Development and Validation of a Teaching Module for Echocardiographic Scoring of Rheumatic Mitral Stenosis

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ABSTRACT

Background: The Wilkins score and commissural calcification scores predict outcomes after percutaneous balloon mitral valvuloplasty. However, many cardiologists are inadequately trained in their application—both in the United States where the incidence of rheumatic heart disease has fallen and in rheumatic heart disease endemic countries where training infrastructure is weak.

Objectives: This study sought to develop a computer-based educational module teaching 2 scoring systems for rheumatic mitral stenosis and to validate the module among cardiology fellows in the United States and Uganda.

Methods: We developed a module organized into 3 sets of 10 echocardiograms each. The module was completed by 13 cardiology fellows from 2 academic centers in the United States and 1 in Uganda. Subject answers were compared with a score assigned by 2 experts in echocardiography. The primary outcome was change in subjects' accuracy from set 1 to set 3, measured by mean absolute deviation from expert scores. Secondary outcomes included change in interoperator variability and individual subject bias from set 1 to set 3.

Results: The mean absolute deviations from expert scores in sets 1 and 3 were 2.09 and 1.82 for the Wilkins score (possible score range 0 to 16) and 1.13 and 0.94 for the commissural calcification score (possible score range 0 to 4). The change from set 1 to set 3 was statistically significant only for 1 of the Wilkins component scores (leaflet calcification, $p < 0.001$.) No change was seen in the interoperator variability. Individual subject bias in assigning the total Wilkins score was reduced from set 1 to set 3.

Conclusions: Use of this module has the potential to enhance the training of cardiologists in the echocardiographic assessment of mitral stenosis. Modified versions of this module or similar ones should be tested in targeted populations of cardiology trainees with the most exposure to mitral stenosis interventions.

Wilkins et al. [1] reported a novel scoring system in 1988 to predict success of percutaneous balloon mitral valvuloplasty (PBMV) for the treatment of mitral stenosis. The Wilkins scoring system relies on 4 echocardiographic characteristics of the mitral valve: leaflet mobility, leaflet thickness, leaflet calcification, and subvalvular thickening. Each variable is scored on a scale of 0 to 4 with higher scores representing more severe involvement. The additive score of 0 to 16 was found to predict outcomes, with higher scores (>8) predictive of suboptimal outcomes.

Several alternative echocardiographic systems for prediction of post-PBMV outcomes have been developed subsequently, including commissural calcification (CC) scoring [2,3]. The CC system, which our module teaches and was published by Sutaria et al. [2] in 2000, scores each quadrant of the commissure 0 or 1 based on the presence of calcification for a total score 0 to 4, with lower scores predicting better outcomes after PBMV. Other proposed scoring systems for pre-procedural assessment of mitral stenosis include assessment of mitral annular calcification [4]; ratio of posterior to anterior mitral valve leaflets [5]; a novel score proposed by Iung and Cormier [6] based on valve flexibility, subvalvular fusion, and leaflet calcification; and a scoring system using real-time 3-dimensional echocardiography [7]. Of these alternative scores, scoring of commissural morphology has shown particularly strong evidence for prediction of post-PBMV results [8].

Case-based modules have been successfully used to teach skills in other areas of echocardiography, including assessment of left ventricular function [9] and a 3-dimensional echocardiography module to enhance assessment of transesophageal echocardiography [10].

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TABLE 1. Expert scores of each mitral stenosis case included in the module

		Wilkins Score					
Set	Case	Wilkins Total (0–16)	Leaflet Mobility (0–4)	Leaflet Thickness (0–4)	Leaflet Calcification (0–4)	Subvalvular Thickening (0–4)	Commissural Calcification (0–4)
Set 1	Case 1	9	2	2	2	3	1
	Case 2	12	3	3	3	3	1
	Case 3	4	1	1	1	1	3
	Case 4	13	3	4	3	3	2
	Case 5	7	1	2	2	2	3
	Case 6	11	2	3	4	2	1
	Case 7	14	4	3	4	3	1
	Case 8	7	2	2	1	2	1
	Case 9	7	1	1	3	2	1
	Case 10	6	2	2	0	2	1
Set 1 median (Q1, Q3)		8 (7, 12)	2.5 (1, 3)	2 (2, 3)	2.5 (1, 3)	2 (2, 3)	1 (1, 2)
Set 2	Case 11	5	1	2	1	1	1
	Case 12	8	2	2	2	2	0
	Case 13	5	1	1	1	2	0
	Case 14	10	3	2	3	2	1
	Case 15	5	1	1	1	2	
	Case 16	8	2	2	2	2	2
	Case 17	9	2	2	2	3	1
	Case 18	14	4	4	4	2	4
	Case 19	6	1	2	1	2	2
	Case 20	7	2	2	1	2	0
Set 2 median (Q1, Q3)		7.5 (5, 9)	2 (1, 2)	2 (2, 2)	1.5 (1, 2)	2 (2, 2)	1 (0, 2)
Set 3	Case 21	10	3	2	3	2	2
	Case 22	11	3	3	3	2	1
	Case 23	6	1	2	1	2	1
	Case 24	4	1	1	1	1	1
	Case 25	9	2	3	2	2	1
	Case 26	8	2	2	2	2	1
	Case 27	6	1	2	1	2	0
	Case 28	8	2	2	2	2	1
	Case 29	8	2	2	2	2	2
	Case 30	4	1	1	1	1	1
Set 3 median (Q1, Q3)		8 (6, 9)	2 (1, 2)	2 (2, 2)	2 (1, 2)	2 (2, 2)	1 (1, 1)
Module Median (Q1, Q3)		8 (6, 10)	2 (1, 2)	2 (2, 2)	2 (1, 3)	2 (2, 2)	1 (1, 2)
p Value	Set 1 vs. set 2	0.28	0.56	0.43	0.34	0.28	0.85
	Set 1 vs. set 3	0.24	0.50	0.47	0.30	0.10	0.27
	Set 2 vs. set 3	0.82	0.82	1.00	1.00	0.34	0.81

Q, quartile.

Our project had 2 objectives. The first objective was to develop a computer-based module that teaches correct application of the Wilkins and CC scoring schema of the mitral valve. The second was to validate the module's use by cardiology fellows in Uganda and the United States. We hypothesized that use of this teaching module by cardiology fellows would improve accuracy, reduce interoperator variability (IOV), and reduce individual subject bias in the application of the Wilkins and CC scores for mitral stenosis.

METHODS

Development of the teaching module

Thirty representative transthoracic echocardiograms were selected, 20 from the University Hospitals-Harrington Heart and Vascular Institute (HHVI) database in Cleveland, OH, USA, and 10 from the Uganda Heart Institute in Kampala, Uganda. Echocardiograms were selected for presence of rheumatic mitral stenosis, transvalvular gradient >5 mm Hg, valve area <1.5 cm^2, and no more