Assessing Relation of Tricuspid Valve Annular Tilt Index with Right Ventricular Enlargement in Patients with Tetralogy of Fallot in Cardiac Magnetic Resonance Imaging

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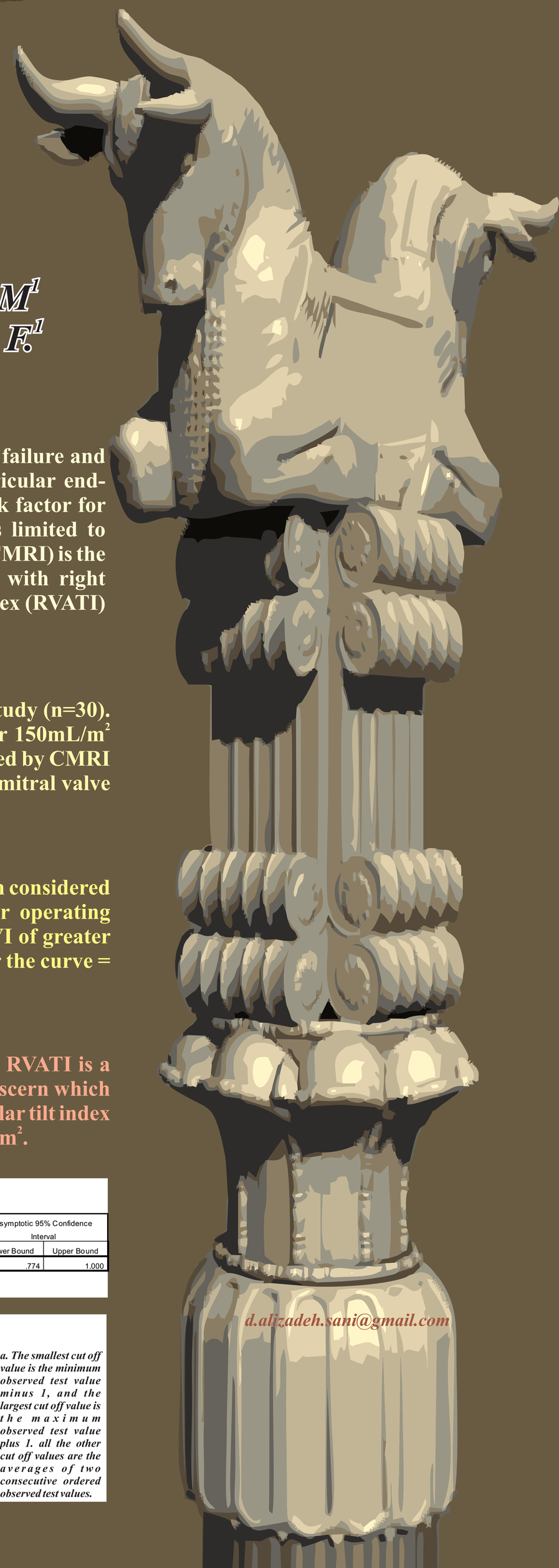

Objectives:

Right ventricular enlargement is an important risk factor for ventricular arrhythmias, right ventricular failure and sudden cardiac deah in patients with repaired tetralogy of fallot (TOF). In another word Right ventricular end-diastolic volume index (RVEDVI) based on the body surface area, greater than 150 mL/m^2 is a chief risk factor for sudden death in TOF patients. Because of abnormal geometry, two-dimensional echocardiography is limited to accurately assess right ventricular end-diastolic volume (RVEDV). Cardiac magnetic resonance imaging (CMRI) is the accepted standard for quantifying RVEDV. There is one study that measured RVEDV enlargement with right ventricular annular tilt (RVAT), but we assess RVEDV enlargement with right ventricular annular tilt index (RVATI) based on the body surface area to reach more accurate results.

Methods:

All patients with repaired TOF with an echocardiogram and CMRI were included in this retrospective study (n=30). The patients were divided into two groups according to RVEDVI: group a, patients with RVEDVI over 150mL/m^2 (n=15); group b, patients with RVEDVI under 150mL/m^2 (n=15). The RVEDV measurements were obtained by CMRI (Fig 2) and the RVAT was determined by measuring the angle of the tricuspid valve plane relative to the mitral valve plane at end-diastole in the apical 4-chamber view in echocardiographic study (Fig 1) (n=30).

Results:

The mean RVEDVI was 151.5±38.8 mL/m^2 in the study groups that 15 patients were over 150mL/m^2 (which considered as lower risk of sudden death). The mean RVATI was 11.0± 2.5 degrees/m^2 in all patients. Receiver operating characteristic analysis demonstrated an RVATI of 17.1 degrees/m^2 as the cutoff for predicting a RVEDVI of greater than 150 mL/m^2 with a sensitivity of 93.3% and specificity of 73.3% (diagram 1 and table 1,2) (area under the curve = 88.4; confidence interval, 75.9 - 100.0; P= .0001).

Conclusions:

The mean RVATI more than 11.0±2.5 degrees/m^2 is associated with an RVEDVI more than 150 mL/m^2. RVATI is a useful echocardiographic technique for detecting increased RVEDI in patients with TOF and may help discern which patients should undergo RVEDVI quantification by CMRI. For more accuracy and unification we use annular tilt index cutoff value in which RVATI more than 17.1 degrees/m^2 considered the same as RVEDVI more than 150mL/m^2.

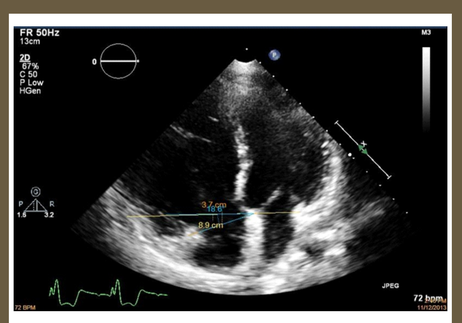

Fig 1.Apical four-chamber view of a patient with severe RV dilation at end-diastole.
A line is drawn from the mitral valve plane at its hinge points (white). A second line is drawn from the tricuspid valve free wall hinge point to the IVS at the initial lines bisecting point (yellow)

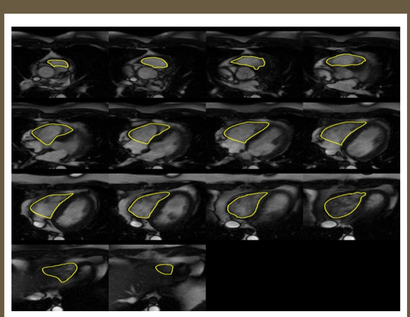

Fig 2.Assessment of RV voulume and function using CMR. After endocardial contours in a stack of RV slices in axial plane have been contoured, RVEDV can be assessed.

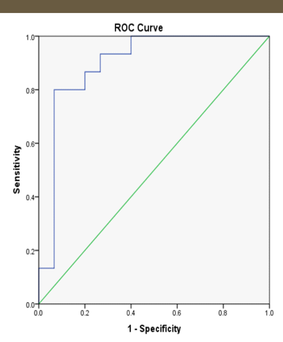

Diagram 1: Roc curve for langle index (AUC=0/884). The diagram shows the cut off sensitivity (true positive) and 1-sensitivity (false positive)

Table 1: Area Under the Curve

Test Result Variable(s): Angle

Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.898	.063	.000	.774	1.000

a. Under the nonparametric assumption
b. Null hypothesis: true area = 0.5

Table 2: Coordinates of the Curve

Test Result Variable(s): Angle

Positive if Greater Than or Equal To[a]	Sensitivity	1 - Specificity
16.5200	1.000	.400
16.6950	.933	.400
16.7500	.933	.333
17.0700	.933	.267
17.4700	.867	.267
17.6950	.867	.200
17.8950	.800	.200
18.0450	.800	.133
18.3950	.800	.067

a. The smallest cut off value is the minimum observed test value minus 1, and the largest cut off value is the maximum observed test value plus 1. all the other cut off values are the averages of two consecutive ordered observed test values.