CASE REPORT

The other side of the coin in primary tricuspid valve disease: The incremental value of 3D echocardiography

Primer triküspid kapak hastalığında madalyonun arka yüzü: Üç boyutlu ekokardiyografinin artan değeri

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Summary– Primary tricuspid valve regurgitation may be encountered in daily practice as a result of multiple etiologies. Described herein are the cases of 2 patients with severe primary tricuspid regurgitation. The underlying mechanism was posterior leaflet prolapse due to spontaneous chordae rupture in 1 case, and iatrogenic posterior leaflet tissue loss during removal of a permanent pacemaker in the other. Transthoracic and transesophageal echocardiography, which permit assessment of the tricuspid valve with multilevel imaging, are the techniques of choice for accurate detection and understanding of the etiology, the severity of valve regurgitation, and the determination of treatment options, in addition to providing assistance with timing and guidance during intervention. Three-dimensional echocardiography offers the ability to visualize the entire tricuspid valve and to identify which leaflets are affected by the pathology.

Özet– Günlük pratikte, birçok nedene bağlı olarak gelişebilen primer triküspit kapak yetersizliği sekonder triküspit kapak yetersizliğinden daha az sıklıkta görülmektedir. Bu yazıda, spontan korda rüptürüne bağlı posteriyor yaprakçık prolapsusu ve kalıcı pacemakerın çıkarılması sırasında oluştuğunu düşündüğümüz iyatrojenik posteriyor yaprakçık doku kaybı nedeniyle ileri triküspit kapak yetersizliği olan iki hasta sunuldu. Triküspit kapağın değerlendirilmesi, transtorasik ve bazen transözofajiyal ekokardiyografi ile çok seviyeli görüntüleme gerektirir ki; etiyolojiyi, kapak yetersizliğinin ciddiyetini, tedavi seçeneklerini ve zamanını belirlemek ve girişim sırasında rehberlik için seçilecek tekniklerdir. Üç boyutlu ekokardiyografi, tüm triküspit kapak yaprakçıklarını aynı anda görüntülemeyi ve hangi yaprakçıkların patolojiden etkilendiğini saptama avantajını sağlar.

Abbreviations:

NYHA	*New York Heart Association*
TR	*Tricuspid valve regurgitation*
TTE	*Transthoracic echocardiography*

Primary tricuspid valve regurgitation (TR) is encountered less frequently than secondary TR. Possible causes of primary TR include rheumatic heart disease, myxomatous degeneration, endocarditis (especially in intravenous drug addicts), trauma/iatrogenic cases, pacemaker or defibrillator leads interfering with leaflet coaptation, carcinoid syndrome, endomyocardial fibrosis, Ebstein's anomaly, congenitally dysplastic valves, and drug-induced valve disease. Although spontaneous tricuspid valve chordae rupture and leaflet prolapse is quite a rare condition, iatrogenic tricuspid valve deformations have been increasingly observed with the growing number of interventional procedures.[1–4] Echocardiography is the primary modality used to evaluate the etiology and to quantify TR, as well as to thoroughly assess the left-sided heart, right ventricle, right atrium, and inferior vena cava to make the appropriate diagnosis and decisions.[3–6]

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Case 1 – A 40-year-old man presented with dyspnea on exertion and at rest persisting for a month. An elec-

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trocardiogram indicated a sinus rhythm of 75/bpm. Transthoracic echocardiography (TTE) revealed prolapse of the posterior tricuspid valve leaflet with redundant tissue, severe TR (vena contracta, 1.02 cm), mild pericardial effusion, and normal left ventricle and mitral valve function (Fig. 1). Posterior tricuspid leaflet prolapse and chordae tendineae rupture were clearly observed with a 3-dimensional (3D), 4-beat, full volume examination using TTE with a Philips X5-1 ultrasound transducer probe (Philips Healthcare, Inc., Andover, MA, USA) (Fig. 2). The absence of a fever and negative blood cultures excluded infective endocarditis. The patient was referred for a surgical repair. He has been well for 6 months following the surgery.

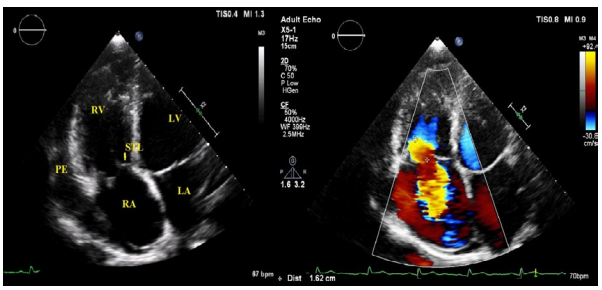

Figure 1. Transthoracic apical 4-chamber view without and with color Doppler showed posterior tricuspid valve leaflet prolapse and a normal septal leaflet. The right side revealed severe tricuspid regurgitation on color Doppler examination (Vena contracta width: 1.02 cm; proximal isovelocity surface area radius: 1.62 cm). LA: Left atrium; LV: Left ventricle; PE: Pericardial effusion; RA: Right atrium; RV: Right ventricle.

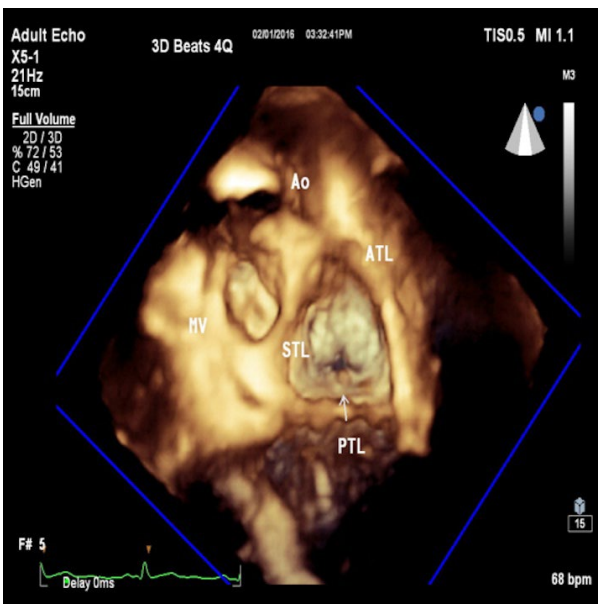

Figure 2. Transthoracic 3-dimensional 4-beat full volume acquisition demonstrated tricuspid valve posterior leaflet prolapse and chordae rupture. Ao: Aorta; ATL: Anterior tricuspid leaflet; MV: Mitral valve; PTL: Posterior tricuspid leaflet; STL: Septal tricuspid leaflet.

Case 2 – A 65-year-old man presented with progressive dyspnea (New York Heart Association [NYHA] class III) on exertion and pretibial edema. An electrocardiogram revealed atrial fibrillation and a paroxysmal pacemaker rhythm. A TTE examination revealed mildly reduced left ventricle systolic function (45%), moderate secondary mitral regurgitation, and severe TR with no or only trivial septal or posterior leaflet tissue (Fig. 3a). His medical history included a first permanent pacemaker implantation in 2004, and pocket hematoma followed by pocket infection and pacemaker re-implantation on the right side of the chest. In 2008, surgical lead extraction was

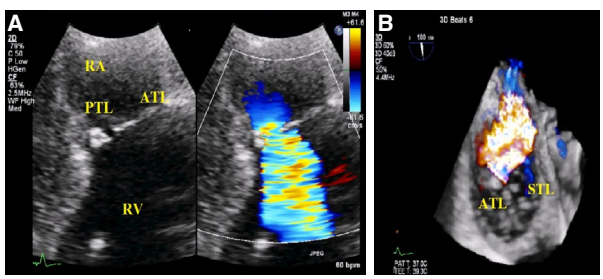

Figure 3. (A) From the transthoracic parasternal long-axis right ventricle inflow view, the anterior tricuspid leaflet appeared normal, but septal or posterior leaflet tissue loss was causing severe tricuspid regurgitation. **(B)** Transesophageal 3-dimensional color flow examination showed severe tricuspid regurgitation from posterior leaflet tissue deformation that likely occurred during removal of a pacemaker. ATL: Anterior tricuspid leaflet; PTL: Posterior tricuspid leaflet; RA: Right atrium; RV: Right ventricle; STL: Septal tricuspid leaflet.

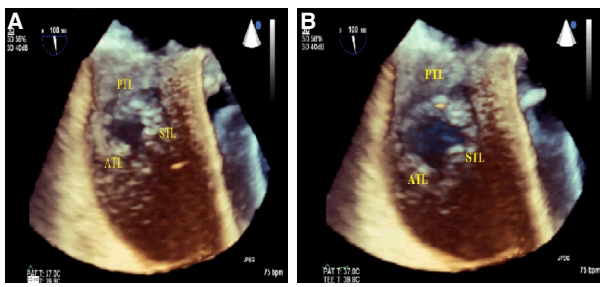

Figure 4. (A, B) F Transesophageal 1-beat 3-dimensional zoom mode clearly showed a posterior leaflet defect in systole and diastole. Normal anterior and septal tricuspid leaflet function was also visible. ATL: Anterior tricuspid leaflet; PTL: Posterior tricuspid leaflet; STL: Septal tricuspid leaflet.

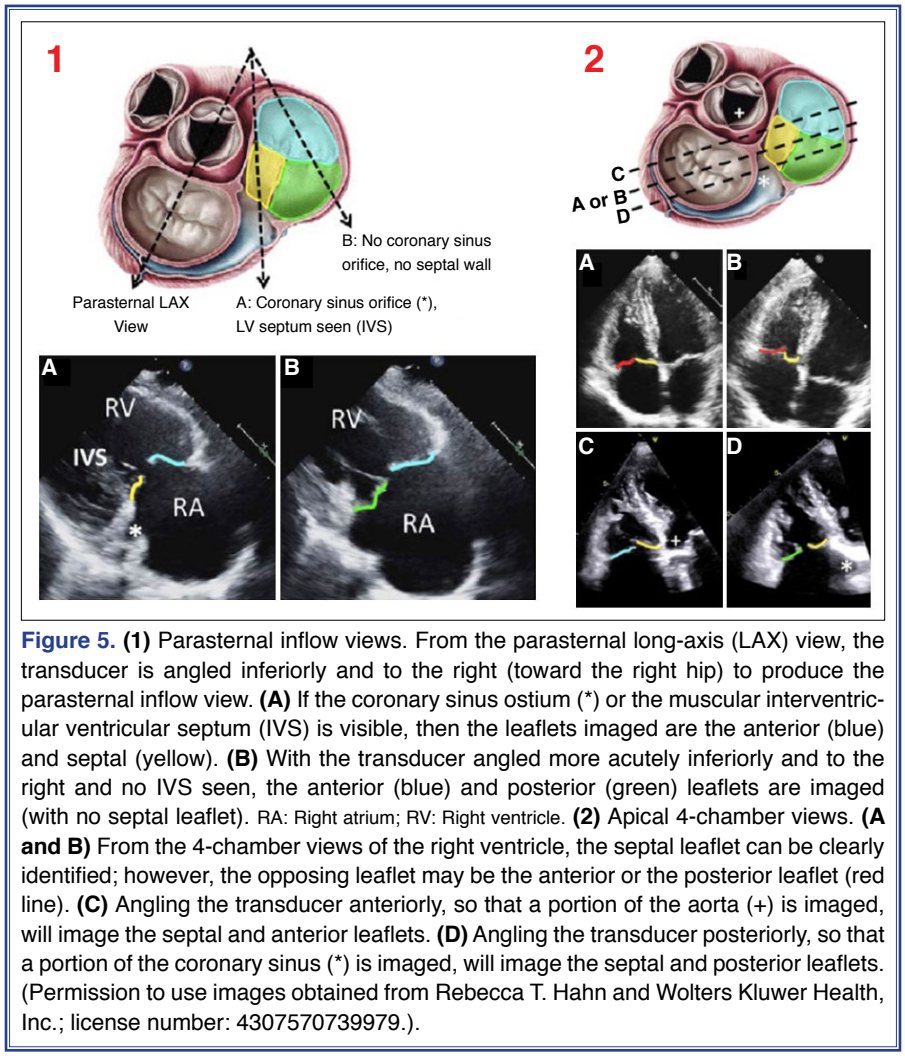

Figure 5. **(1)** Parasternal inflow views. From the parasternal long-axis (LAX) view, the transducer is angled inferiorly and to the right (toward the right hip) to produce the parasternal inflow view. **(A)** If the coronary sinus ostium (*) or the muscular interventricular ventricular septum (IVS) is visible, then the leaflets imaged are the anterior (blue) and septal (yellow). **(B)** With the transducer angled more acutely inferiorly and to the right and no IVS seen, the anterior (blue) and posterior (green) leaflets are imaged (with no septal leaflet). RA: Right atrium; RV: Right ventricle. **(2)** Apical 4-chamber views. **(A and B)** From the 4-chamber views of the right ventricle, the septal leaflet can be clearly identified; however, the opposing leaflet may be the anterior or the posterior leaflet (red line). **(C)** Angling the transducer anteriorly, so that a portion of the aorta (+) is imaged, will image the septal and anterior leaflets. **(D)** Angling the transducer posteriorly, so that a portion of the coronary sinus (*) is imaged, will image the septal and posterior leaflets. (Permission to use images obtained from Rebecca T. Hahn and Wolters Kluwer Health, Inc.; license number: 4307570739979.).

performed due to infective endocarditis, and an epicardial VVI pacemaker had been surgically inserted. The 2D mid-esophageal 4-chamber view and 3D 1-beat zoom mode (Fig. 4), along with 3D color Doppler examination (Fig. 3b) showed severe TR, probably due to posterior leaflet tissue loss during removal of the pacemaker. Surgery to repair the tricuspid valve was recommended, but the patient declined. He has been followed up with medical treatment for continued NYHA class II dyspnea for 1 year.

DISCUSSION

Imaging of the tricuspid valve has some challenges and should include careful imaging from multiplane views due to the unique shape of the tricuspid valve (thin, nonuniform 3 leaflets, triangular, saddle-shaped annulus). The anterior and septal tricuspid leaflet (if the septum/left ventricle are in view) or posterior leaflet (with a more extreme rightward and inferior tilt) may be observed in 2D TTE parasternal inflow views. Parasternal short-axis views may allow for imaging of the anterior and posterior leaflet. From the apical 4-chamber view, the septal and anterior tricuspid leaflets may be imaged, and the posterior leaflet may be seen with posterior angulation (Fig. 5).[3–6] None of these windows can image all of the tricuspid leaflets simultaneously, but a 2D transesophageal echocardiography transgastric view can show all 3 leaflets of the tricuspid valve at the same time. Three-dimensional echocardiography is still necessary to image all of the tricuspid leaflets together and to fully characterize the mechanism of valve pathologies and determine which leaflets are affected, especially in cases of posterior leaflet disease.[3,4,6–8] Arrhythmia is another problem for 3D full-volume acquisition; in such cases, 1-beat zoom mode or a narrow sector is

used, as in Case 2. Images from 3D TTE may sometimes be of better quality when compared with 3D transesophageal images due to the anterior and apical position of the tricuspid valve, as in Case 1.

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