EuroIntervention
2024;20:e463-e464
published online e-edition April 2024
DOI: 10.4244/EIJ-E-24-00006

EDITORIAL

The miracle of left ventricular recovery after transcatheter aortic valve implantation

Harold L. Dauerman*, MD; Rony Lahoud, MD, MPH

**Corresponding author: Division of Cardiology, McClure 1, University of Vermont Medical Center, 111 Colchester Avenue, Burlington, VT, 05401, USA. E-mail: Harold.dauerman@uvmhealth.org*

The authors' affiliation can be found at the end of this article.

In this issue of EuroIntervention, Witberg et al[1] analyse data from the AMTRAC Registry to examine the incidence, predictors and outcomes of left ventricular (LV) recovery post-transcatheter aortic valve implantation (TAVI). Of 10,872 TAVI patients included in this 17-centre registry from Europe and Israel, 914 had severe LV dysfunction prior to TAVI (LV ejection fraction [LVEF] ≤30%). LVEF recovered by ≥10% in 59.5% of patients and normalised to ≥50% in approximately one-quarter of patients. Compared to patients with a baseline LVEF >30%, no LV recovery was associated with increased mortality, LV recovery with similar mortality, and LV normalisation with lower mortality at 3 years. The miraculous nature of these results deserves further examination.

Article, see page e487

While it may seem obvious that unloading the ventricle with an aortic intervention would lead to early improvements in LV systolic function, these findings should not be taken for granted. For example, it also seems obvious that revascularisation of multivessel coronary artery disease (CAD) should improve LV systolic function in patients with ischaemic cardiomyopathy. Yet, revascularisation with either percutaneous coronary intervention (PCI) or coronary artery bypass graft (CABG) was not associated with increased LV recovery for patients with extensive CAD and an EF <35% in 2 landmark trials, REVIVED-BCIS2 for PCI[2] and STICH for CABG[3].

Unlike the failure of coronary revascularisation to improve LV function, TAVI leads to significant LV recovery (improvement in LVEF ≥10%) for 32.8-62.2% of patients across multiple TAVI trial-based analyses[4-6], including the surgical aortic valve replacement (SAVR) cohort in PARTNER Cohort A[4] **(Table 1)**. The current AMTRAC Registry is notable for being the first analysis demonstrating LV recovery in patients with severe cardiomyopathy only (LVEF ≤30%) and thus reassures clinicians about the value of TAVI in this high-risk group. LV recovery is associated with improved survival in all these analyses, and its impact can be inferred on pathophysiology beyond the heart. LV recovery likely leads to improvements in cardiac output post-TAVI; thus, the observation that patients in Northern New England were 3 times more likely to experience acute kidney recovery than injury after either SAVR or TAVI may be an indirect reflection of improved cardiac function[7].

Witberg et al identify 4 key predictors of LV recovery after TAVI, including absence of prior myocardial infarction and high aortic valve gradients (>40 mmHg)[1]. These predictors are similar to those identified in prior analyses and emphasise that LV recovery may not occur for all patients after TAVI; a common predictor of LV recovery is the absence of prior myocardial infarction[1,4-6], suggesting that recovery requires a ventricle with minimal post-infarct fibrosis. The utility of imaging studies in assessing pre-TAVI myocardial fibrosis burden should be evaluated prospectively to improve patient selection and prognosis.

The strength of the AMTRAC Registry is the inclusion of patients that are poorly represented in prior analyses, i.e., those with an LVEF <30%. But, there are important limitations to this study. First, the lack of uniformity in post-TAVI echocardiogram timing complicates comparison with other studies (with standard trial-mandated 30-day echocardiogram) and potentially biases survival analysis – the 30-day landmark analysis may be insufficient, as the mean time-to-echocardiogram was 34 days. Second, the lack of serial echocardiograms means that this analysis cannot confirm

Table 1. Recent studies on left ventricular recovery after TAVI.

Study registry Authors (Publication year)	Patient inclusion	LV recovery (EF increase ≥10%) Patients, %	Timing of LV recovery assessment	Predictors of LV recovery HR (95% CI)
PARTNER Cohort A Elmariah et al[4] (2013)	N=108 (EF <50%) Mean EF 37.1%	51.6	30 days post-TAVI, echo timing per trial protocol	Prior PPM: 0.34 (0.15-0.77) Baseline EF: 0.91 (0.86-0.95) Mean AVG (per mmHg): 1.03 (1.01-1.06)
Medtronic CoreValve U.S. Pivotal Trial Dauerman et al[5] (2016)	N=156 (EF ≤40%) Mean EF 32%	62.2	30 days post-TAVI, echo timing per trial protocol	Prior MI: 0.44 (0.19-1.03) Mean AVG >40 mmHg: 4.59 (1.76-11.96)
PARTNER 1, 2 and S3 Kolte et al[6] (2022)	N=659 (EF <50%) Mean EF 37.8%	32.8	30 days post-TAVI, echo timing per trial protocol	AVA: 0.19 (0.05-0.73) Cancer: 0.56 (0.37-0.86) LVEDD: 0.59 (0.44-0.78) Diabetes: 0.61 (0.4-0.92) Prior MI: 0.65 (0.42-0.98) Baseline EF: 0.93 (0.9-0.95) SVI: 1.03 (1-1.06) BMI: 1.06 (1.02-1.1)
AMTRAC Registry Witberg et al[1] (2023)	N=914 (EF ≤30%) Mean EF 27.3%	59.5	0-60 days post-TAVI, echo timing per site practice: median 34 days (IQR 10-45 days)	Prior MI: 0.45 (0.28-0.71) GFR <60 mL/min: 0.49 (0.32-0.77) LF-LG AS: 0.50 (0.29-0.84) Mean AVG (per mmHg): 1.02 (1.01-1.04)

AVA: aortic valve area; AVG: aortic valve gradient; BMI: body mass index; CI: confidence interval; EF: ejection fraction; GFR: glomerular filtration rate; HR: hazard ratio; IQR: interquartile range; LF-LG AS: low-flow, low-gradient aortic stenosis; LV: left ventricular; LVEDD: left ventricular end-diastolic diameter; MI: myocardial infarction; PPM: permanent pacemaker; SVI: stroke volume index; TAVI: transcatheter aortic valve implantation

early (prior to discharge)[4-6] recovery and will miss some undefined percentage of patients with late recovery[5]. Finally, the exclusion of 112 patients for lack of post-TAVI LVEF data creates further ambiguity in the survival analysis. Despite these limitations, Witberg et al should be congratulated on furthering our understanding of the miracle of post-TAVI LV recovery; the exclusive focus on AS patients with an LVEF ≤30% extends and confirms this remarkable observation to an especially high-risk and poorly studied population.

Authors' affiliation

University of Vermont Larner College of Medicine, Burlington, VT, USA

Conflict of interest statement

H.L. Dauerman is a consultant for Medtronic and Boston Scientific; and has research grants from Boston Scientific and Medtronic. R. Lahoud has research grants from Medtronic.

References

1. Witberg G, Levi A, Talmor-Barkan Y, Barbanti M, Valvo R, Costa G, Frittitta V, De Backer O, Willemen Y, van Der Dorpel M, Mon M, Sugiura A, Sudo M, Masiero G, Pancaldi E, Arzamendi D, Santos-Martinez S, Baz JA, Steblovnik K, Mauri V, Adam M, Wienemann H, Zahler D, Hein M, Ruile P, Aodha BN, Grasso C, Branca L, Estévez-Loureiro R, Amat-Santos IJ, Mylotte D, Bunc M, Tarantini G, Nombela-Franco L, Sondergaard L, Van Mieghem NM, Finkelstein A, Kornowski R. Outcomes and predictors of left ventricle recovery in patients with severe left ventricular dysfunction undergoing TAVI. *EuroIntervention.* 2024;20:e487-95.

2. Perera D, Clayton T, O'Kane PD, Greenwood JP, Weerackody R, Ryan M, Morgan HP, Dodd M, Evans R, Canter R, Arnold S, Dixon LJ, Edwards RJ, De Silva K, Spratt JC, Conway D, Cotton J, McEntegart M, Chiribiri A, Saramago P, Gershlick A, Shah AM, Clark AL, Petrie MC; REVIVED-BCIS2 Investigators. Percutaneous Revascularization for Ischemic Left Ventricular Dysfunction. *N Engl J Med.* 2022;387:1351-60.

3. Panza JA, Ellis AM, Al-Khalidi HR, Holly TA, Berman DS, Oh JK, Pohost GM, Sopko G, Chrzanowski L, Mark DB, Kukulski T, Favaloro LE, Maurer G, Farsky PS, Tan RS, Asch FM, Velazquez EJ, Rouleau JL, Lee KL, Bonow RO. Myocardial Viability and Long-Term Outcomes in Ischemic Cardiomyopathy. *N Engl J Med.* 2019;381:739-48.

4. Elmariah S, Palacios IF, McAndrew T, Hueter I, Inglessis I, Baker JN, Kodali S, Leon MB, Svensson L, Pibarot P, Douglas PS, Fearon WF, Kirtane AJ, Maniar HS, Passeri JJ; PARTNER Investigators. Outcomes of transcatheter and surgical aortic valve replacement in high-risk patients with aortic stenosis and left ventricular dysfunction: results from the Placement of Aortic Transcatheter Valves (PARTNER) trial (cohort A). *Circ Cardiovasc Interv.* 2013;6:604-14.

5. Dauerman HL, Reardon MJ, Popma JJ, Little SH, Cavalcante JL, Adams DH, Kleiman NS, Oh JK. Early Recovery of Left Ventricular Systolic Function After CoreValve Transcatheter Aortic Valve Replacement. *Circ Cardiovasc Interv.* 2016;9:e003425.

6. Kolte D, Bhardwaj B, Lu M, Alu MC, Passeri JJ, Inglessis I, Vlahakes GJ, Garcia S, Cohen DJ, Lindman BR, Kodali S, Thourani VH, Daubert MA, Douglas PS, Jaber W, Pibarot P, Clavel MA, Palacios IF, Leon MB, Smith CR, Mack MJ, Elmariah S. Association Between Early Left Ventricular Ejection Fraction Improvement After Transcatheter Aortic Valve Replacement and 5-Year Clinical Outcomes. *JAMA Cardiol.* 2022;7:934-44.

7. Lahoud R, Butzel DW, Parsee A, Huang YL, Solomon RJ, DeVries JT, Flynn JM, Iribarne A, Lee PV, Ross CS, Malenka DJ, Dauerman HL. Acute Kidney Recovery in Patients Who Underwent Transcatheter Versus Surgical Aortic Valve Replacement (from the Northern New England Cardiovascular Disease Study Group). *Am J Cardiol.* 2020;125:788-94.