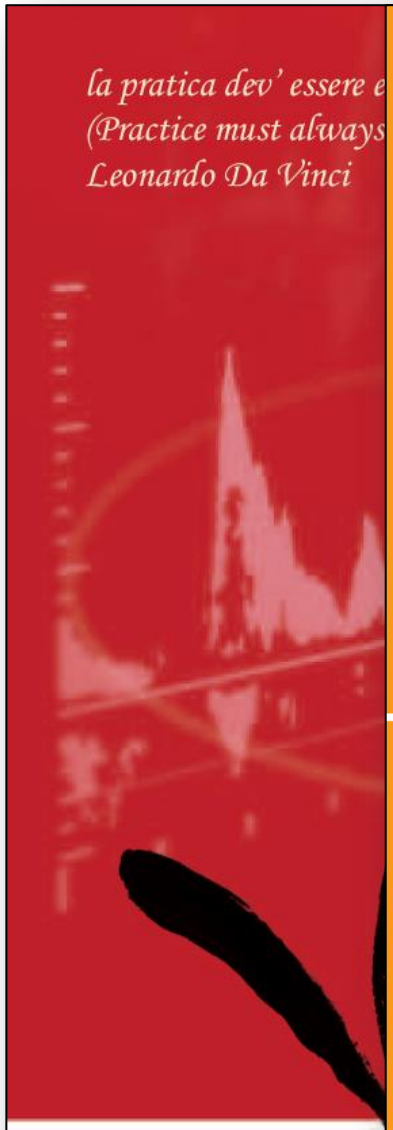


Reconstruc
A practical

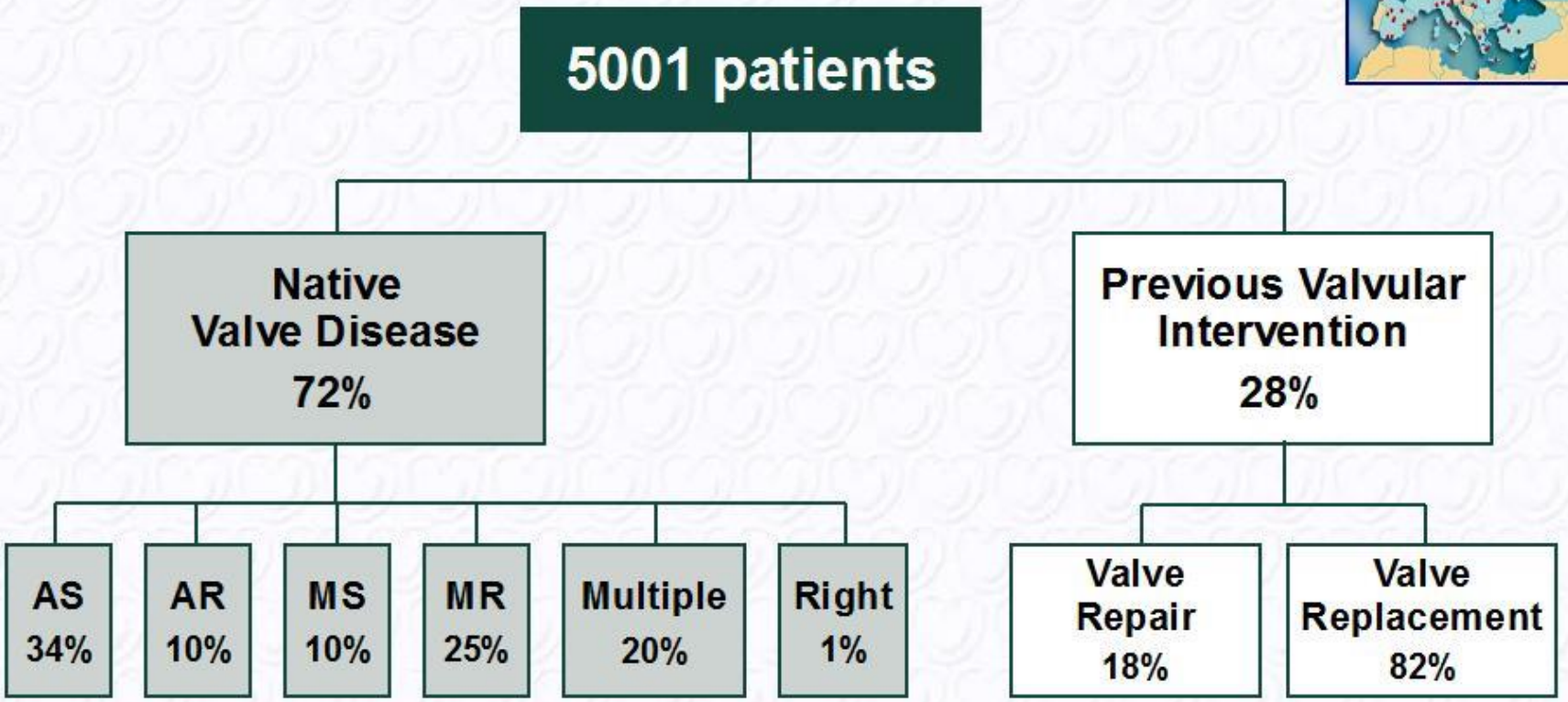
Day 1

08.30	Arrival, registration	
09.00	Welcome and introduction	*H.-J. Schäfers*
09.45	Aortic regurgitation and aneurysm- Epidemiology and guidelines	*W. Fehske*
	BREAK	
10.30	Anatomy of aortic valve and root	*M. Heinemann*
11.00	AV repair – the Homburg approach	*H.-J. Schäfers*
11.30	Why and when to repair the aortic valve	*I. El-Hamamsy*
	BREAK	
13.00	Videos root repair	*H.-J. Schäfers*
14.00	Root repair – the Tel Aviv approach	*E. Raanani*
14.20	Echo assessment of AR and its mechanisms	*W. Fehske*
14.40	Repair or Ross operation	*I. El-Hamamsy*
	BREAK	
15.30	The AV junction in aortic repair	*E. Lansac*
16.00	Videos cusp repair	*H.-J. Schäfers*
17.00	Results of cusp and root repair	*C. Giebels*
18.00	Adjourn	

Day 2

07.45	Case presentations Live operations: Moderation E. Raanani	
08.00	Case #1 Root repair	
09.30	Case #2 Root repair	
10.15	Shortcut to echo – intraop. echo and morphology	*F. Langer*
	BREAK	
11.15	Case #3 Root repair	
12.15	Discussion	
	BREAK	
13.00	Reimplantation should be the preferred technique	*E. Raanani*
13.15	Remodeling is my standard approach	*H.-J. Schäfers*
14.00	3-dimensional echo in aortic valve repair	*W. Fehske*
14.30	How to start root repair	*H.-J. Schäfers*
	BREAK	
15.30	Wetlab **(bring your loupes!)**	*Faculty*
18.00	Adjourn	

Distribution of Valvular Heart Diseases in the Euro Heart Survey



lung et al. *Eur Heart J* 2003;24:1244-53

European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 & European Journal of Cardio-Thoracic Surgery 2012 - doi:10.1093/ejcts/ezs455).

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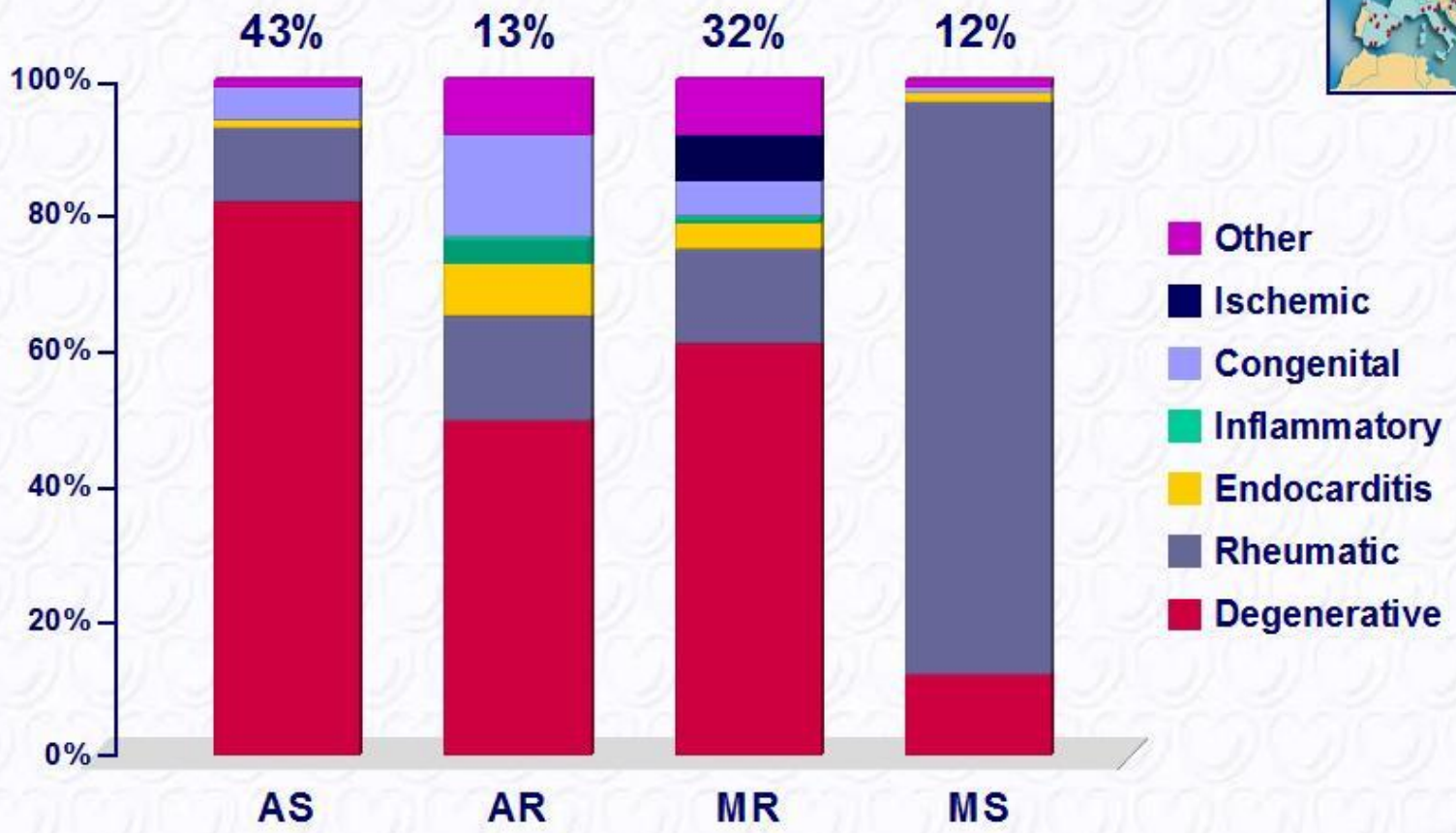
Aetiologies of Single Valvular Heart Diseases in the Euro Heart Survey



Iung et al. *Eur Heart J* 2003;24:1244-53

European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 & European Journal of Cardio-Thoracic Surgery 2012 - doi:10.1093/ejcts/ezs455).

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Patient Characteristics in the Euro Heart Survey

	Age (years)	≥ 70 years (%)	≥ 1 comorbidity (%)
AS	69±12	56	36
AR	58±16	25	26
MS	58±13	18	22
MR	65±14	44	42

Iung et al. *Eur Heart J* 2003;24:1244-53

European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 & European Journal of Cardio-Thoracic Surgery 2012 - doi:10.1093/ejcts/ezs455).

Heart Online First, published on April 21, 2017 as 10.1136/heartjnl-2016-310894

ORIGINAL RESEARCH ARTICLE

Epidemiology of valvular heart disease in a Swedish nationwide hospital-based register study

Pontus Andell,[1] Xinjun Li,[2] Andreas Martinsson,[1] Charlotte Andersson,[3] Martin Stagmo,[1] Bengt Zöller,[2] Kristina Sundquist,[2] J Gustav Smith[1,4]

Table 1 Study population, cases and incidence rates of valvular heart disease in Sweden between 2003 and 2010

	Men (n=5 060 355)					Women (n=5 103 856)				
Population	**N**	**Age, years**	**IQR**	**IR**	**95% CI**	**N**	**Age, years**	**IQR**	**IR**	**95% CI**
Any VHD	34582	70	58–79	75.5	74.7 to 76.3	31221	76	64–83	53.0	52.5 to 53.6
Subtypes										
Aortic stenosis	18890	74	64–81	37.8	37.3 to 38.3	17429	80	72–85	24.2	23.8 to 24.5
Aortic regurgitation	8376	63	43–73	20.2	19.7 to 20.6	5477	71	57–79	10.8	10.6 to 11.1
Mitral stenosis	635	64	45–76	1.5	1.4 to 1.6	1282	74	58–81	2.3	2.2 to 2.5
Mitral regurgitation	9779	69	59–77	21.3	20.9 to 21.7	8816	74	61–81	16.0	15.7 to 16.4
Pulmonary stenosis	1109	6	0–20	3.7	3.5 to 4.0	1351	4	0–22	4.8	4.5 to 5.0
Pulmonary regurgitation	344	16	8–33	1.0	0.9 to 1.2	293	19	8–42	0.9	0.8 to 1.0
Tricuspid stenosis	151	49	5–72	0.4	0.4 to 0.5	151	62	15–76	0.4	0.3 to 0.4
Tricuspid regurgitation	1192	73	62–80	2.5	2.3 to 2.6	1693	75	65–82	2.8	2.7 to 3.0
Two concurrent VHD	3656	–	–	8.5	8.2 to 8.8	3206	–	–	5.8	5.6 to 6.0
Three or more concurrent VHD	279	–	–	0.7	0.6 to 0.8	291	–	–	0.3	0.3 to 0.3

Incidence rate (IR) per 1 00 000 person-years at risk between 2003 and 2010 in the Swedish population with 95% CIs. A 3-year washout period was used between 2000 and 2002 to only include incident cases. Age is presented as median age at diagnosis and interquartile range (IQR). VHD, valvular heart disease.

Heart Online First, published on April 21, 2017 as 10.1136/heartjnl-2016-310894

ORIGINAL RESEARCH ARTICLE

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Table 3 Comorbidity profiles for valvular heart disease in Sweden between 2003 and 2010

	Population		AS		AR		MS		MR		PS		PR		TS		TR	
Total cases	**10 164 211**	**%**	**36 319**	**%**	**13 853**	**%**	**1917**	**%**	**18 595**	**%**	**2460**	**%**	**637**	**%**	**302**	**%**	**2885**	**%**
Non-valvular congenital heart disease	36 381	0.4	800	2.2	966	7.0	120	6.3	799	4.3	1374	55.9	336	52.7	96	31.8	162	5.6
Rheumatic fever	2847	0.0	34	0.1	21	0.2	5	0.3	24	0.1	1	0.0	0	0.0	1	0.3	2	0.1
Endocarditis	6695	0.1	991	2.7	742	5.4	72	3.8	928	5.0	18	0.7	2	0.3	3	1.0	123	4.3
Atherosclerotic vascular disease	616 714	6.1	17 572	48.4	4196	30.3	635	33.1	6755	36.3	71	2.9	40	6.3	59	19.5	970	33.6
Cancer	670 226	6.6	7235	19.9	2006	14.5	241	12.6	3386	18.2	68	2.8	26	4.1	26	8.6	577	20.0
Infections	1 948 980	19.2	12 634	34.8	4377	31.6	715	37.3	6479	34.8	1100	44.7	221	34.7	129	42.7	1088	37.7
Autoimmune disorders	697 905	6.9	10 419	28.7	2677	19.3	469	24.5	4176	22.5	138	5.6	53	8.3	46	15.2	654	22.7
Heritable connective tissue disorders	2785	0.0	9	0.0	81	0.6	0	0.0	45	0.2	3	0.1	1	0.2	0	0.0	4	0.1
Abdominal hernia or prolapse	382 766	3.8	3447	9.5	1324	9.6	137	7.1	1985	10.7	76	3.1	28	4.4	22	7.3	297	10.3
Carcinoid	1323	0.0	20	0.1	12	0.1	0	0.0	22	0.1	4	0.2	4	0.6	4	1.3	31	1.1
Pulmonary hypertension	2863	0.0	118	0.3	33	0.2	28	1.5	141	0.8	11	0.4	3	0.5	5	1.7	104	3.6
Ascending aortic aneurysm/dissection	9846	0.1	911	2.5	1430	10.3	9	0.5	177	1.0	2	0.1	3	0.5	4	1.3	17	0.6
Atrial fibrillation	296 450	2.9	9546	26.3	3118	22.5	749	39.1	7178	38.6	66	2.7	46	7.2	81	26.8	1473	51.1
Heart failure	237 209	2.3	11 646	32.1	2890	20.9	664	34.6	7301	39.3	74	3.0	37	5.8	70	23.2	1367	47.4
Non-valvular thoracic surgery	132 096	1.3	6005	16.5	2614	18.9	323	16.8	3245	17.5	409	16.6	80	12.6	103	34.1	533	18.5

For each valvular heart disease, numbers and percentages of cases with concomitant comorbidities, defined by International Classification of Diseases codes, are shown. The numbers and percentages in the total population are also shown for comparison. AS, aortic stenosis; AR, aortic regurgitation; MS, mitral stenosis; MR, mitral regurgitation; PS, pulmonary stenosis; PR, pulmonary regurgitation; TS, tricuspid stenosis; TR, tricuspid regurgitation.

Aortic Aneurysm

Incidence	**5 – 10 cases per 100.000 inhabitants USA** Clouse WD et al (1998) JAMA 280(22):1926–1929
Definitions	Aneu aorta asc, arch, descending aorta **Asc: Dil > 50% refrerred to normal values** (norm: asc 33 ±4 mm; **>41**, arch: 24 ±3 mm; **>30**)
Etiology	**atherosclerosis**, **tissue disease**: Marfan, Loeys-Dietz-S.;Ehlers-Danlos-S.; Turner S. **inherited familiar disease** **valve disease**: BAV, UAV Incidence of aortic dissection x 5 – 10 **infective disease**: aortitis bacteria, viral, fungi inf, syphilitic, tuberculosis

S. Leontyev · M. Misfeld · F.W. Mohr: Chirurg 2014 · 85:758–766

Inflamatory diseases associated with aortitis

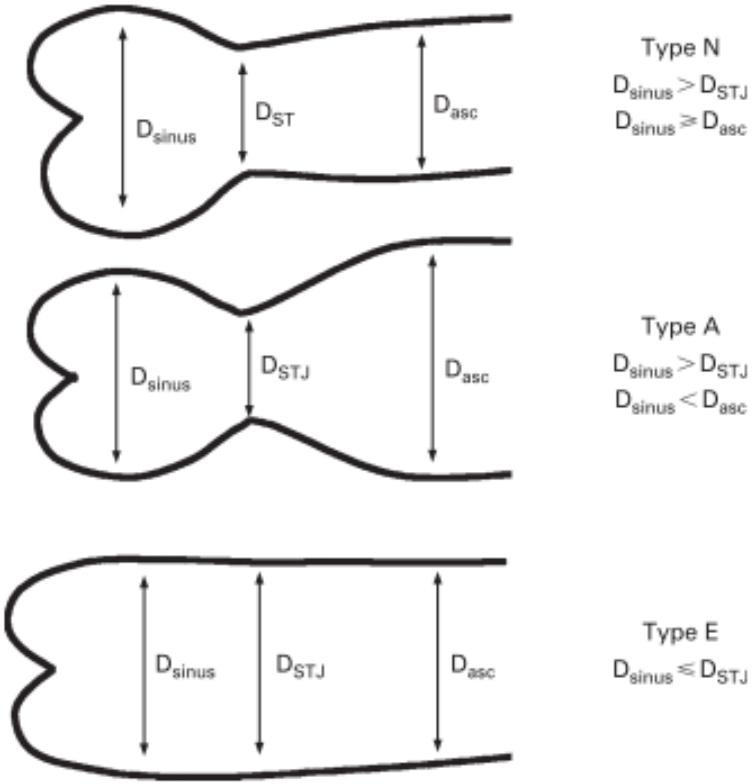
Disease	Diagnostic criteria	Definitive diagnosis
Giant cell arteritis	• Age at onset >50 years • Recent-onset localized headache • Temporal artery tenderness or pulse attenuation • Elevated erythrocyte sedimentation rate >50 mm/h • Artery biopsy showing necrotizing vasculitis	Three or more criteria are present (sensitivity >90%; specificity >90%)
Takayasu arteritis	• Age at onset <40 years • Intermittent claudication • Diminished brachial artery pulse • Subclavian artery or carotid bruit • Systolic blood pressure variation of >10 mmHg between arms • Aortographic evidence of aorta or aortic branch stenosis	Three or more criteria are present (sensitivity 90.5%; specificity 97.8%)
Behçet disease	• Oral ulceration • Recurrent genital ulceration • Uveitis or retinal vasculitis • Skin lesion, erythema nodosum, pseudofolliculitis or pathergy	Oral ulceration plus two of the other three criteria
Ankylosing spondylitis	• Onset of pain at age <40 years • Back pain for >3 months • Morning stiffness • Subtle symptom onset • Improvement with exercise	Four of the diagnostic criteria are present

European Heart Journal (2014); 35:2873–2926 - doi:10.1093/eurheartj/ehu281

Morphology of aortic root

Epidemiology?

- Classification of aortic valve and aortic root shape
- Scheme provides more information related to aortic root with possible implications for screening patients for potential complications
  - Aortic root dissection
- Type N aortic root most frequent, followed by Type A
- Type A aortic root seen more commonly in fusion of the right coronary and non-coronary leaflets



Schaefer et al, Heart 2008; 94: 1634-1638

Bicuspid valves

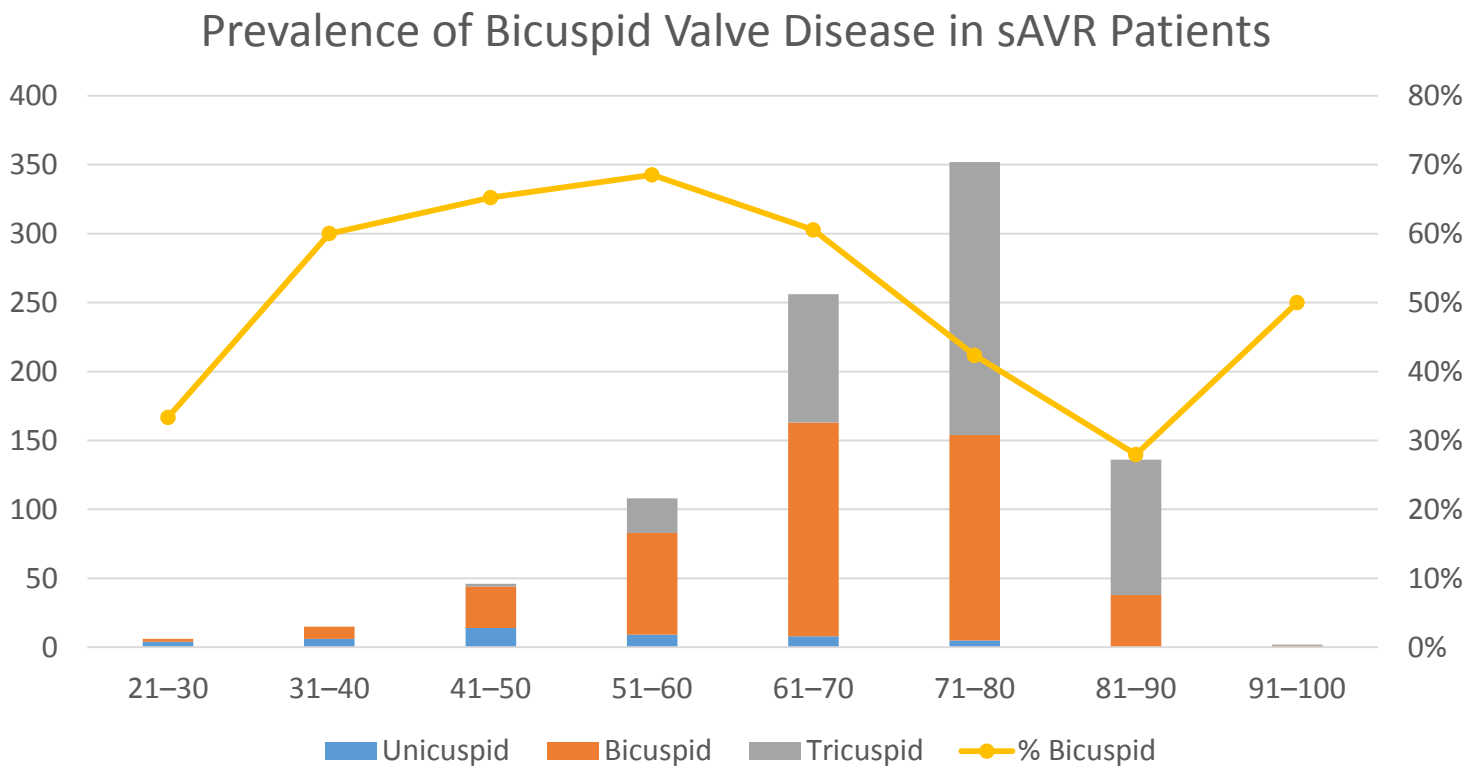
- Two leaflets instead of three
- Two symmetric leaflets

- Three leaflets with raphe («seam»)
- Elliptical valve orifice / Asymmetric calcification

- Possible additional intrinsic structural defect of the aortic media with subsequent aortic dilation

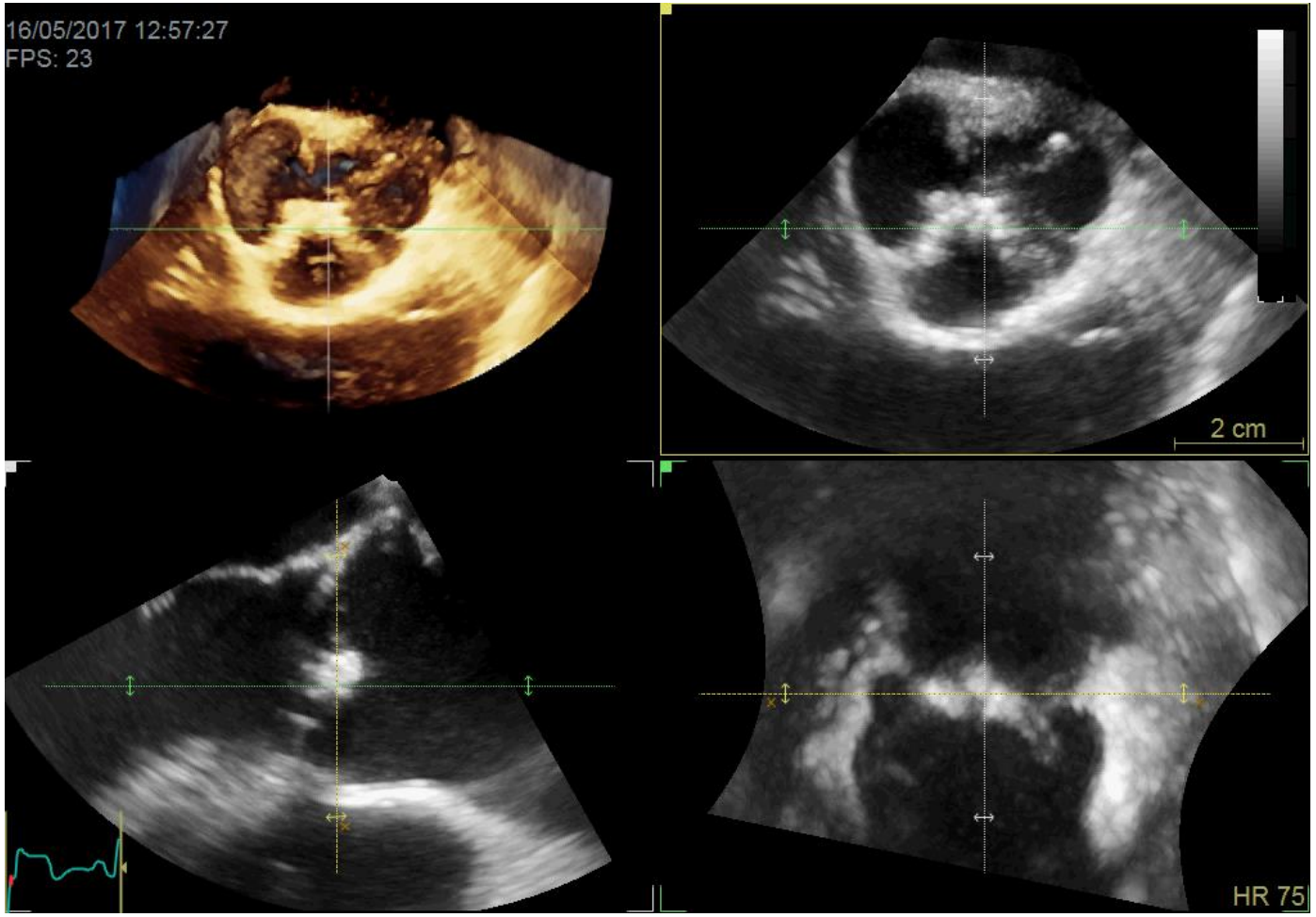
Jeger R. Presentation. SSC/SSCS Joint Annual Meeting Zürich, 10. June 2015

More than 50% of surgical valve replacement take place in bicuspid or unicuspid aortic valves



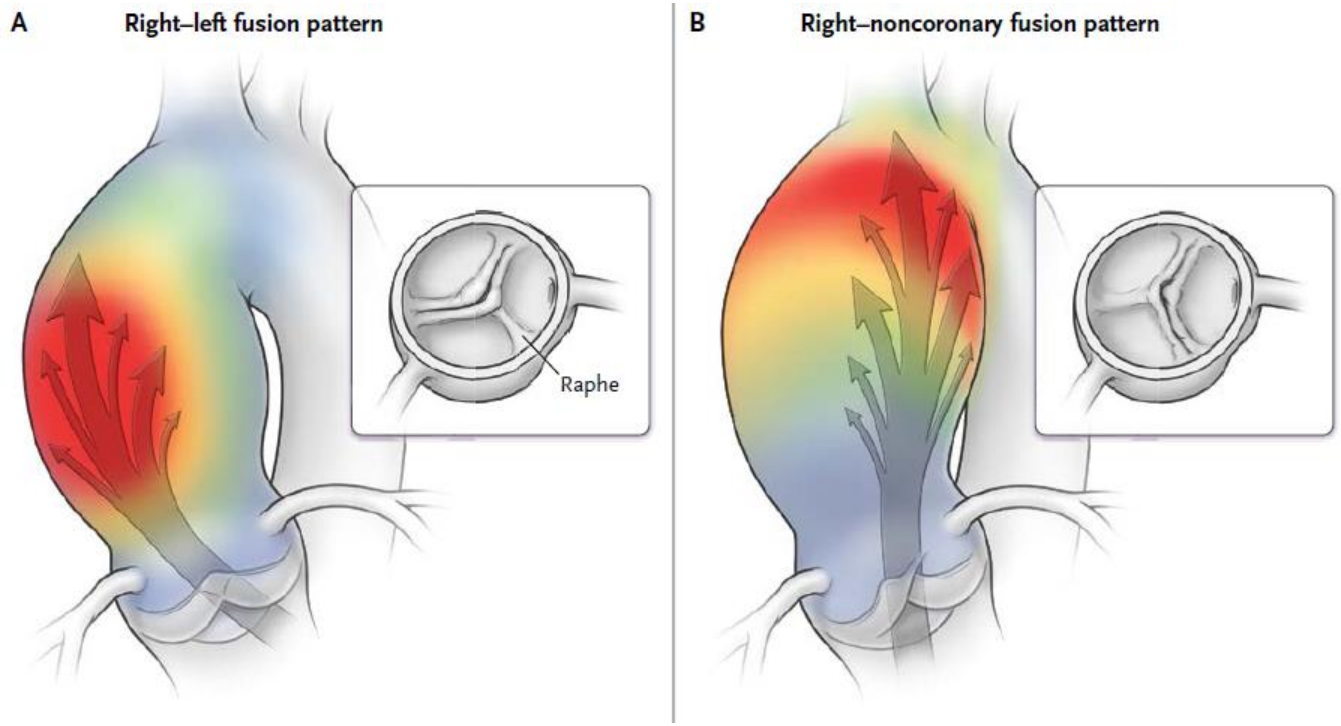
Roberts and Co, Frequency by Decades of Unicuspid, Bicuspid, and Tricuspid Aortic Valves in Adults Having Isolated Aortic Valve Replacement for Aortic Stenosis, With or Without Associated Aortic Regurgitation. Circulation 2005,111(7):920-5.

54 y, m, asymptomatic, TIA, cardiac source of emboli?



Formation of ascending aortic anomalies

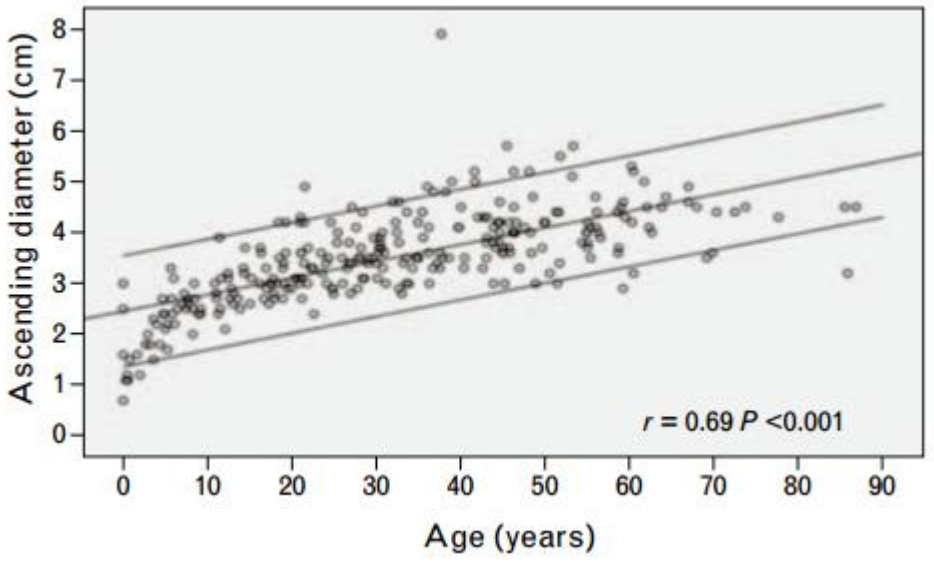
- The fusion configuration directs non-parallel flow across the aortic valve resulting in a jet directed toward the side of the aorta
- The resulting higher wall shear stress may promote aortic dilatation



VermaS et al. N Engl J Med 2014;370:1920-9.

Correlation between ascending aorta diameter and age in bicuspid aortic valve patients

- Dilatation of the ascending aorta was found to be correlated with age
- AS of the bicuspid valve was also found to increase with age
- **AR though showed a higher incidence in mid-age groups**



Age, years (*n*)	Ascending aortic diameter >3.6 cm, *n* (%)	At least moderate AR, *n* (%)	At least moderate AS, *n* (%)
<30 (181)	19/134 (14.2)	24/181 (13.3)	7/181 (3.9)
30–39 (52)	22/46 (47.8)	17/52 (32.7)	1/52 (1.9)
40–49 (49)	34/46 (73.9)	16/49 (32.7)	6/48 (12.5)
50–59 (32)	23/29 (79.3)	10/32 (31.3)	4/29 (13.8)
>60 (23)	18/22 (81.8)	5/22 (22.7)	6/23 (26.1)
P	<0.001	0.002	<0.001

Morosin et al. J Cardiovasc Medicine 2016 epublished ahead of print

2014 version

2014 ESC Guidelines on the Diagnosis and Treatment of Aortic Diseases

Chairpersons
Raimund Erbel (Germany) and Victor Aboyans (France)

www.escardio.org/guidelines European Heart Journal (2014); 35:2873–2926 - doi:10.1093/eurheartj/ehu281

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Comparison of methods for imaging the aorta

Advantages/disadvantages	TTE	TOE	CT	MRI	Aortography
Ease of use	+++	++	+++	++	+
Diagnostic reliability	+	+++	+++	+++	++
Bedside/interventional use	++	++	–	–	++
Serial examinations	++	+	++(+)	+++	–
Aortic wall visualization	+	+++	+++	+++	–
Cost	–	–	– –	– – –	– – –
Radiation	0	0	– – –	–	– –
Nephrotoxicity	0	0	– – –	– –	– – –

+ means a positive remark and — means a negative remark. The number of signs indicates the estimated potential value

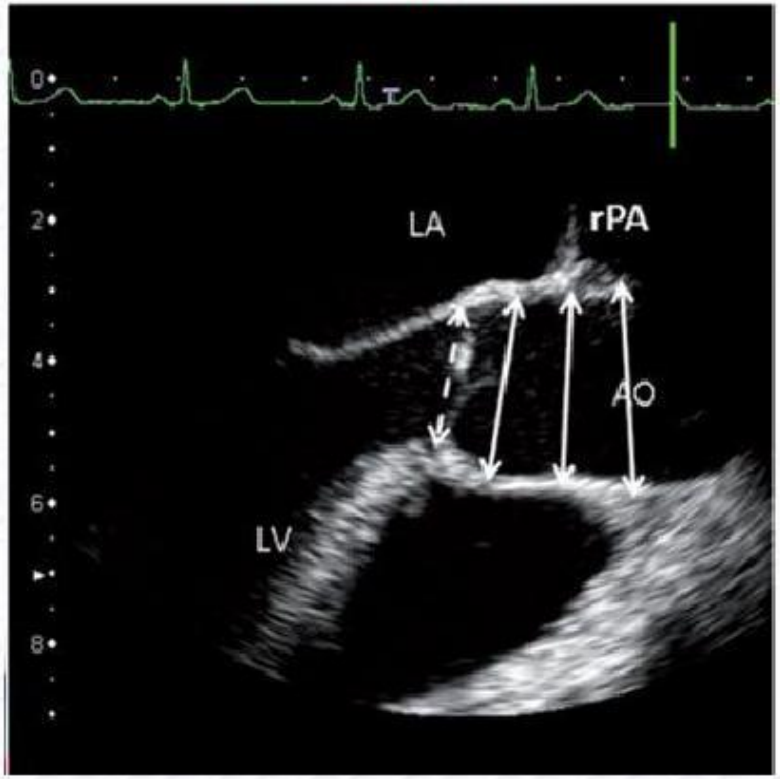
++(+) only for follow-up after aortic stenting (metallic struts), otherwise limit radiation

European Heart Journal (2014); 35:2873–2926 - doi:10.1093/eurheartj/ehu281

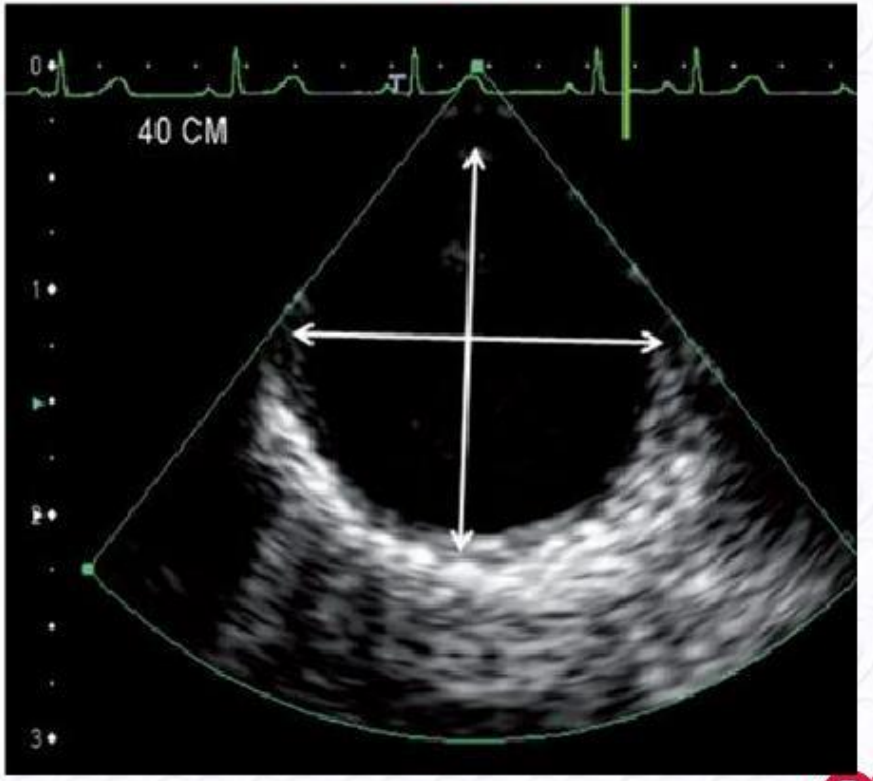
Transoesophageal echocardiographic long-axis and cross-sectional image of the ascending and descending aorta, indicating the points of diameter measurements: sinus of Valsalva, beginning of the ascending aorta, ascending aorta at the level of the right pulmonary artery. Also shown, the measurement of the aortic valvular ring.

Transoesophageal Echocardiogram

ascending aorta



descending aorta



European Heart Journal (2014); 35:2873–2926 - doi:10.1093/eurheartj/ehu281

Imaging the aorta

Recommendations	Class	Level
It is recommended to measure diameters at pre-specified anatomical landmarks, perpendicular to the longitudinal axis.	I	C
In case of repetitive imaging of the aorta over time to assess change in diameter, it is recommended to use the imaging modality with the lowest iatrogenic risk.	I	C
In case of repetitive imaging of the aorta over time to assess change in diameter, it is recommended to use the same imaging modality with a similar method of measurement.	I	C
It is recommended to report all relevant aortic diameters and abnormalities according to the aortic segmentation.	I	C
It is recommended to assess renal function, pregnancy, and history of allergy to contrast media in order to select the optimal imaging modality of the aorta with minimal radiation exposure, except for emergency cases.	I	C
The risk of radiation exposure should be assessed, especially in younger adults and in those undergoing repetitive imaging.	IIa	B
Aortic diameters may be indexed to the body surface area, especially for the outliers in body size.	IIb	B

European Heart Journal (2014); 35:2873–2926 - doi:10.1093/eurheartj/ehu281

Interventions of thoracic aortic aneurysm (TAA)

Recommendations	Class	Level
Interventions on ascending aorta		
Surgery is indicated in patients who have aortic root aneurysm, with maximal aortic diameter ≥50 mm for patients with Marfan syndrome.	I	C
Surgery should be considered in patients who have aortic root aneurysm, with maximal ascending aortic diameter: ≥45 mm for patients with Marfan syndrome with risk factors. ≥50 mm for patients with bicuspid valve with risk factors. ≥55 mm for other patients with no elastopathy.	IIa	C
Lower thresholds for intervention may be considered according to body surface area in patients of small stature or in the case of rapid progression, aortic valve regurgitation, planned pregnancy, and patient's preference.	IIb	C
Interventions on aortic arch aneurysms		
Surgery should be considered in patients who have isolated aortic arch aneurysm with maximal diameter ≥55 mm.	IIa	C
Aortic arch repair may be considered in patients with aortic arch aneurysm who already have an indication for surgery of an adjacent aneurysm located in the ascending or descending aorta.	IIb	C

Management of aortic root dilatation in patients with bicuspid aortic valve (BAV)

Recommendations	Class	Level
Patients with known BAV should undergo an inital TTE to assess the diameters of the aortic root and ascending aorta.	I	C
Cardiac MRI or CT is indicated in patients with BAV when the morphology of the aortic root and the ascending aorta cannot be accurately assessed by TTE.	I	C
Serial measurement of the aortic root and ascending aorta is indicated in every patient with BAV, with an interval depending on aortic size, increase in size and family history.	I	C
In the case of a diameter of the aortic root or the ascending aorta >45 mm or an increase >3 mm/year measured by echocardiography, annual measurement of aortic diameter is indicated.	I	C
In the case of aortic diameter >50 mm or an increase >3 mm/year measured by echocardiography, measurement confirmation using another imaging modality (CT or MRI) is indicated.	I	C

European Heart Journal (2014); 35:2873–2926 - doi:10.1093/eurheartj/ehu281

Management of aortic root dilatation in patients with bicuspid aortic valve (BAV)

Recommendations	Class	Level
In case of BAV, surgery of the ascending aorta:		
is indicated in case of aortic root or ascending aortic diameter >55 mm.	I	C
is indicated in case of aortic root or ascending aortic diameter >50 mm in the presence of other risk factors.	I	C
is indicated in case of aortic root or ascending aortic diameter >45 mm when surgical aortic valve replacement is scheduled.	I	C
β-blockers may be considered in patients with BAV and dilated aortic root >40 mm.	IIb	C
Because of familial occurrence, screening of first-degree relatives should be considered.	IIa	C
In patients with any elastopathy or BAV with dilated aortic root (>40 mm), isometric exercice with a high static load (e.g. weightlifting) is not indicated and should be discouraged.	III	C

European Heart Journal (2014); 35:2873–2926 - doi:10.1093/eurheartj/ehu281

European Heart Journal – Cardiovascular Imaging (2013) **14**, 611–644
doi:10.1093/ehjci/jet105

RECOMMENDATIONS

Recommendations for the echocardiographic assessment of native valvular regurgitation: an executive summary from the European Association of Cardiovascular Imaging

Patrizio Lancellotti[1]*, Christophe Tribouilloy[2], Andreas Hagendorff[3], Bogdan A. Popescu[4], Thor Edvardsen[5], Luc A. Pierard[1], Luigi Badano[6], and Jose L. Zamorano[7], On behalf of the Scientific Document Committee of the European Association of Cardiovascular Imaging: Thor Edvardsen, Oliver Bruder, Bernard Cosyns, Erwan Donal, Raluca Dulgheru, Maurizio Galderisi, Patrizio Lancellotti, Denisa Muraru, Koen Nieman, Rosa Sicari, Document reviewers: Erwan Donal, Kristina Haugaa, Giovanni La Canna, Julien Magne, Edyta Plonska

ESC/EACTS Guidelines for the Management of Valvular Heart Disease

European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 &
European Journal of Cardio-Thoracic Surgery 2012 -
doi:10.1093/ejcts/ezs455).

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European Heart Journal
doi:10.1093/eurheartj/ehs109

ESC/EACTS GUIDELINES

Guidelines on the management of valvular heart disease (version 2012)

The Joint Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

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European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 &
European Journal of Cardio-Thoracic Surgery 2012 -
doi:10.1093/ejcts/ezs455).

Aortic Regurgitation

European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 &
European Journal of Cardio-Thoracic Surgery 2012 -
doi:10.1093/ejcts/ezs455).

EACTS

EUROPEAN SOCIETY OF CARDIOLOGY®

Indications for surgery in severe aortic regurgitation

	Class	Level
Surgery is indicated in symptomatic patients.	I	B
Surgery is indicated in asymptomatic patients with resting LVEF ≤ 50%.	I	B
Surgery is indicated in patients undergoing CABG or surgery of ascending aorta, or on another valve.	I	C
Surgery should be considered in asymptomatic patients with resting EF > 50% with severe LV dilatation: LVEDD > 70 mm, or LVESD > 50 mm or LVESD > 25 mm/m^2 BSA.	IIa	C

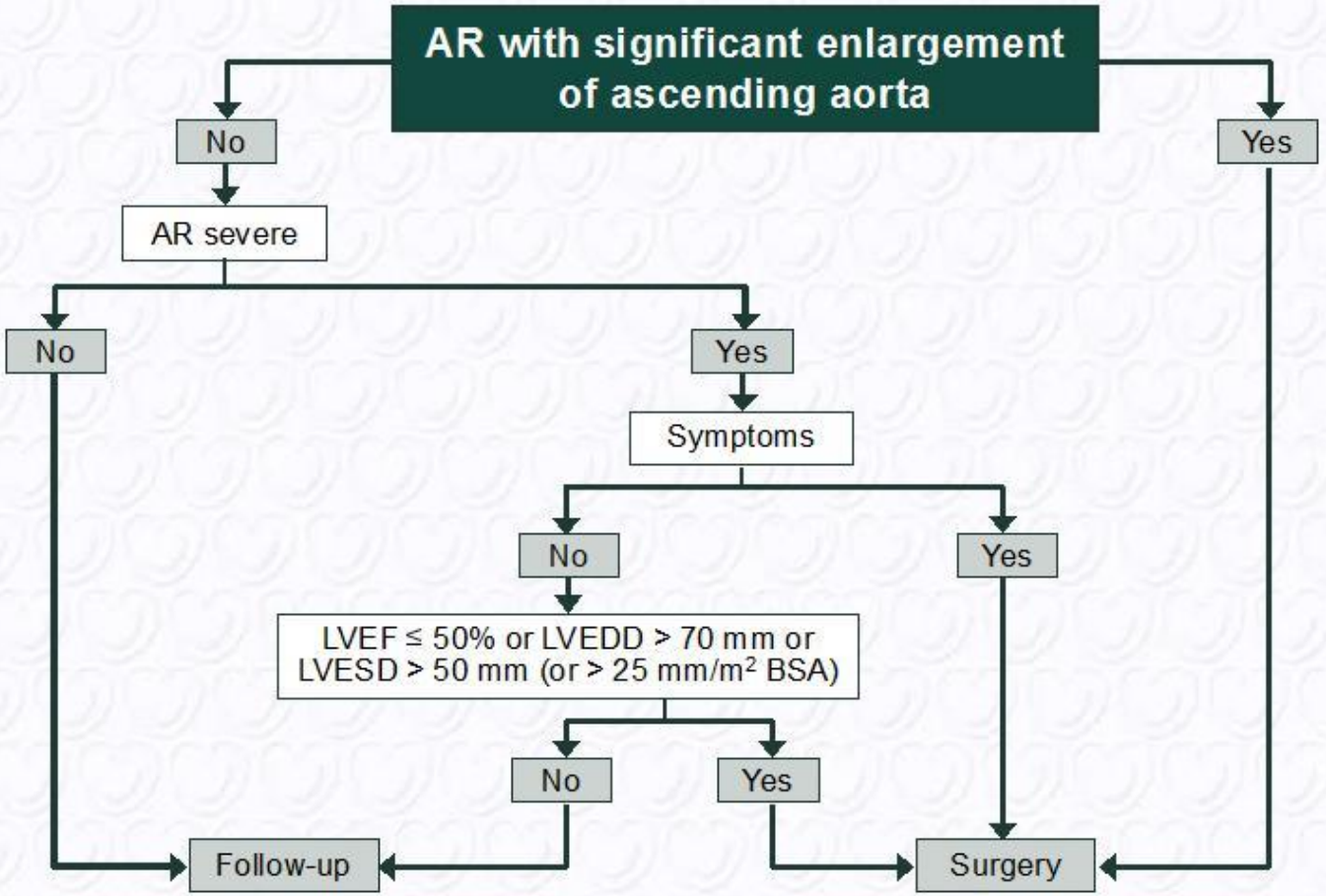
European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 & European Journal of Cardio-Thoracic Surgery 2012 - doi:10.1093/ejcts/ezs455).

Indications for surgery in aortic root disease (whatever the severity of AR)

	Class	Level
Surgery is indicated in patients who have aortic root disease with maximal ascending aortic diameter ≥ 50 mm for patients with Marfan syndrome	I	C
Surgery should be considered in patients who have aortic root disease with maximal ascending aortic diameter: • ≥ 45 mm for patients with Marfan syndrome with risk factors, • ≥ 50 mm for patients with bicuspid valve with risk factors, • ≥ 55 mm for other patients.	IIa	C

European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 & European Journal of Cardio-Thoracic Surgery 2012 - doi:10.1093/ejcts/ezs455).

Management of aortic regurgitation



European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 & European Journal of Cardio-Thoracic Surgery 2012 - doi:10.1093/ejcts/ezs455).

- Echocardiography is the key examination in the diagnosis and

4.3 Results of surgery

Treatment of isolated AR has traditionally been by valve replacement. In the past 20 years, repair strategies for the regurgitant aortic valve have been developed for tricuspid aortic valves and congenital anomalies.[65–67] When there is an associated aneurysm of the aortic root, conventional surgical therapy has consisted of the combined replacement of the aorta and valve with reimplantation of the coronary arteries. Valve-sparing aortic replacement is increasingly employed in expert centres, especially in young patients, to treat combined aortic root dilatation and valve regurgitation.[65–67]

Supra-coronary ascending aortic replacement can be performed with or without valve repair when root size is preserved.[67]

Replacement of the aortic valve with a pulmonary autograft is less frequently used and is mostly applied in young patients (<30 years).[68]

tissue Doppler and strain rate imaging may be useful in the future.[55]

2017 AHA/ACC Focused Update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

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Circulation

American Heart

Class I

1. **Operative intervention to repair the aortic sinuses or replace the ascending aorta is indicated in patients with a bicuspid aortic valve if the diameter of the aortic sinuses or ascending aorta is greater than 5.5 cm (113, 268, 269). *(Level of Evidence: B)***

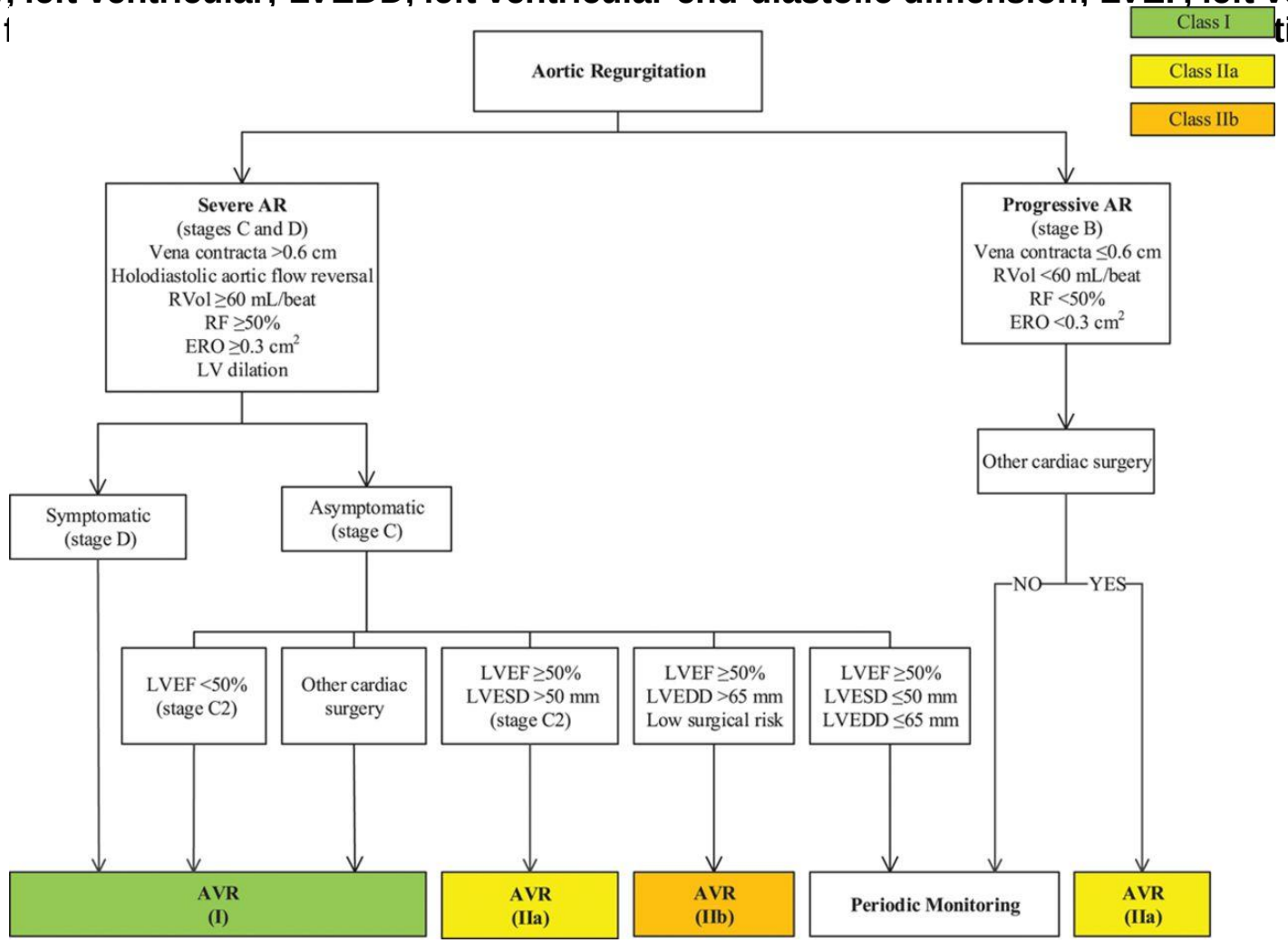
Class IIa

1. **Operative intervention to repair the aortic sinuses or replace the ascending aorta is reasonable in patients with bicuspid aortic valves if the diameter of the aortic sinuses or ascending aorta is greater than 5.0 cm and a risk factor for dissection is present (family history of aortic dissection or if the rate of increase in diameter is ≥0.5 cm per year). *(Level of Evidence: C)***

Class IIa

2. **Replacement of the ascending aorta is reasonable in patients with a bicuspid aortic valve who are undergoing aortic valve surgery because of severe AS or AR (Sections 3.2.3 and 4.3.3) if the diameter of the ascending aorta is greater than 4.5 cm. *(Level of Evidence: C)***

Indications for AVR for Chronic AR. AR indicates aortic regurgitation; AVR, aortic valve replacement (valve repair may be appropriate in selected patients); ERO, effective regurgitant orifice; LV, left ventricular; LVEDD, left ventricular end-diastolic dimension; LVEF, left ventricular ejection f tion; and



Nishimura R A et al. Circulation. 2014;129:e521-e643