CASE REPORT

Visualization of traumatic tricuspid insufficiency by three-dimensional echocardiography

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Summary A 19-year-old male was admitted to the emergency room of our hospital after a motor vehicle accident. During his first physical examination, a holosystolic murmur was heard at the fourth left parasternal border. Transthoracic echocardiography showed severe tricuspid insufficiency, but the cause of tricuspid insufficiency was unclear. Therefore, three-dimensional echocardiography was performed and demonstrated flail anterior, posterior and septal leaflets of the tricuspid valve. The diagnosis was tricuspid insufficiency due to papillary muscle rupture secondary to chest blunt trauma. Surgical repair of the tricuspid valve was performed in this patient. After surgery, the signs and symptoms of right ventricular heart failure were relieved. In this case, three-dimensional echocardiography was very useful for the evaluation of spatial destruction of the tricuspid valve and papillary muscle.

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Introduction

Traumatic tricuspid regurgitation is a rare cardiovascular complication of blunt chest trauma. It has been gradually increasing due to an increase in traffic accidents over the past 40 years [1–3]. Three-dimensional echocardiography, which has advantages for spatial and anatomical resolution, has been introduced for the evaluation of tricuspid valve structure and function [4]. We describe a case of traumatic tricuspid insufficiency with prolapse of the whole tricuspid leaflets due to papillary muscle rupture.

Case report

A 19-year-old male was admitted to the emergency room of our hospital after a motor vehicle accident for further examination of consciousness disturbance and blunt chest trauma. No evidence of fractures or bleeding was revealed by the initial examination, including the skull and thorax. A holosystolic murmur was heard at the fourth left parasternal border. A chest X-ray demonstrated mild
cardiomegaly with right atrial enlargement. The electrocardiogram showed sinus tachycardia with complete right bundle branch block and negative T waves in leads II, III, aVF, and V1–V4. Two-dimensional transthoracic echocardiography showed severe tricuspid insufficiency with prolapse of the tricuspid valves into the right atrium using Vivid 7 Dimension ultrasound machine (GE Healthcare, Chalfont St Giles, UK) with an M4S probe (Fig. 1). For detailed assessment of the tricuspid valve and its surrounding structures, three-dimensional echocardiography (3DE) was used with a 3V probe. Further detailed analysis was performed with customized software EchoPAC PC (BT08; GE Healthcare). The 3D data set, including that for full volume scan, was acquired in 4 consecutive cardiac cycles during a breath-hold with ECG gating. The frame rate was 21 frames/s. Surgeon’s view by 3DE showed prolapse of the anterior, posterior and septal leaflets (Fig. 2). 3DE demonstrated flail anterior and septal leaflets of the tricuspid valve, with the anterior papillary muscle that was partially peeled from the interventricular septum (Fig. 3). The diagnosis was tricuspid insufficiency due to papillary muscle rupture secondary to chest blunt trauma. We recommended early surgical intervention to him, but he hesitated about it because his symptoms were controlled with medications. Therefore, the patient was medically treated despite the existence of severe tricuspid regurgitation. However, symptoms and signs of right-sided heart failure worsened at 3 months after diagnosis. Therefore, this patient agreed to undergo an operation, and was referred for surgical repair of the tricuspid valve and its surrounding components including the papillary muscles and chordae tendineae. During surgery, anterior and posterior papillary muscles were found to have been broadly

Figure 1  (A) Two-dimensional echocardiography showing prolapse of anterior and septal leaflets of the tricuspid valves into the right atrium in the parasternal short-axis view. RV, right ventricle; RA, right atrium; Ao, aorta; AL, anterior leaflet; SL, septal leaflet. (B) Color Doppler echocardiography showing severe tricuspid insufficiency.

Figure 2  Surgeon’s view by three-dimensional echocardiography showing prolapse of the anterior, posterior and septal leaflets. AL, anterior leaflet; PL, posterior leaflet; SL, septal leaflet; IVS, interventricular septum.
peeled off from the endocardium of right ventricle, resulting in prolapse of anterior, posterior and septal tricuspid leaflets. Artificial chordae were attached to the free wall from heads of papillary muscles using expanded polytetrafluoroethylene sutures (CV-5). Additionally, ring annuloplasty was performed using an Edwards MC3 ring (30 mm). After surgery, transesophageal echocardiography showed that tricuspid valve regurgitation was reduced, and his cardiac symptoms were relieved. 3DE was very useful in the evaluation of spatial abnormalities of the tricuspid valve and helps in making a decision for surgical intervention.

Discussion

Traumatic tricuspid insufficiency had been reported as a rare complication of blunt chest trauma. However, this condition has been reported with increasing frequency over the last 40 years. Motor vehicle accidents are a major cause of traumatic tricuspid insufficiency [1–3]. In the acute phase of blunt chest trauma, tricuspid regurgitation may go undetected because the associated injuries of other organ systems tend to obscure the cardiac involvement [5]. Therefore, the frequency of traumatic tricuspid insufficiency is probably underestimated [1]. However, because tricuspid regurgitation with flail leaflets is a serious and progressive disease [6], the early diagnosis of this disorder is very important. Since Doppler echocardiography offers the best opportunity for early diagnosis, our case could have been diagnosed as traumatic tricuspid insufficiency by Doppler echocardiography. According to previous reports in the literature, if the tricuspid regurgitation is severe, the prognosis is poor even in asymptomatic patients. Enlargement of the right ventricle in the presence of tricuspid regurgitation is also predictive of a poor outcome [6]. A poorer outcome with medical management compared with surgical intervention was confirmed by high-event rates in the natural history beginning from the time of diagnosis [6]. Surgical intervention should be considered in such patients because it entails low operative mortality and provides symptomatic improvement [6,7]. Surgical repair of the tricuspid valve has been advocated as a more aggressive strategy compared with valve replacement [1]. Repair of the tricuspid valve is recommended before the deterioration of right ventricular function [6,7]. In our case, severe tricuspid regurgitation and enlargement of the right ventricular cavity were recognized by routine echocardiography after symptoms of right ventricular failure developed. 3DE can be used to provide fast and noninvasive evaluation of tricuspid valve function that is more spatial and anatomically realistic compared with conventional echocardiography [4]. Some previous studies showed that 3DE can evaluate left ventricular volume, mass, and 3D geometry of the mitral and tricuspid valves [4]. 3DE was very useful in our patient to understand the anatomy of the tricuspid valve. In addition, 3DE can demonstrate flail anterior and septal leaflets of the tricuspid valve, with the anterior papillary muscle that was partially peeled off from the interventricular septum. 3DE provides detailed information about abnormalities of the tricuspid valve and its surrounding structures before surgery, and is clinically useful in making a decision for surgical intervention.

References


