Traumatic rupture of the tricuspid valve and multi-modality imaging

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Introduction: Motor vehicle accident (MVA) account for most cases of traumatic rupture of the tricuspid valve. Valve rupture during an MVA is generated by an abrupt deceleration coupled with an increase in right-side cardiac pressures (Valsalva maneuver and thorax compression).

Case: A 39-year-old asymptomatic man was referred for an echocardiogram due to the presence of a systolic murmur. He had no prior significant medical history, except for a remote MVA 3 years ago. Real-time 3D echocardiography (RT3DE) showed a tear in the body of the anterior leaflet and not at the cord, as was suggested by two-dimensional transthoracic echocardiography (2D-TTE). Based on these findings, the mechanism was considered anterior leaflet rupture of the tricuspid valve, secondary to chest blunt trauma. The anterior leaflet was repaired using two polytetrafluoroethylene sutures, and tricuspid annuloplasty with an Edwards ring was performed.

Conclusions: Multimodality imaging helps to determine timing of surgery in asymptomatic traumatic tricuspid rupture. The combination of echocardiography and magnetic resonance imaging provide information of volumetric data and contractility of the right ventricle (RV) during follow-up. RT3DE gives information relevant to the morphological and functional characterization of the valve, allowing the planning of appropriate surgical procedure.

Keywords: Traumatic rupture of the tricuspid valve; three-dimensional transthoracic echocardiography; cardiac magnetic resonance

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Case report

A 39-year-old asymptomatic man was referred for an echocardiogram due to the presence of a systolic murmur. He had no prior significant medical history, except for a remote MVA 3 years ago.

His vital signs were heart rate 70/min, and blood pressure 120/70 mmHg. His jugular venous pressure was not elevated, had no peripheral edema or hepatomegaly, but a holosystolic murmur was heard at the fourth left parasternal border. A chest X-ray demonstrated normal clinical course. Echocardiography plays an important role in the diagnosis, follow-up, and surgical indication in patients with tricuspid valve rupture (2,3).
cardiac silhouette. The electrocardiogram showed sinus rhythm. Two-dimensional transthoracic echocardiography (2D-TTE) revealed severe tricuspid regurgitation (TR) and a moderately dilated right ventricle (RV) with apparent normal systolic function (Figure 1, Figure 1A) (Figures 2-5). The precise mechanism for this valve dysfunction was not clearly defined; it appeared to be secondary to the annulus; (D) right: post-processed full volume image. Tricuspid valve is viewed from the RV (systole) tricuspid valve is closed and folded. Note the persistence of a linear image indicative of an anterior leaflet rupture (arrow). Data acquisition was performed by two experienced sonographers using an ×3 matrix transducer connected to an RT-3DE system (IE33, Philips Medical Systems). Harmonic RT3DE imaging was performed in the same setting with the fully sampled matrix array transducer (×4, 2 to 4 MHz) that uses 3,000 elements to obtain a pyramidal volume data set from a single window. 2D-TTE, two-dimensional transthoracic echocardiography; RT3DE, real-time 3D echocardiography; RA, right atrium; RV, right ventricle; TR, tricuspid regurgitation.

Figure 1 TTE. (A) Left: longitudinal view of the RV during systole. Note the linear structure in the mid-portion of the tricuspid anterior leaflet (arrow) consistent with cord rupture. Nevertheless, it is interesting to note that central coaptation is not lost; (B) right side: color Doppler image showing severe TR; (C) left: post-processed full volume image. Tricuspid valve is viewed from the RV (diastole). Note a tear in the body of the anterior leaflet (arrow) and not at the chord, as was suggested by 2D-TTE. The tear is observed from the free border to the annulus; (D) right: post-processed full volume image. Tricuspid valve is viewed from the RV (systole) tricuspid valve is closed and folded. Note the persistence of a linear image indicative of an anterior leaflet rupture (arrow). Data acquisition was performed by two experienced sonographers using an ×3 matrix transducer connected to an RT-3DE system (IE33, Philips Medical Systems). Harmonic RT3DE imaging was performed in the same setting with the fully sampled matrix array transducer (×4, 2 to 4 MHz) that uses 3,000 elements to obtain a pyramidal volume data set from a single window. 2D-TTE, two-dimensional transthoracic echocardiography; RT3DE, real-time 3D echocardiography; RA, right atrium; RV, right ventricle; TR, tricuspid regurgitation.

Figure 2 TTE. Two-dimensional echocardiography. Four chamber view for see right ventricle (RV) (4). Available online: http://www.asvide.com/articles/310
in the body of the anterior leaflet and not at the cord, as was suggested by 2D-TTE (Figure 1C). Based on these findings, the mechanism was considered anterior leaflet rupture of the tricuspid valve, secondary to chest blunt trauma. Nevertheless, it is interesting to note that central coaptation is not lost, this probably acted to preserve some residual tricuspid valve function and the patient was not in clinical RV failure (Figures 6, 7).

We recommended early surgical intervention to prevent RV failure.

The anterior leaflet was repair using two
polytetrafluoroethylene sutures, and tricuspid annuloplasty with an Edwards MC ring was performed. Post-operative 2D-TTE demonstrated no residual TR and good leaflet apposition. His recovery was uncomplicated and he was discharged 6 days post-operative.

RT3DE was very useful in the evaluation of spatial abnormalities of the tricuspid valve and helps in making a decision for surgical intervention.

Discussion

MVA are a major cause of traumatic tricuspid insufficiency (10-12). In the acute phase of blunt chest trauma, TR may often go undetected because the associated injuries of other organs tend to obscure the cardiac involvement (13). Therefore, the frequency of traumatic tricuspid insufficiency is probably underestimated (10). However, because TR with flail leaflets is a serious and progressive disease (14), the early diagnosis of this disorder is very important. According to previous reports in the literature, if the TR is severe, the prognosis is poor even in asymptomatic patients.

Enlargement of the RV in the presence of TR is also predictive of a poor outcome (14). Surgical intervention should be considered in such patients because it entails low operative mortality and provides symptomatic improvement (15-17).

Knowledge of RV diameter and function in addition to data regarding the systemic venous circulation is of interest prior to tricuspid valve surgery (18-20). For the assessment of the RV, contractility parameters obtained with tissue Doppler or 2D-strain echocardiography, plus high quality volumetric and diameters data obtained with cardiac magnetic resonance provide an excellent combination for preoperative evaluation (Figure 8).

RT3DE emerges as a novel useful imaging tool, offering a detailed anatomic and functional assessment of the tricuspid valve (21,22).

Conclusions

Multimodality imaging may help to determine the time of surgery in asymptomatic traumatic tricuspid rupture. The combination of echocardiography and magnetic resonance imaging provide information of volumetric data and contractility of the RV during follow-up.

RT3DE gives information relevant to the morphological and functional characterization of the valve, allowing the planning of appropriate surgical procedure.

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References
