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3D-echo in preoperative assessment of aortic cusps effective height

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Abstract

Effective height, which represents the height difference between the central free margins and the aortic insertion lines can be easily determined by 2-D echocardiography and allows for identification of prolapse in the native cusps and assessment of prolapse correction after valve repair. Nonetheless, it allows to see only two of three aortic valve (AV) coaptation planes and this may lead to misunderstanding of the underlying pathophysiological mechanism for aortic regurgitation and hence in unsuccessful repair. In contrast, 3D transoesophageal echocardiography and multiple plane reconstruction lets visualize all the three coaptation planes between the AV cusps and it represents an invaluable tool in the assessment of aortic valve geometry. It is highly recommendable before AV repair to accurately study the complex three dimensional cusps anatomy and their geometric interrelation with aortic root.

Key words: Aortic valve; Aortic repair; Aortic prolapse; Echocardiography

Core tip: 3D transesophageal echocardiography and multiple plane reconstruction lets visualize all the three coaptation planes between the aortic valve (AV) cusps and overcomes the limits of 2-D echocardiography which allows to see only two of three AV coaptation planes and this may lead to misunderstanding of the underlying pathophysiological mechanism for aortic regurgitation and hence in unsuccessful repair. It is highly recommendable before AV repair to accurately study the complex three dimensional cusps anatomy and their geometric interrelation with aortic root.

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TO THE EDITOR

In the recent years aortic valve (AV) repair has gained increasing interest in the treatment of aortic root pathology[1] as a feasible alternative to aortic valve replacement[2].

Good results have been achieved with valve-preserving aortic replacement for patients in whom aortic regurgitation is solely caused by aortic root dilatation with morphologically preserved valve leaflets[3]. In contrast, cusp repair still remains a surgical challenge when prolapse of cusp tissue impairs coaptation[4].

The most prominent echocardiographic phenomenon indicating cusps prolapse is a decreased effective height (eH) which represents the height difference between the central free margins and the aortic insertion lines[4]. This measurement, which depends on the complex re-

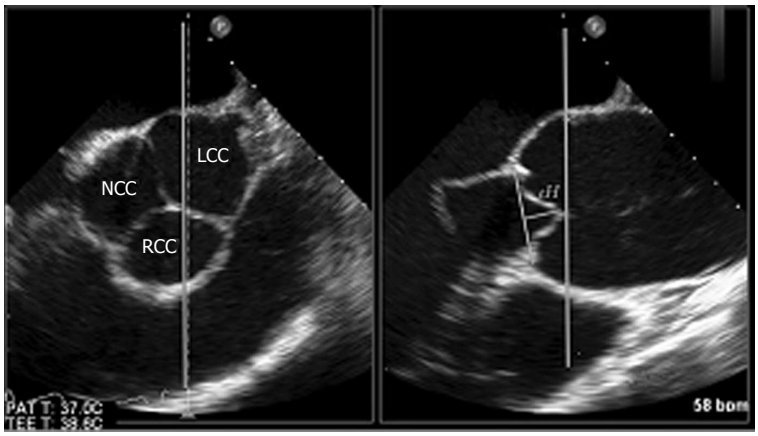

Figure 1 Established method of measuring the effective height in the 2-D short axis (left) and long axis image of the proximal aorta (right). As shown, only the coaptation between the right coronary cusp anteriorly and the left coronary cusp posteriorly can be measured. RCC: Right coronary cusp; LCC: Left coronary cusp; NCC: Noncoronary cusp.

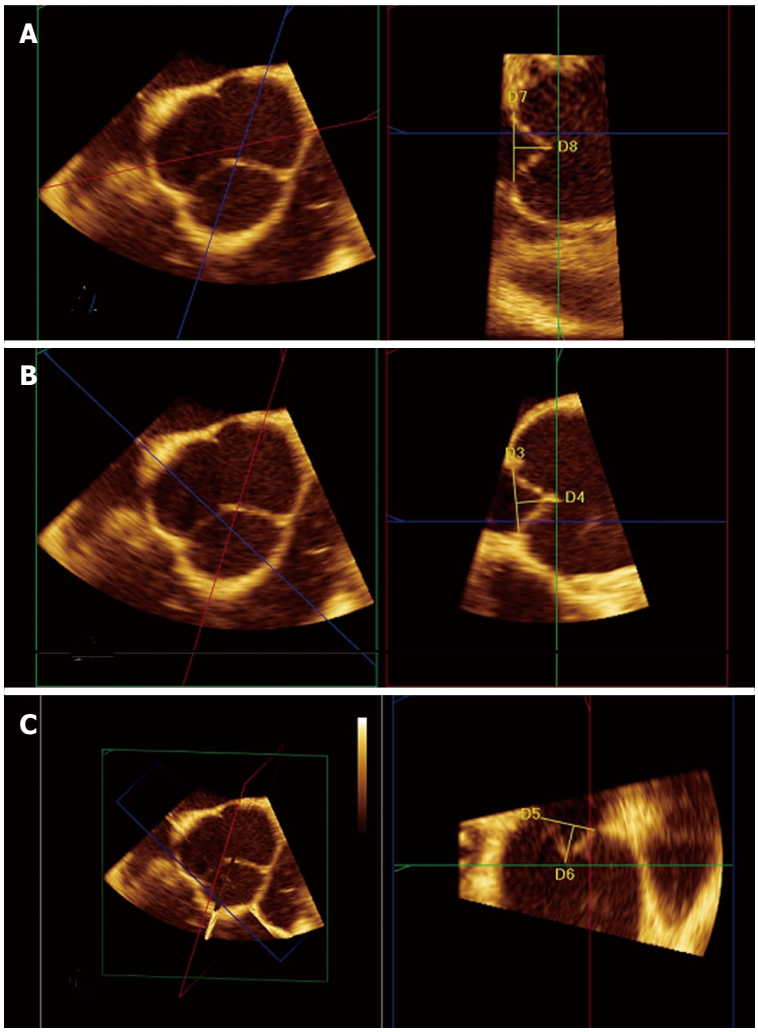

Figure 2 Images of a normal aortic valve from multiple plane reconstruction of the aortic valve with 3D transoesophageal echocardiography. A: The red plane intersects the coaptation surface of the noncoronary cusp (NCC) and left coronary cusps (LCC) The yellow line labelled D8 (12.7 mm) represents the LCC effective height; B: The red plane intersects the coaptation surface of the LCC and right coronary cusps (RCC) The yellow line labelled D4 (13.9 mm) represents the effective height; C: The red plane intersects the coaptation surface of the NCC and RCC. The yellow line labelled D6 (12.7 mm) represents the effective height.

lationship of root and cusp, can be easily determined by 2-D echocardiography and allows for identification of prolapse in the native cusps and assessment of prolapse correction after valve repair. Nonetheless, with 2-D transesophageal echocardiography (2D-TEE) only two of three AV coaptation planes can be seen and the eH, a unidimensional value, can be measured only between the right coronary cusp anteriorly and either the non- or left coronary cusp (depending on probe rotation) posteriorly (Figure 1).

As a result, pathology of the AV cusp not included in the view may go undetected and this may eventually result in misunderstanding of the underlying pathophysiological mechanism for aortic regurgitation and hence in unsuccessful repair.

Recent development of real-time 3D transoesophageal echocardiography (3D-TEE) allows multiple plane reconstruction (MPR) which lets visualize all the three coaptation planes between the AV cusps. Using MPR is possible to adjust the orthogonal imaging planes for op-

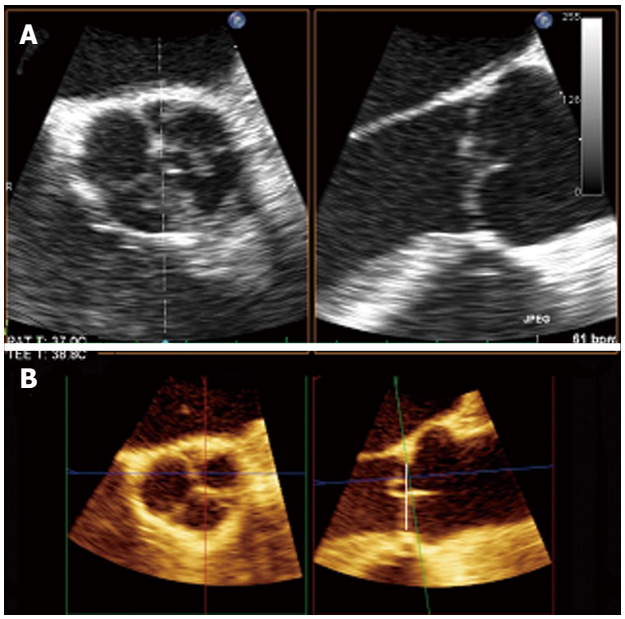

Figure 3 Patient male, 53-year-old. A: On 2 D there is no clear demonstration of prolapse; B: Multiple plane reconstruction of the aortic valve with 3D transesophageal echocardiography: on reformatted image a prolapse of left coronary cusps is shown (right).

timal visualization of all three aortic coaptation lines. By moving the planes is possible to identify the points where the cusps come together and to obtain, for each one, an accurate determination of the eH (Figure 2). 3D-echo multi-plane reconstruction is a valuable tool in the assessment of valve geometry and it is highly recommendable before AV repair to accurately study the complex three dimensional cusps anatomy and their geometric interrelation with aortic root as a functional unit (Figure 3). This is important since effective cusps height is a significant predictor of aortic valve repair failure. Indeed, an effective height > 8 mm is associated with 99.6% probability of clinically insignificant aortic regurgitation. Other significant predictors are residual regurgitation, a coaptation length < 4 mm and a level of cusp coaptation which is below the aortic annulus (type C)[5].

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