# Cardiac Magnetic Resonance Versus Transthoracic Echocardiography for the Assessment and Quantification of Aortic Regurgitation in Patients Undergoing Transcatheter Aortic Valve Implantation

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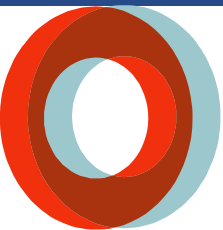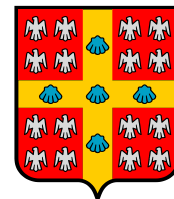
Potential conflicts of interest

Speaker's name: Henrique B. Ribeiro

✓ ❑   *No conflicts of interest to declare*

Background - I

- **Residual aortic regurgitation (AR) secondary to paravalvular leaks (PVL) remains a major limitation of the TAVI procedures, and even mild AR may be related with worse clinical outcomes.[1]**

- **Transthoracic echocardiographic (TTE) is the main method for AR quantification, but the severity of residual AR following TAVI has been controversial and lacks validation.[1,2]**

- **Both in the VARC-2 and Partner trial have weighted more heavily on the circumferential extent of paravalvular AR, although it has not been well validated.[2]**

[1]Athappan et al. JACC 2013;61:1585-95
[2]Hahn et al. JACC 2013;61:2514-21.

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Background - II

- **Cardiac magnetic resonance** (CMR) is a non-invasive and safe technique that allows serial assessment of left ventricular (LV) mass, volume and function.

- **CMR** allows the **direct measurement** of the **severity of AR** with high accuracy and reproducibility, by using the technique of **phase-contrast velocity mapping**.

Smith et al. Eur Heart J. 2012;33:372-83
Cawley PJ, et al. Circ Cardiovasc Imaging. 2013;6:48-57
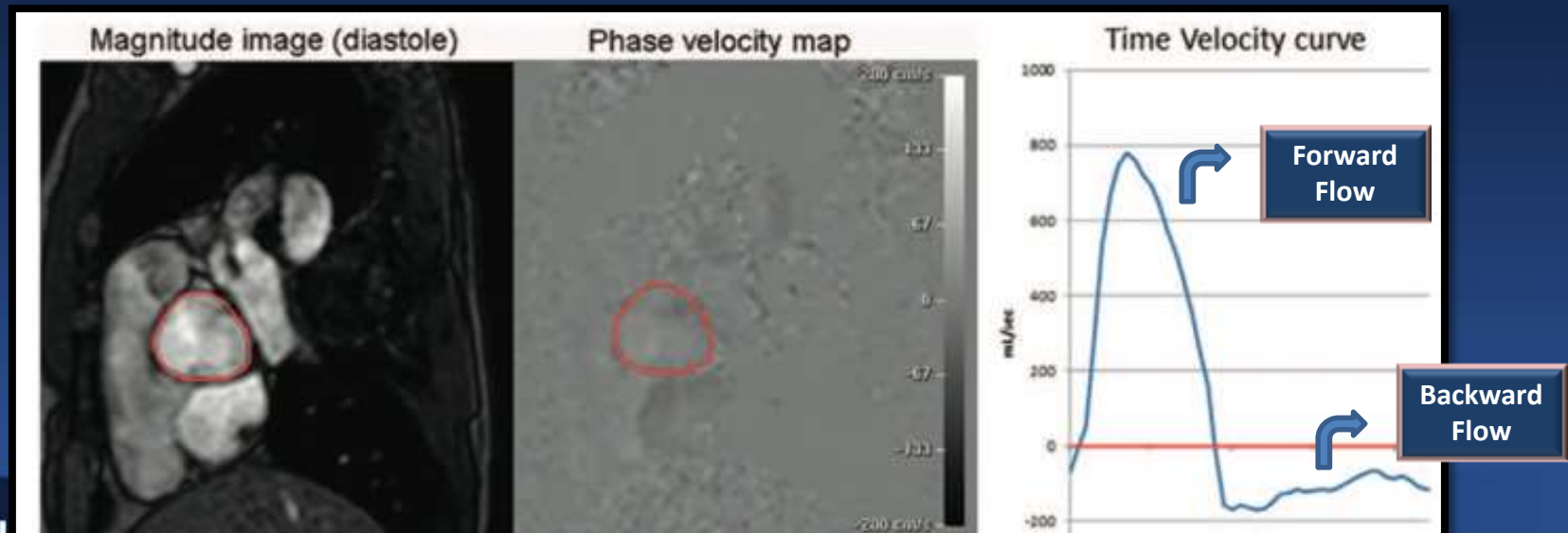
Objectives

The objective of this study was to compare TTE and CMR for assessment of AR in patients undergoing TAVI with a balloon-expandable valve.

Methods

- **50 prospective, non-consecutive patients**
- TAVI with balloon-expandable valves
- Quebec Heart & Lung Institute - Canada

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- Clinical, TTE and CMR data were prospectively collected pre-TAVI
- Exams performed < 7 days apart in similar hemodynamic conditions

After TAVI

→

CMR not repeated:
- 4 pts: pacemaker
- 2 pts: death
- 2 pts: logistic reasons

- **42 pts** had a **repeated** CMR and TTE

Methods: Echocardiography

Transthoracic Echo (TTE) were centrally Analyzed at the Quebec Heart & Lung Institute **Echo Core-Lab**

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- **VARIABLES:** aortic annulus diameter, LVEF (biplane Simpson method), mean gradient, EOA, and **AR grade**

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AR GRADE

Multi-parametric Approach[1]
- Number of AR jets
- Jet(s) width and extent (in LV)
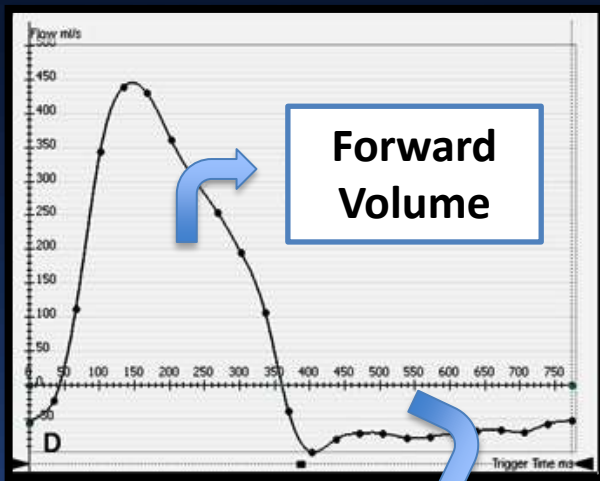- Quantitative + Semi-quantitative variables

Circumferential Extent of AR[2]
- No or Trace
- Mild: <10% circumference
- Moderate: 10% - 29%
- Severe: ≥ 30%

[1]Zoghbi WA, et al. JASE 2009;22:975-1014; [2]Kappetein et al. JACC 2012;60:1438–54

Methods: CMR

AR grade by CMR according to **Regurgitant Fraction (RF):**

Forward Volume

Regurgitant Volume

$$\frac{\text{Regurgitant volume (RV)}}{\text{Total forward volume}} \times 100$$

AR classification by CMR:
- None/trace: < 5%
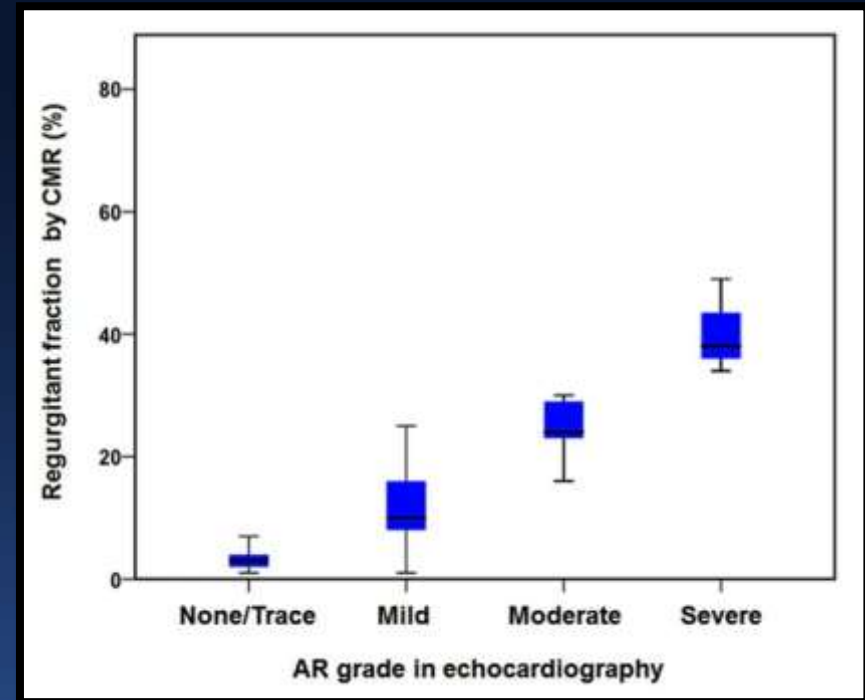- Mild: 5 - 19%
- Moderate: 20-29%
- Severe: ≥ 30%

[1]Gabriel et al. Am J Cardiol 2011;108:1014-20.

Results: Baseline Characteristics

	All (n=50)
Clinical Variables	
Age (years)	79 ± 7
Male gender	28 (56.0)
Diabetes	15 (30.0)
Hypertension	41 (82.0)
Atrial Fibrillation	16 (30.8)
Coronary Artery Disease	32 (64.0)
COPD	17 (32.7)
eGFR (ml/min)	66.2 ± 20.8
Logistic EuroSCORE (%)	22.0 ± 13.9
STS-PROM score, %	6.0 ± 3.7
Procedural Variables	
Transfemoral approach	29 (58.0)
Sapien	9 (18.0)
Sapien XT	39 (78.0)
Sapien 3	2 (4.0)

RF and RV by CMR according to Echo grade of AR – PRE-TAVI

Regurgitant Volume (RV)
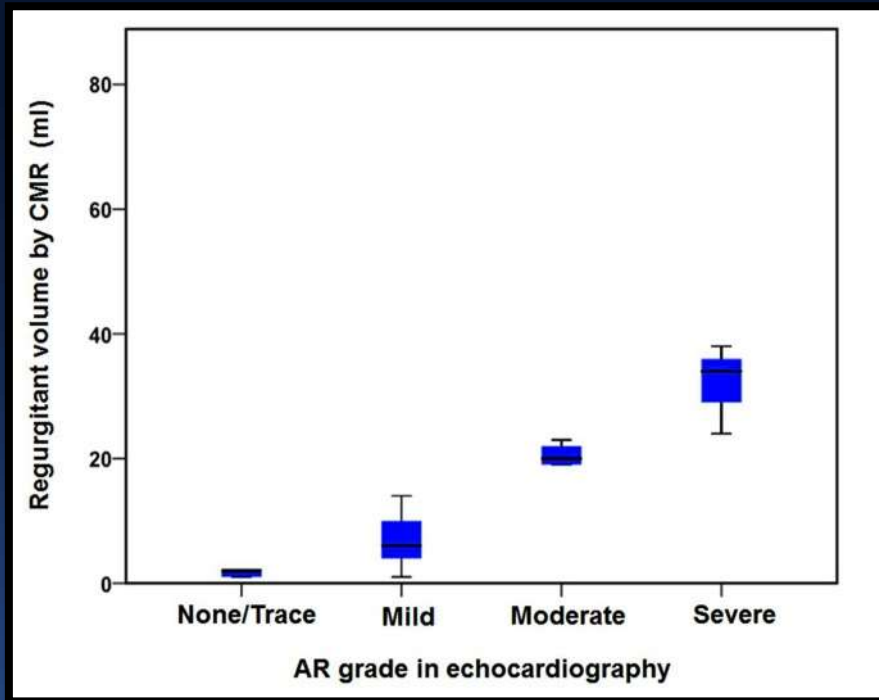
Correlation: Rs=0.79; p<0.001

Regurgitant Fraction (RF)

Correlation: Rs=0.80; p<0.001
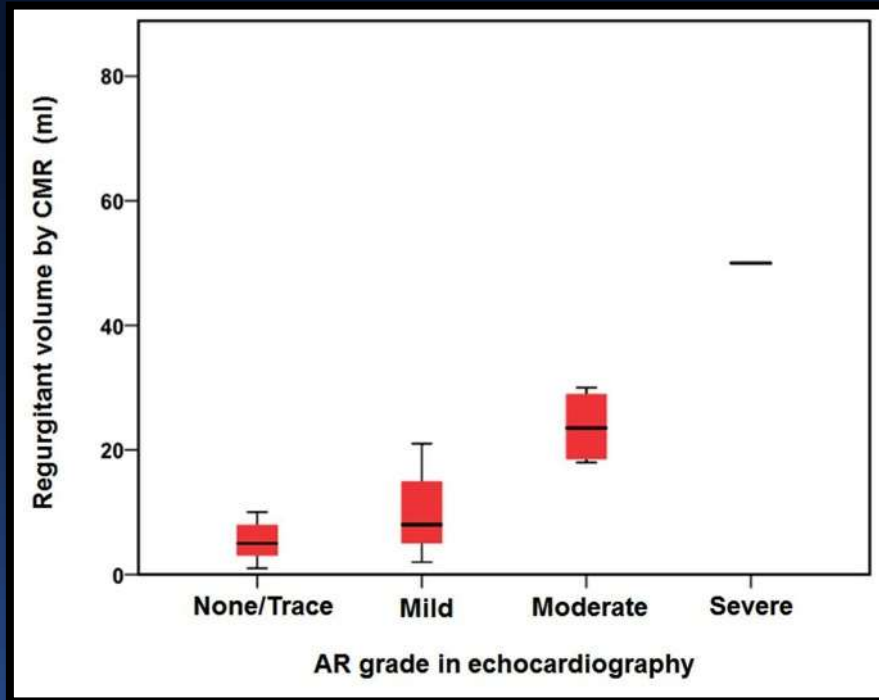
RF and RV by CMR According to Echo grade of AR - POST-TAVI

Regurgitant Volume (RV)

Correlation: R_s=0.59; p<0.001

Regurgitant Fraction (RF)

Correlation: R_s=0.59; p<0.001

RF and RV by MRI according to Number of PVLs

Regurgitant Volume (RV)

Regurgitant Fraction (RF)

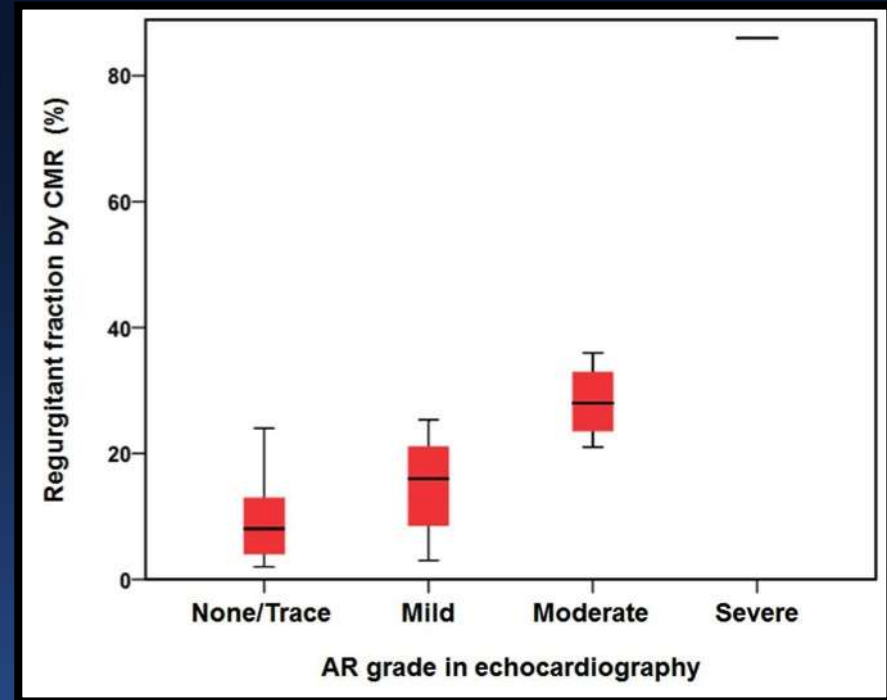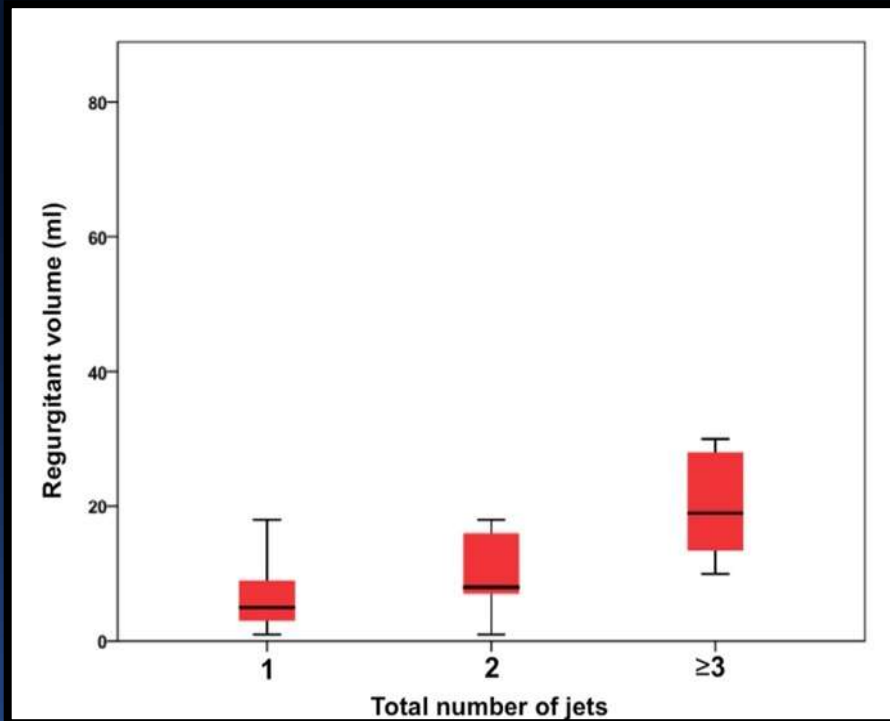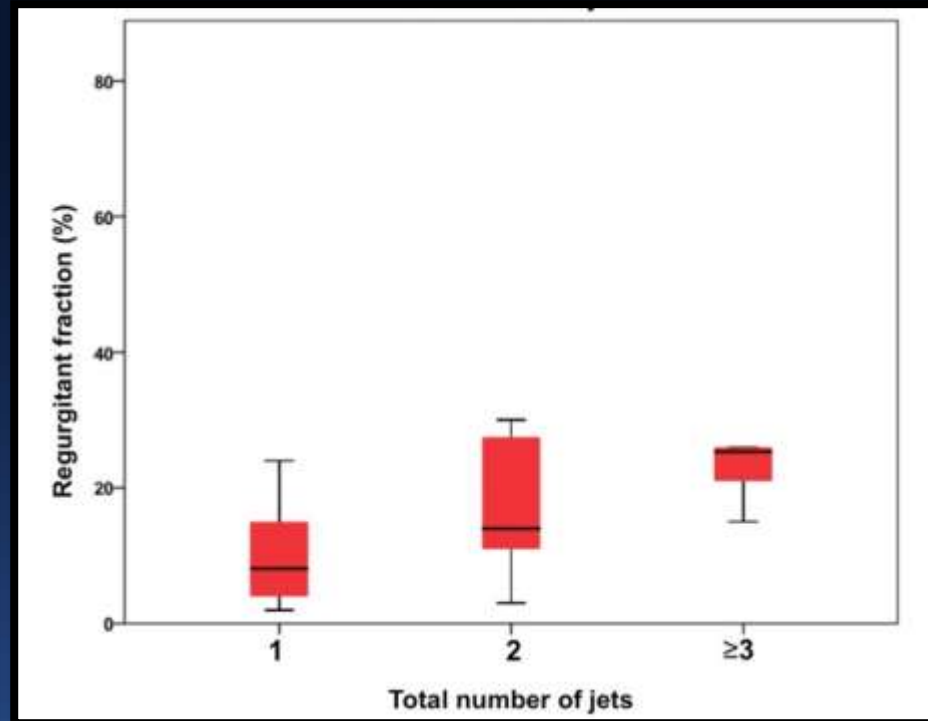Correlation: $R_s=0.60$; $p<0.001$

Correlation: $R_s=0.50$; $p<0.001$

Multi-parametric Echo AR grade vs. CMR – Pre-TAVI

ECHO / CMR	None/Trace	Mild	Moderate	Severe	Total
None/Trace	13 (76)	2 (8)	-	-	15
Mild	4 (24)	22 (84)	1 (20)	-	27
Moderate	-	2 (8)	3 (60)	-	5
Severe	-	-	1 (20)	2 (100)	3
Total	17	26	5	2	40/50 (80)
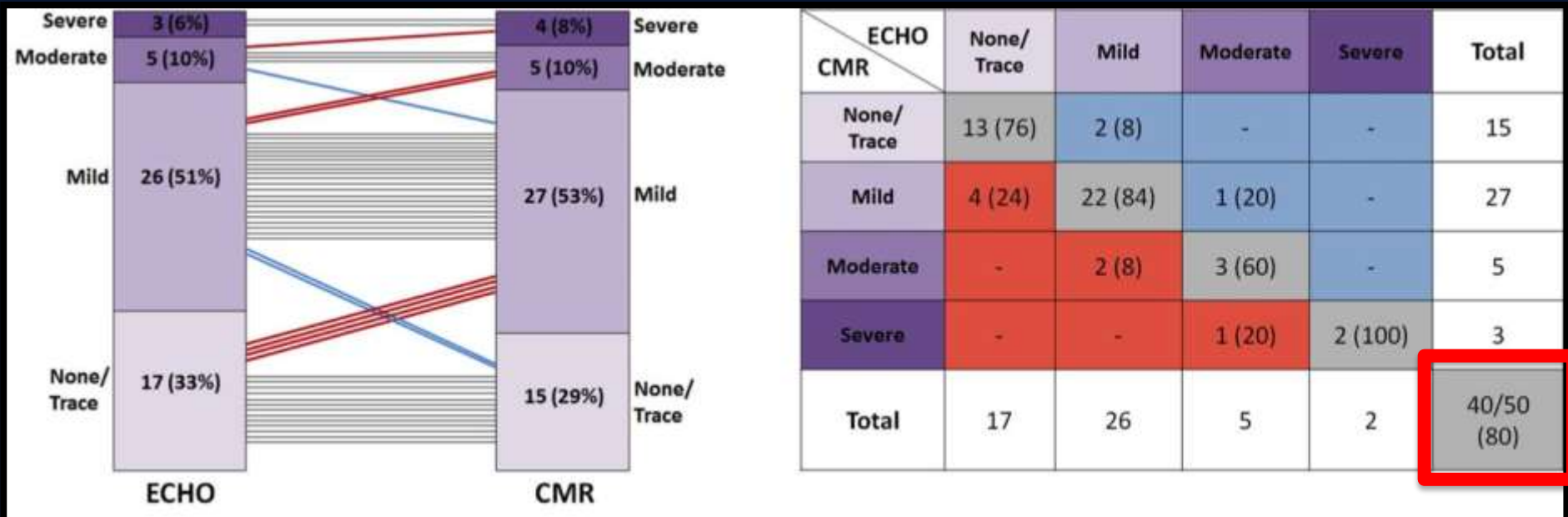
Kappa=0.766; p<0.001

Multi-parametric Echo AR grade vs. CMR – Post-TAVI

ECHO / CMR	None/ Trace	Mild	Moderate	Severe	Total
None/ Trace	7 (27)	2 (18)	-	-	9
Mild	18 (69)	4 (36)	-	-	22
Moderate	1 (4)	5 (46)	2 (50)	-	8
Severe	-	-	2 (50)	1 (100)	3
Total	26	11	4	1	14/42 (33)
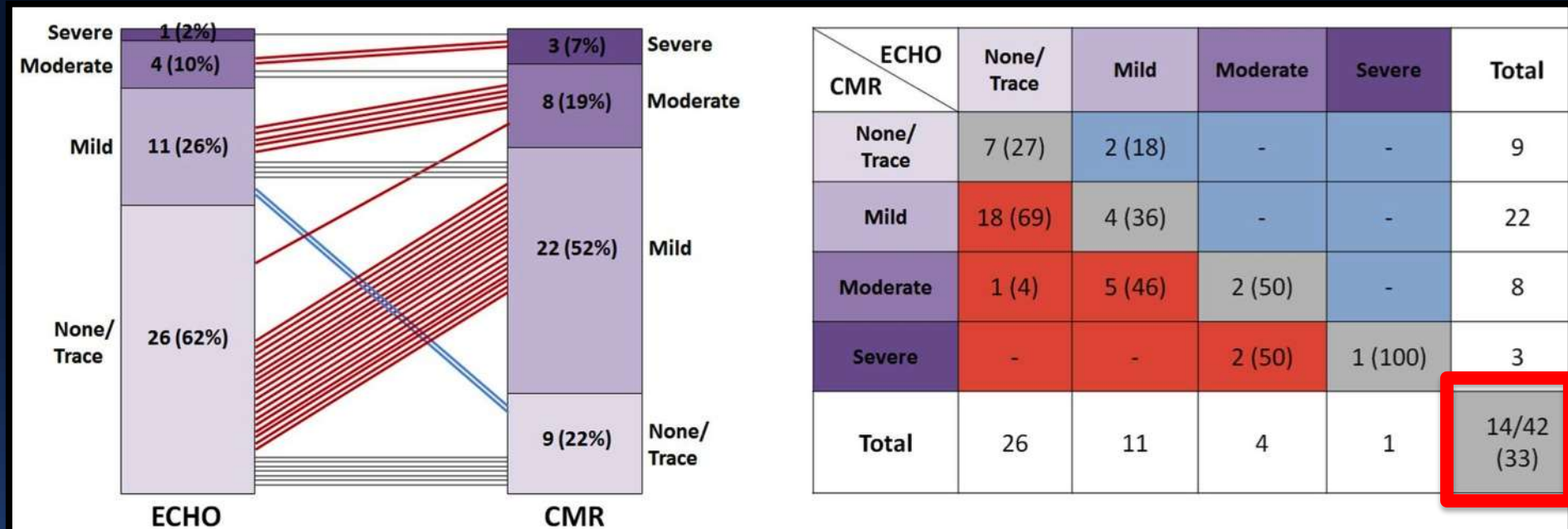
Kappa=0.300, p=0.375

Underestimation by Echo in 62%

Circumferential extent AR grade vs. CMR – Post-TAVI

ECHO / CMR	None/Trace	Mild	Moderate	Severe	Total
None/Trace	12 (75)	4 (40)	4 (44)	2 (29)	22
Mild	3 (19)	4 (40)	2 (22)	1 (14)	10
Moderate	1 (6)	2 (20)	2 (22)	3 (43)	8
Severe	–	–	1 (11)	1 (14)	2
Total	16	10	9	7	19/42 (45)
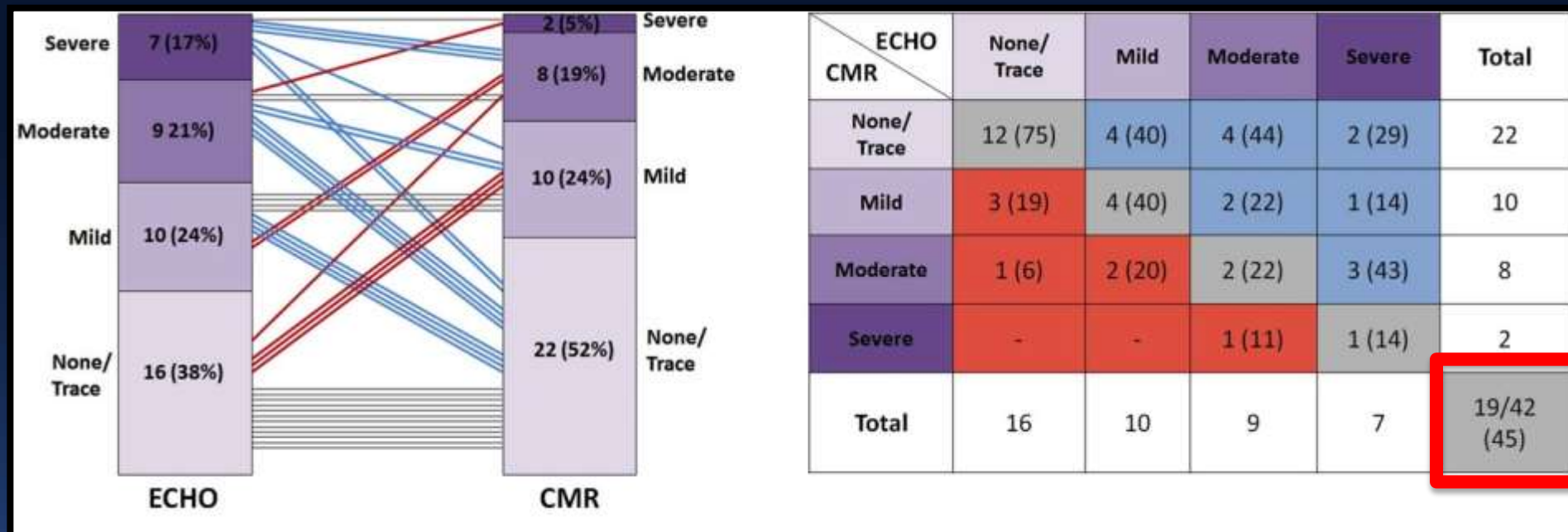
Overestimation by Echo in 38%

Correlation with CMR (regurgitant fraction): R_s=0.33; p=0.034

Discrepancies between Echo and CMR quantification of AR.

Echo

CMR

Circumferential Extent ≥ 30
SEVERE - AR

MILD - AR

RF = 14%

Circumferential Extent < 10
MILD - AR

RF = 36%

SEVERE - AR
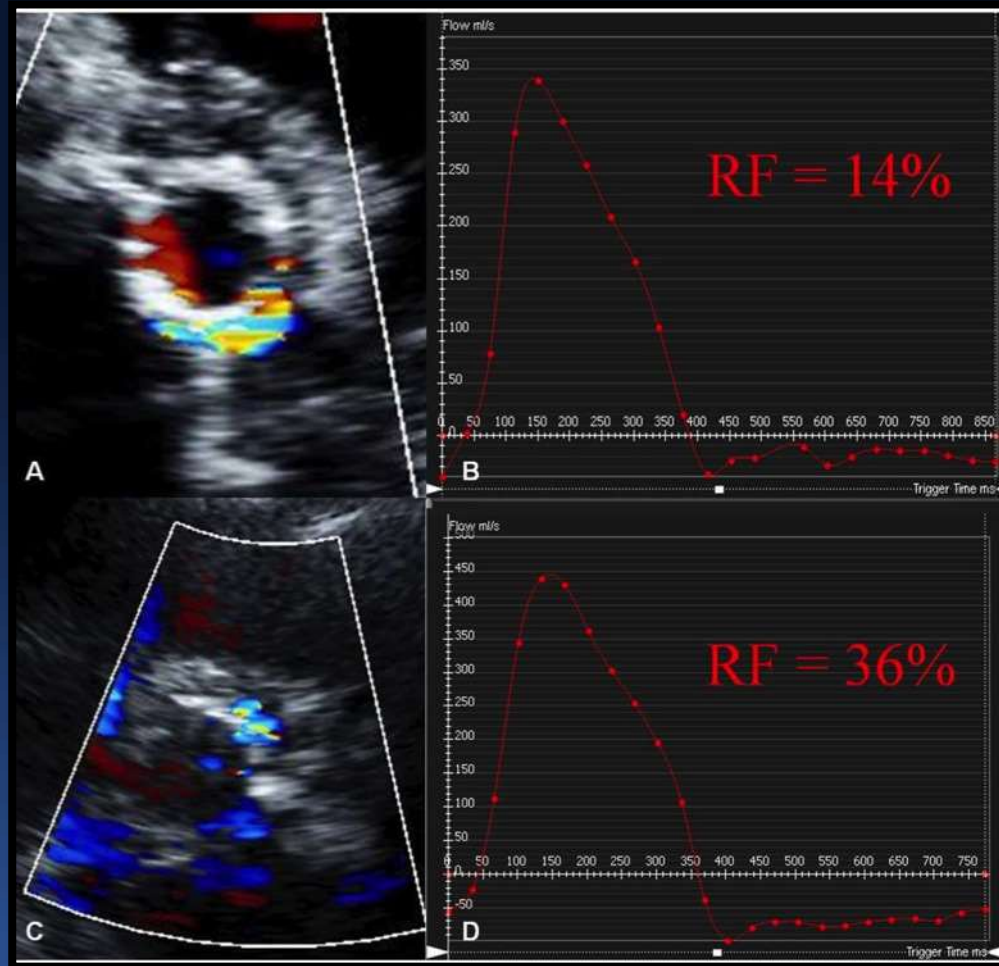
RF = Regurgitant Fraction by Cardiac Magnetic Resonance (CMR)

Conclusions - I

- In patients with severe AS undergoing TAVI with a balloon-expandable valve TTE may underestimate or overestimate the severity of residual AR as compared with CMR

- The multiparametric TTE integrative approach, but not the circumferential extent of AR, showed the best correlation with AR severity as determined by CMR

- Circumferential extent of prosthetic AR correlated poorly with AR severity CMR, with significant overestimation of AR grade

Conclusions - II

▸ **The use of CMR in selected patients, particularly in those exhibiting discordances between echocardiography results and clinical outcomes, might help to better quantify the AR grade**

▸ **In such patients, greater AR by CMR may translate into the implementation of additional measures (leak closure, valve-in-valve, SAVR) to improve clinical outcomes.**