Optimal Management of Chronic Severe Aortic Regurgitation — How to Determine Cutoff Values for Surgical Intervention? —

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Aortic regurgitation (AR) is a common valvular heart disease, but the optimal timing of surgical intervention remains controversial. In the natural history of chronic severe AR, sudden death is rare, and the annual mortality rate is comparatively low. Considering the hemodynamic features of combined volume and pressure overload and long-term compensation in patients with chronic AR, symptoms related to AR do not frequently occur. Therefore, the progression of left ventricular (LV) dysfunction is a key factor in determining the timing of surgical intervention in patients with severe chronic AR. In addition to symptoms, an ejection fraction <50% and an LV endsystolic diameter (LVESD) >45 mm are appropriate cutoff values for surgical intervention in Japanese patients, whereas LV end-diastolic diameter is not a good indicator. An LVESD index of 25 mm/m² is controversial, because adjusting for body size may cause overcorrection in Japanese patients who have a small body size compared with Westerners. Accumulation of data from the Japanese population is indispensable for establishing guidelines on optimal management of patients with chronic AR.

Key Words: Aortic valve; Left ventricular function; Surgery; Survival

Aortic regurgitation (AR) is one of the common valvular heart diseases, although its prevalence is comparatively low compared with aortic stenosis and mitral regurgitation.^{1,2} AR is characterized by diastolic reflux of blood from the aorta into the left ventricle (LV), resulting in an increase in total stroke volume (SV). Acute AR is rare, but it induces rapid cardiac decompensation; thus, most patients require emergency surgical intervention.³ Chronic AR is generally well tolerated for a long period, and few patients show symptoms (New York Heart Association [NYHA] functional class ≥III) before LV dysfunction occurs. The optimal timing of surgical intervention in asymptomatic patients with chronic severe AR remains controversial in current guidelines.^{4–6} Considering the increasing number of elderly patients and the small body size of Japanese compared with Westerners, the optimal cutoff value of ejection fraction (EF) and LV size for surgical intervention may need to be reconsidered. Here we review previous studies related to the treatment of severe chronic AR to obtain a clinical perspective on chronic AR in Japan.

Hemodynamics and Natural History of Chronic AR

In patients with chronic AR, the LV responds to chronic volume overload via a series of compensatory mechanisms, including an increase in end-diastolic volume, an increase in chamber compliance that accommodates this increase in volume without a rise in filling pressure, and hypertrophy.⁷ In contrast to mitral regurgitation, in which part of the SV

regurgitates into the left atrium, a low-pressure chamber, LV afterload increases in AR, resulting from an increase in SV and systolic pressure. Combined volume and pressure overload is a hemodynamic feature of chronic AR (**Figure 1**),^{8–10} resulting in eccentric hypertrophy and a spherical LV (**Figure 2**). As indicated by Laplace's law: wall stress = $p \times r / 2h$ (p : LV pressure, r : LV radius; h : wall thickness), the increase in wall thickness is a compensatory mechanism;⁷ thus, a normal EF is maintained long-term, and the majority of patients with chronic AR remain asymptomatic during hemodynamic compensation.^{8,11} This long-term asymptomatic phase is the main feature of the natural history of chronic AR. However, a long-term increase in afterload may lead to a reduction in EF, which is initially reversible, but can become irreversible. In this natural course of chronic AR, patients are usually asymptomatic until the development of LV dysfunction, and may remain asymptomatic even with advanced LV dysfunction.

Data related to the natural history of patients with severe chronic AR are outdated. In 1991, Bonow et al reported the clinical course of 104 asymptomatic patients with a normal EF, showing that ≈60% of them remained asymptomatic during 11 years of follow-up, and sudden cardiac death was rare (1.9%).¹² In 1995, Tornos et al prospectively investigated the natural history of 101 asymptomatic patients with severe chronic AR and normal LV systolic function.¹³ During a follow-up period of 4.6 years, there were no cardiac deaths, and 14 patients (14%) required surgical intervention, including 8 for development of symptoms and 6 for LV dysfunction. Previous American

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Figure 1. Hemodynamic features of chronic AR. **(A)** In diastole, inflow from the LA and regurgitant volume from the aorta pour into the LV simultaneously, resulting in volume overload. **(B)** In systole, systolic aortic pressure increases, which is accompanied by an increase in total SV, and LV afterload also increases. Subsequently, an increase in wall thickness occurs as a compensatory mechanism. AR, aortic regurgitation; LA, left atrium; LV, left ventricle; SV, stroke volume.

Figure 2. Typical echocardiographic images of chronic severe AR. Blood pressure on echocardiography is 138/39mmHg. **(A)** Parasternal view in diastole (LV end-diastolic dimension 77mm). The LV shows eccentric hypertrophy. **(B)** Parasternal view in systole (LV endsystolic dimension 49mm). **(C,D)** Apical 4- and 3-chamber views in diastole. The LV is spherical. **(E)** Color image in apical 3-chamber view. AR flow reaches to the LV apex and the PISA radius is enlarged. AR, aortic regurgitation; LV, left ventricle/ventricular; PISA, proximal isovelocity surface area.

Table 1. Timing of Surgical Intervention in Asymptomatic Patients: EF

Author (year) ^{Ref.}	Country	Period of study	No. of patients	Mean age	BSA	Symptoms	Outcome assessed	Findings
Forman et al (1980) ³⁵	ZAF	1972–1978	229	NA	NA	NA	Postoperative survival	High-risk group identified by preoperative angiographic EF <50%
Greves et al (1981) ³⁶	USA	1973–1979	45	45	NA	Symptomatic 49% Asymptomatic 51%	Postoperative survival	High-risk group identified by preoperative angiographic EF <45%
Klodos et al (1996) ³⁷	USA	1980–1989	219	54	NA	Symptomatic 36% Asymptomatic 64%	Postoperative survival	High-risk group identified by preoperative angiographic EF <50%
Tornos et al (2006) ³²	ESP	1982–2002	170	50	NA	Symptomatic 39% Asymptomatic 61%	Postoperative survival	High-risk group identified prospectively by preoperative low EF (mean EF 42%)
Zhang et al (2015) ³⁸	CHN	2005–2011	105	50	1.7	Symptomatic 38% Asymptomatic 62%	Postoperative recovery of LVEDD	Preoperative EF >52% may be a good predictor of successful recovery of dilated LVEDD early after AVR
de Meester et al (2015) ³⁹	BEL	1995–2012	160	50	1.9	Asymptomatic	Postoperative survival	No benefits of AVR for survival in patients with preoperative LVESD <50 mm, LVEDD <70 mm, and EF >50%
Murashita et al (2017) ⁴⁰	USA	2004–2014	530	57	NA	Symptomatic 32% Asymptomatic 68%	Postoperative survival	High-risk group identified by preoperative EF <60%
de Meester et al (2019) ⁴¹	BEL	1995–2012	356	51	NA	Symptomatic 18% Asymptomatic 82%	Postoperative survival	Mortality rate started to increase with EF <55%
Taniguchi et al (1987) ⁴²	JPN	1978–1985	62	42	NA	Symptomatic 50% Asymptomatic 50%	Postoperative survival	High-risk group identified by preoperative EF <40%
Amano et al (2016) ⁴³	JPN	1995–2010	80	59	1.6	NA	Postoperative cardiac death	High-risk group identified by preoperative EF <50%

AVR, aortic valve replacement; EDD, end-diastolic diameter; EF, ejection fraction; ESD, endsystolic diameter; LV, left ventricular; NA, not applicable.

College of Cardiology (ACC)/American Heart Association (AHA) guidelines in 2006 summarized the data on the natural history of chronic AR. The average mortality rate was only 0.18% per year, and the progression rate to symptoms, death, or LV dysfunction was 4.3% per year.¹⁴ Based on the low incidence of sudden death during follow-up, the optimal timing of surgical intervention should be determined from the perspective of postoperative long-term outcomes.

Diagnosis of Severe AR

Severity of AR

Echocardiography is a key diagnostic tool for AR, and the etiology and severity of AR should be evaluated, even when mild AR is detected. The 3 parameters of the color jet (flow convergence, vena contracta, and jet area) are widely used to assess the severity of AR,¹⁵ but there are many pitfalls in this evaluation.¹⁶ As a quantitative method, the proximal isovelocity surface area (PISA) method can be used.¹⁷ However, in clinical settings, PISA quantitation

of AR is used less often than for mitral regurgitation, because shadowing from aortic valve thickening and calcification often prevent accurate evaluation of flow convergence in the far field. The usefulness of the 3D vena contracta area using transesophageal echocardiography (TEE) has been reported,^{18–20} but determining the severity of AR using echocardiography alone is often difficult. Thus, additional imaging modalities are sometimes required to confirm AR severity.

Cardiac magnetic resonance imaging (MRI) can quantify AR directly by phase-contrast velocity mapping in a plane perpendicular to the aorta.^{21,22} This method measures the regurgitant volume and fraction (reverse volume/forward volume × 100%), is the most validated approach, and is not affected by coexisting valvular regurgitation lesions.^{23–25} Aortography with the Sellers classification using a cardiac catheter is still useful for evaluating the severity of AR. When evaluating severity, especially in patients with moderate or severe AR, an integrated approach using echocardiography, cardiac MRI, and/or aortography is required in the clinical setting.

Table 2. Timing of Surgical Intervention in Asymptomatic Patients: LVESD

Author (year) ^{Ref.}	Country	Period of study	No. of patients	Mean age	BSA	Symptoms	Outcome assessed	Findings
Gaasch et al (1983) ⁴⁵	USA	1975–1980	32	45	1.9	NA	Postoperative LV enlargement	Patients with preoperative LVESD >50 mm or an LVESD index of 26 mm/m ² showed poor outcomes (persistent LV enlargement)
Tornos et al (2006) ³²	ESP	1982–2002	170	50	NA	Symptomatic 39% Asymptomatic 61%	Postoperative survival	Low-risk group identified by preoperative LVESD of 48 mm
Detaint et al (2008) ⁴⁶	USA	1991–2003	93	58	NA	Asymptomatic	Cardiac events	Patients with asymptomatic severe AR with an endsystolic volume index ≥45 mL/m ² had more frequent cardiac events (cardiac death, congestive heart failure, and new atrial fibrillation) under conservative management
Turk et al (2010) ⁴⁷	USA	1993–2007	79	60	NA	Asymptomatic	Postoperative survival	Low-risk group identified by preoperative LVESD <50 mm, LVEDD <70 mm, and LVEF >50%
de Meester et al (2015) ³⁹	BEL	1995–2012	160	50	1.9	Asymptomatic	Postoperative survival	No benefits of AVR for survival in patients with preoperative LVESD <50 mm, LVEDD <70 mm, and LVEF >50%
Saisho et al (2015) ⁴⁸	JPN	1989–2010	177	58	1.6	NA	Postoperative normal LV function	Postoperative LV function was preserved in patients with preoperative LVESD index ≤26.7 mm/m ² (≈LVESD 43 mm)
Amano et al (2016) ⁴³	JPN	1995–2010	80	59	1.6	NA	Postoperative survival	Low-risk group identified by preoperative LVESD ≤47 mm or an LVEF ≥56%
Sato et al (2017) ⁴⁹	JPN	2012–2015	60	62	1.7	Asymptomatic	MACE and AVR	In asymptomatic patients with moderate to severe AR and an LVESD <50 mm, endsystolic volume index during exercise was an independent predictor of outcomes

AR, aortic regurgitation; AVR, aortic valve replacement; EDD, end-diastolic diameter; EF, ejection fraction; ESD, endsystolic diameter; LV, left ventricular; MACE, major adverse cardiovascular event; NA, not applicable.

Etiology and Structural Evaluation of AR

An etiological evaluation and structural assessment of the aortic valve and aorta should also be performed because aortic valve repair is an option for surgical intervention. Functional classification of the aortic root and valve allow for logical application of valve-sparing surgical procedures.^{26,27} 3D TEE as well as computed tomography is useful for measuring geometric height as an index of cusp length and effective height as an index of cusp prolapse or tethering.^{28,29}

Optimal Management of Chronic Severe AR

Timing of Surgical Intervention in Symptomatic Patients

The prognosis of symptomatic patients with severe AR is poor,^{30–32} and so symptoms related to AR are a strong indication (Class I) for aortic valve surgery.^{4–6} In most studies related to chronic severe AR, being symptomatic is defined as NYHA class of III or IV, and patients classified as NYHA class II are asymptomatic, although Dujardin et al reported that patients with mild dyspnea (NYHA class II) display higher mortality rates compared with patients classified as NYHA class I during conservative treatment.³¹

In patients with minimal symptoms, an additional evaluation with exercise stress echocardiography to confirm the occurrence of symptoms and/or the presence of LV contractile reserve is useful.^{33,34}

Timing of Surgical Intervention in Asymptomatic Patients

EF In asymptomatic patients with severe AR, LV systolic dysfunction with reduced EF is a crucial indication for surgical intervention. Current guidelines from the Japanese Circulation Society (JCS), the ACC/AHA, and the European Society of Cardiology (ESC) strongly recommend (Class I) aortic valve surgery in patients with a decreased EF.^{4–6} Several investigators have identified the relationship between a low preoperative EF and postoperative outcomes (survival and LV function) (Table 1).^{32,35–43} and the EF cutoff value for surgical indication is 50% in the current JCS and ESC guidelines.^{4,6} However, in the 2020 ACC/AHA guidelines, the EF cutoff value is 55%.⁵ Murashita et al demonstrated that a preoperative EF <60% is related to a high all-cause mortality rate after correction for chronic severe AR.⁴⁰ In another study by de Meester et al, the postoperative all-cause mortality rate began to increase when the preoperative EF was <55%.⁴¹ However, the lower limit of EF in

Table 3. Timing of Surgical Intervention in Asymptomatic Patients: LVESD Index

Author (year) ^{Ref.}	Country	Period of study	No. of patients	Mean age	BSA	Symptoms	Outcome assessed	Findings
Dujardin et al (1999) ³¹	USA	1984–1995	192	56	1.9	Symptomatic 50% Asymptomatic 50%	Survival with conservative treatment	Survival of patients with a baseline LVESD ≥ 25 mm/m ² was lower than expected and different from that of patients with an LVESD < 25 mm/m ²
Sambola et al (2008) ⁵⁰	ESP	1982–2005	147	51	1.8	Symptomatic 76% Asymptomatic 24%	Postoperative survival	In patients with a low BSA (1.43–1.68 mm/m ²), an LVESD index of 25 mm/m ² should be used as a cutoff value for surgery rather than an LVESD of 50 mm
Brown et al (2009) ⁵¹	USA	1996–2006	301	55	2.0	Symptomatic 44% Asymptomatic 56%	Postoperative survival	Preoperative LVESD index of 20 mm/m ² ($\approx$ LVESD 40 mm) and an LVEDD index of 30 mm/m ² ($\approx$ LVEDD 60 mm) were the best cutoff values for late survival after AVR
Mentias et al (2016) ⁵²	USA	2003–2010	1,061 (484: nonsurgical)	54	2.0	Symptomatic 13% Asymptomatic 87%	Survival with conservative treatment	Nonsurgical patients with an LVESD index ≤ 20 mm/m ² had excellent 5-year survival. However, the risk of death significantly and continuously increased beyond an LVESD index > 20 mm/m ²
Young et al (2019) ⁵³	USA	2006–2017	748 (387: nonsurgical)	58	2.0	Symptomatic 46% Asymptomatic 54%	Survival	Compared with patients with an LVESD index < 20 mm/m ² , those with an LVESD index of 20–25 mm/m ² and ≥ 25 mm/m ² had an increased risk of death
de Meester et al (2019) ⁴¹	BEL	1995–2012	356	51	NA	Symptomatic 18% Asymptomatic 82%	Postoperative survival	Patients with preoperative LVESD ≥ 25 mm/m ² are at higher risk of death or of developing HF symptoms postoperatively
Saisho et al (2015) ⁴⁸	JPN	1989–2010	177	58	1.6	NA	Postoperative normal LV function	Postoperative LV function was preserved in patients with preoperative LVESD index ≤ 26.7 mm/m ²
Maeda et al (2019) ⁵⁴	JPN	1991–2010	162	59	1.6	Asymptomatic	Postoperative survival	Survival after AVR in patients with an LVESD index > 25 mm/m ² or an LVEDD > 65 mm was similar to the general population. Preoperative LVESD index > 25 mm/m ² affected survival > 10 years after AVR

AR, aortic regurgitation; AVR, aortic valve replacement; EDD, end-diastolic diameter; EF, ejection fraction; ESD, endsystolic diameter; LV, left ventricular; MACE, major adverse cardiovascular event; NA, not applicable.

healthy subjects was reported as 52% in males and 54% in females.⁴⁴ Thus, the EF cutoff value of 55% is within the normal EF range. In Japanese data, Amano et al⁴³ identified a preoperative EF $< 50\%$ as high-risk for postoperative cardiac death, although a preoperative EF $< 56\%$ was not. It is noteworthy that cardiac death was set as a primary endpoint in that study. The ultimate goal of aortic valve surgery in patients with severe AR is to improve cardiac outcomes; therefore, additional studies are needed to identify the optimal cutoff value to achieve favorable cardiac outcomes after aortic valve surgery.

LV Endsystolic Diameter (LVESD) and LVESD Index LVESD is also a crucial indicator for surgical intervention in asymptomatic patients with chronic severe AR. Current JCS, ACC/AHA, and ESC guidelines recommend aortic valve surgery (Class IIa) in patients with an increased LVESD.^{4–6} The LVESD in patients with chronic AR reflects not only LV volume and pressure overload, but also the degree of LV systolic function. In asymptomatic patients with a normal EF, an increased LVESD indicates progres-

sion of LV remodeling and subsequent LV systolic dysfunction, resulting in an increased mortality rate after aortic valve surgery.^{12,13} Several studies have identified a relationship between preoperatively increased LVESD or LV endsystolic volume and postoperative survival or the occurrence of cardiac events (**Table 2**).^{32,39,43,45–49} In the current ACC/AHA and ESC guidelines, the cutoff value for LVESD that indicates surgery is 50 mm.^{5,6} In 1983, Gaasch et al identified that patients with a preoperative LVESD index > 26 mm/m² (LVESD > 50 mm) showed poor outcomes in terms of postoperative LV enlargement.⁴⁵ Tornos et al reported that their early operation group (mean LVESD 48 mm) demonstrated improved long-term survival compared with the conventional group with a mean LVESD of 55 mm.³² Moreover, several studies have identified no benefits of aortic valve surgery on postoperative survival in patients with a preoperative LVESD < 50 mm, an LVEDD < 70 mm, and an LVEF $> 50\%$.^{39,47} Therefore, in the USA and Europe, an LVESD of 50 mm is the cutoff value for surgical intervention to improve postoperative outcomes. However, in

Japanese studies, Saisho et al showed that postoperative LV function is preserved in patients with a preoperative LVESD index $\leq 26.7 \text{ mm/m}^2$ ($\approx$ LVESD 43 mm),⁴⁸ and Amano et al identified a low-risk group of patients with a preoperative LVESD $\leq 47 \text{ mm}$ for postoperative survival.⁴³ Considering these results, the lower LVESD cutoff value of 45 mm for aortic valve surgery as Class IIa in the JCS guidelines may be valid for Japanese individuals who have a small body size.

Recent studies related to prognostic markers of chronic severe AR have paid much attention to the LVESD index adjusted for body size (Table 3).^{31,41,48,50–54} In the ACC/AHA guidelines, patients with an LVESD index $>25 \text{ mm/m}^2$ have a Class IIa indication for surgical intervention.⁵ In 2009, Brown et al showed that a preoperative LVESD index of 20 mm/m^2 was the best cutoff value for better survival late after aortic valve surgery, although 44% of their study population was symptomatic (NYHA class $\geq$ III).⁵¹ Recent big data related to survival in the USA have identified that the risk of death significantly and continuously increased beyond an LVESD index $>20 \text{ mm/m}^2$.^{52,53} In the data, patients who did not undergo aortic valve surgery during follow-up showed a poor prognosis, but the causes of death were not specified, whether or not death was valve related. The watchful waiting strategy might not be possible in these patients. Therefore, it is difficult to conclude that further early surgical intervention confers any benefit to patients with severe chronic AR. In Europe, Sambola et al reported that an LVESD index of 25 mm/m^2 should be used as a cutoff value for surgery rather than an LVESD of 50 mm in patients with a small body surface area ($1.43\text{--}1.68 \text{ mm/m}^2$).⁵⁰ Their data is reflected to the ESC guidelines in 2017, in which the annotation was added that a cutoff LVESD index value of 25 mm/m^2 appears to be more appropriate in patients with a small body size.⁶ In 2019, de Meester et al confirmed that patients with a preoperative LVESD index $\geq 25 \text{ mm/m}^2$ are at a higher risk of death or of developing HF symptoms postoperatively.⁴¹ In the USA and Europe, where average body surface area is $1.9\text{--}2.0 \text{ m}^2$, an LVESD index $\geq 25 \text{ mm/m}^2$ may be an appropriate cutoff value, especially in patients with a small body size. Conversely, in Asian countries, including Japan, where average body surface area is $1.6\text{--}1.7 \text{ m}^2$, using LVESD adjusted by body surface area as an optimal cutoff value for surgical intervention should be considered carefully because of LVESD overcorrection.^{38,43,48,54} Saisho et al reported that an LVESD index of 25 mm/m^2 was not an appropriate cutoff value for death, freedom from cardiac death, or rehospitalization for HF in the long term after surgical intervention, although postoperative LV function was preserved in patients with a preoperative LVESD index $\leq 26.7 \text{ mm/m}^2$.⁴⁸ Maeda et al also demonstrated that postoperative survival between patients with an LVESD index $\leq 25 \text{ mm/m}^2$ and an LVESD index $>25 \text{ mm/m}^2$ was not different, and survival in both groups was not statistically different from the general population, although a preoperative LVESD index $>25 \text{ mm/m}^2$ affected survival >10 years after aortic valve surgery in the limited population who could be followed up for >10 years after aortic valve surgery.⁵⁴ More data are needed to determine the threshold values of LV systolic diameter for predicting optimal postoperative outcomes, especially for the Japanese population.

LV End-Diastolic Diameter Current ACC/AHA and JCS guidelines provide a weak recommendation (Class

IIb) for aortic valve surgery in patients with enlarged LVEDD (65 mm).^{4,5} There is insufficient evidence to conclude an appropriate cutoff value for surgical intervention based on LVEDD.^{51,55} Recent data conclude that LVEDD is not related to postoperative outcomes.^{41,43} LVEDD is a marker of the severity of LV volume overload in patients with chronic AR, but it does not reflect the increase in afterload and LV systolic dysfunction. Therefore, LVEDD is inferior to LVESD as a prognostic marker to decide the optimal timing of surgical intervention. Moreover, measurement error in LVEDD occurs easily compared with LVESD, especially in patients with severe AR and a spherical LV.⁵⁶ Therefore, in the clinical setting, LVESD is more useful as an indication for surgery in patients with chronic severe AR than LVEDD.

Surgical Indication and Medical Therapy in Patients With Severe LV Dysfunction and Postoperative Follow-up

As severe chronic AR is characterized by a long asymptomatic period, patients sometimes exhibit LV dysfunction at the initial diagnosis. Postoperative survival and the likelihood of residual LV dysfunction are lower in patients with severe LV dysfunction than in those with mildly reduced or normal LV function.^{32,57,58} However, the benefits of surgical intervention have been identified, even in patients with severe LV dysfunction.⁵⁸ Surgical intervention followed by medical treatment is a better treatment option than long-term medical therapy alone.

Originally, the goal of medical therapy in patients with chronic severe AR was to reduce systolic hypertension and LV wall stress to improve LV function.^{59,60} In inoperable patients with concomitant diseases, angiotensin-converting enzyme inhibitors/angiotensin II receptor blockers are preferable because relief of symptoms is sometimes achieved or the improvement in LV dysfunction may lead to operable conditions.⁶¹ Regarding β -blockers, a reduction in heart rate induces an increase in SV and systolic hypertension, as well as worsening of AR due to prolongation of diastole. Thus, the effectiveness of β -blockers in patients without an indication for surgical intervention has not been established. However, previous reports showed that β -blockers were effective in patients with severe AR and LV dysfunction.^{62,63}

In terms of the postoperative course of patients with severe chronic AR and LV dysfunction, previous studies suggest that improvements in LV function after aortic valve surgery are achieved by an early reduction in volume overload and late remodeling.^{64–66} In 1988, Bonow et al evaluated the postoperative improvement in EF and identified that 59% of patients with preoperative LV dysfunction had not achieved postoperative normalization of EF 6–8 months after aortic valve surgery.⁶⁵ In 2011, however, Sénéchal et al reported that 82% of patients showed positive early LV remodeling, even 1 week after aortic valve surgery,⁶⁶ as surgical techniques and postoperative outcomes have improved compared with those in the 1980s.⁶⁷ More recently, Amano et al showed that LV function improved after aortic valve surgery in Japanese patients with severe AR and impaired EF, and EF was $>50\%$ in most patients 1 year after surgery.⁴³ Saisho et al also reported Japanese data on LV recovery immediately after, 1 year after, and late after aortic valve surgery.⁴⁸

Therefore, even in patients with severe chronic AR and severe LV dysfunction, surgical intervention should be considered concomitant with substantial medical therapy. A preoperative evaluation of the degree of cardiac damage with multimodality imaging, including cardiac MRI, may provide important information on postoperative management.

Conclusions

Many patients with chronic severe AR become symptomatic for the first time after progression of LV dysfunction. In the current JCS guidelines, an EF <50% and LVESD >45 mm are Class I or IIa recommendations for surgical intervention. Moreover, LVEDD >65 mm and an LVESD index >25 mm/m² are Class IIb recommendations. Accumulation of data from among the Japanese population is indispensable for establishing guidelines on optimal management of patients with chronic AR.

Disclosures

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