efficacy of the X-plane method in the diagnosis of semilunar valve pathologies in daily practice.

Keywords: Echocardiography, valve disease, X-plane echocardiography

ÖZET

Ortogonal-biplane görüntüleme (X-plane) nispeten yeni bir araçtır ve mitral kapak ve sol atriyal apendiks değerlendirmesi hakkında kapsamlı bilgi sağlar. X düzlemi yöntemi ise semilunar kapak patolojilerinin tanısında umut vadeden bir yöntemdir. Aşağıda, tanıyı netleştirmek için X-plane yönteminin kullanıldığı iki olgu sunulmaktadır.

Olgu 1: 63 yaşında erkek hasta nefes darlığı şikayeti ile kliniğimize başvurdu. Sağ ventrikül dilatasyonu ve hipertrofi değerlendirildi. Sağ ventrikül basıncının aşırı yüklenmesinin kesin nedenini belirlemek için X-plane ile pulmoner kapak değerlendirildi ve biküspit pulmoner kapak saptandı. Bu hastaya pulmoner kapak perkütan valvüloplasti yapıldı.

Olgu 2: 48 yaşında erkek hasta serebrovasküler olay öyküsü ile hastanemize başvurdu. İlk trans-toraksik ve transözofageal ekokardiyografisinde koroner olmayan uçta hiperekoik mobil kitle görüldü. Bununla birlikte, aort kapağını saptamak için X-plane kullanıldıktan sonra, görülen bu yapının koroner olmayan kapağın komissüre bitişik olan prolapsus gösteren kısmı olduğu görüldü. Bu iki olgu sunumu, günlük pratikte semilunar kapak patolojilerinin tanısında x düzlem yönteminin etkinliğini göstermiştir.

Anahtar Kelimeler: Ekokardiyografi, kapak hastalığı, X-plane ekokardiyografi

Orthogonal-biplane imaging (X-plane) is a relatively new tool and provides comprehensive information about mitral valve and left atrial appendage evaluation and atrial septal defect sizing. Since 2-dimensional and 3-dimensional echocardiography are useful to detect valve geometry and size defects of the atrial septum, additional measurements and methods are required in certain patient groups. Below, we report 2 case reports that illustrate the usefulness of the 3-dimensional X-plane method while evaluating valve anatomy in daily practice.

CASE REPORT OLGU SUNUMU

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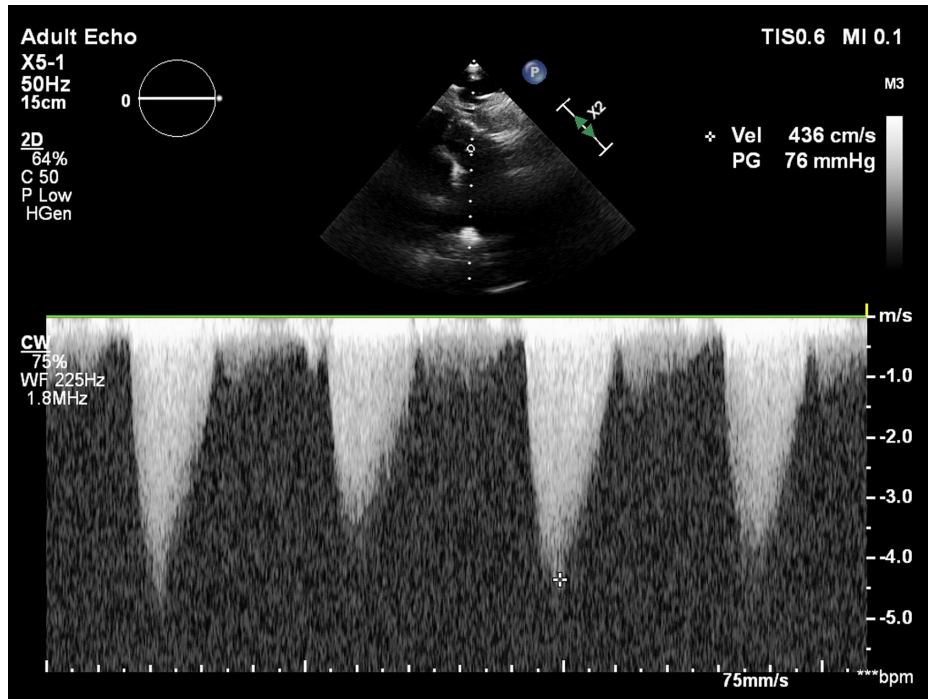


Figure 1. Transvalvular pulmonary gradient representing pulmonary stenosis.

Case Reports

Case 1

A 63-year-old patient was admitted to our outpatient clinic with symptoms of atypical chest pain and dyspnea. His electrocardiogram was in sinus rhythm with right ventricular hypertrophy and right bundle branch block. In his physical examination, a 3-4/6 systolic murmur was heard in the pulmonary area. Transthoracic echocardiography (TTE) showed pulmonary valvular stenosis with a gradient of 69 mm Hg and mild to moderate pulmonary regurgitation with a pressure half-time of 250 msn. The pulmonary valve was observed by the 3D X-plane method and a bicuspid pulmonary valve was precisely demonstrated (Figure 1, Video 1, Video 2). The configuration of the pulmonary valve was changed so that the pulmonic valve could be evaluated perpendicularly with the X-plane imaging and the orthogonal axis revealed that the valve was a bicuspid pulmonary valve. Systolic D septum was observed due to pressure overload. The right ventricle was slightly dilated and significantly hypertrophied depending on the pressure. To exclude other conditions which may cause right atrial and ventricular dilatation, transesophageal echocardiography was performed and the interatrial and ventricular septum was found to be intact. The patient was counseled by the heart team and pulmonary balloon valvuloplasty was performed successfully.

ABBREVIATIONS

LAA	Left atrial appendage
TOE	Transesophageal echocardiography
TTE	Transthoracic echocardiography
X-plane	Orthogonal-biplane imaging

Case 2

A 48-year-old male patient applied to our outpatient with a history of cerebrovascular events. His electrocardiogram was in sinus rhythm with the normal axis. Physical examination revealed a 3/6 systolic murmur specifically in the aortic area. TTE represented a raphe between the right and left coronary cusp of the aortic valve, moderate aortic regurgitation, and a nodular calcification on the raphe. Transesophageal echocardiography (TOE) was performed for a more detailed assessment of the aortic valve. In the parasternal long axis of TOE, a hyper-echogenic, mobile image was detected on the non-coronary cusp on the aortic face of the aortic valve (Video 3). At first sight, it was considered a mass that could be a source of cerebrovascular events. No mobile mass was observed in the aortic short axis evaluation in 2D and 3D echocardiography (Video 4, Video 5). Thereupon, orthogonal axes were examined with the X-plane to localize the mobile mass. After this mobile structure was examined by the X-plane method, it turns out that it was the prolapsed part of the non-coronary cusp adjacent to the commissure by using the X-plane method (Video 6). Three-dimensional analysis of the aortic valve in the short axis remained to be normal (Video 3). The patient was decided to be followed up annually.

Discussion

TTE and TEE are used in order to diagnose valvular diseases for decades. Despite the fact that the majority of valvular abnormalities are still diagnosed by traditional methods, further evaluation is required in certain patient groups.

Three-dimensional echocardiography data acquisition modes are simultaneous multiplane mode, focused wide sector (zoom mode), and full volume-gated acquisition.¹ X-plane mode

provides a double screen to display 2 real-time images. The second image is derived from the first reference view by rotating 30° to 150°¹ is a relatively new tool in order to assess multiplanar imaging of interatrial septum, mitral and aortic valve, and left atrial appendage (LAA), either 2D or color superimposed.

Left atrial appendage morphology is a challenging topic in clinical practice. It is problematic to check LAA in patients with a smaller size of LAA. Anselmino et al² reported that the 3D X-plane method increases reproducibility in such patient groups and can be combined with a specific diagnostic algorithm. In clinical practice, evaluating LAA at 135° is very important for the complete exclusion of thrombus in TOE. Xplane has made this assessment easy and routine in this window of TOE.^{2,3}

Compared to the surgical findings 2D X-plane was a sensitive technique (overall 2D X-plane sensitivity 88% vs. 80% for 3D) to identify MV prolapse and the inter-observer agreement for identification of the prolapsing MV scallop was excellent. While 2D X-plane is an easy, accurate, and noninvasive imaging modality, standard 2D supplemented with 2D X-plane is suggested to be used in the outpatient clinic for optimal assessment of mitral valve anatomy, mechanism of regurgitation, and exact tips of rheumatic stenotic valves.^{4,5}

For the considerable group of patients, the use of X-plane for semilunar cusps is extremely informative. It facilitates the diagnosis of aortic valve prolapse, masses, perforation, and paravalvular leak localization. In cases where the pulmonary valves are thick or retracted, a second plane provides additional evaluation. Since the signals are perpendicular to the pulmonary valve in the aortic short axis, it is not possible to see the short axis of the pulmonary valve with the X-plane mode. However, in our patient, with RV hypertrophy, the anatomically altered pulmonary valve was easily evaluated with X-plane in the short axis as a bicuspid pulmonary valve.

To the best of our knowledge, there is no case report with a pulmonary bicuspid valve diagnosed by X-plane imaging. It is a highly valuable and reproducible approach in transthoracic echocardiography. It is noninvasive, less time-consuming, and can be used in daily routine. Additionally, the X-plane method can be used in both TTE and TOE for assessing the valvular and subvalvular anatomy of the aortic valve.

Data Availability Statement: The data that demonstrate the findings of this case are available from the corresponding author upon reasonable request.

Informed Consent: The consent of the patient was obtained before this report was written.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – G.B.G.; Design – G.B.G., G.K.; Supervision – G.B.G.; Materials – K.M.S.; Data Collection and/or Processing – K.M.S.; Analysis and/or Interpretation – T.A.; Literature Review – T.A.; Writing – T.A.; Critical Review – T.A.

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Video 1: Two-dimensional transthoracic view of the bicuspid pulmonary valve.

Video 2: X-plane imaging of pulmonary valve (transthoracic echocardiography, short axis view).

Video 3: Transesophageal parasternal long axis view of aortic valve demonstrating a suspicious hyperechogenic mobile image detected on the non-coronary cusp on the aortic face.

Video 4: Transesophageal parasternal short axis view of the aortic valve.

Video 5: Transesophageal parasternal short-axis view of the aortic valve (3-dimensional imaging).

Video 6: X-plane imaging of the aortic valve illustrates that a prolapsed part of the aortic valve can easily be mistaken as a mobile mass.

References

- Lang RM, Badano LP, Tsang W, et al. EAE/ASE recommendations for image acquisition and display using three dimensional echocardiography. *EJH*-2012. *J Am Soc Echocardiogr.* 2012;25(1):3-46. [\[CrossRef\]](#)
- Anselmino M, Frea S, Gili S, et al. Left atrial appendage morphology at transesophageal echocardiography: how to improve reproducibility? *Minerva Cardiol Angiol.* 2021;69(2):178-184. [\[CrossRef\]](#). Epub 2020 Jul 10.
- Yosefy C, Azhibekov Y, Brodtkin B, Khalameizer V, Katz A, Laish-Farkash A. Rotational method simplifies 3-dimensional measurement of left atrial appendage dimensions during transesophageal echocardiography. *Cardiovasc Ultrasound.* 2016;14(1):36. [\[CrossRef\]](#)
- McGhie JS, de Groot-de Laat L, Ren B, et al. Transthoracic two-dimensional xplane and three-dimensional echocardiographic analysis of the site of mitral valve prolapse. *Int J Cardiovasc Imaging.* 2015;31(8):1553-1560. [\[CrossRef\]](#). Epub 2015 Aug 15.
- Alfakhouri A, Heidrich FM, Sveric KM, et al. Three-dimensional transoesophageal echocardiography is crucial for valid assessment of mitral valve leaflet morphology in severe mitral regurgitation prior to interventional repair. *Acta Cardiol.* 2018;73(4):352-360. [\[CrossRef\]](#). Epub 2017 Oct 5.