Evaluación de la función protésica por imágenes

Dr. Sebastián Robaina

Tipos de bioprótesis valvulares aorticas

Table 1 Types of prosthetic heart valves

- Biological
  - Stented
    - Porcine bioprosthesis
    - Pericardial bioprosthesis
  - Stentless
    - Porcine bioprosthesis
    - Pericardial bioprosthesis
    - Aortic homograft
    - Pulmonary autograft (Ross procedure)
  - Sutureless
  - Transcatheter
- Mechanical
  - Bileaflet
  - Single tilting disk
  - Caged ball

Table 2 Designs and models of biological replacement heart valve

Stented porcine replacement valve
- Hancock standard and Hancock II
- Medtronic Mosaic[a]
- Carpentier-Edwards standard and supra-annular
- St Jude Medical Biocor, Bioimplant, Epic
- AorTech Aspire
- Labcor
- Carbomedics Synergy

Stentless valve Porcine
- St Jude Medical Toronto[a]
- Medtronic Freestyle
- Cryolife-O'Brien[a]
- Cryolife-Ross Stentless porcine pulmonary
- Edwards Prima Plus
- AorTech Aspire
- St Jude Biocor
- Labcor
- St Jude Quattro stentless mitral
- Shelhigh Skeletorized Super-Stentless aortic porcine and pulmonic
- Medtronic-Venpro Contegra pulmonary valve conduit

Stented pericardial replacement valve
- Carpentier-Edwards Perimount
- Carpentier Edwards Magna
- Mitroflow Synergy
- St Jude Biocor pericardia
- St Jude Trifecta
- Labcor pericardial
- Sorin Pericarbon MORE[a]

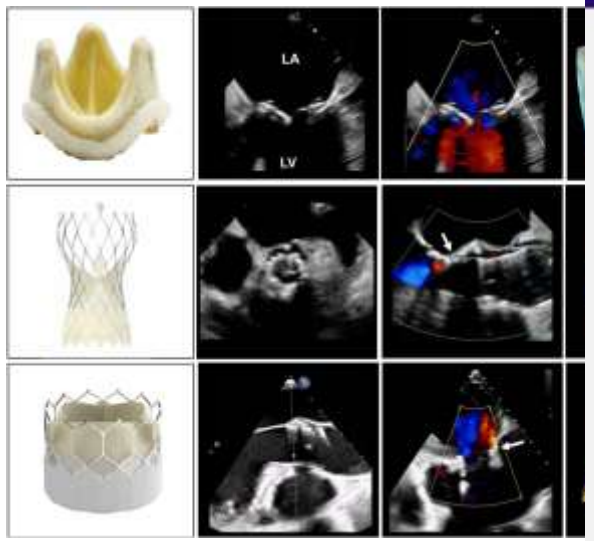
Stentless pericardial
- Sorin Pericarbon
- 3F-SAVR
- Freedom Solo

Sutureless
- Perceval S (Sorin)
- Edwards Intuity (Edwards Lifesciences)
- 3F Enable (ATS Medical)
- Trilogy (Arbor Surgical Technologies)

[a]Indicates withdrawn from market.

Patrizio Lancellotti. Recommendations for the imaging assessment of prosthetic heart valves: a report from the European Association of Cardiovascular Imaging endorsed by the Chinese Society of Echocardiography, the Inter-American Society of Echocardiography, and the Brazilian Department of Cardiovascular Imaging. European Heart Journal – Cardiovascular Imaging. 2016 doi:10.1093/ehjci/jew025

Tipos de bioprótesis valvulares aorticas:



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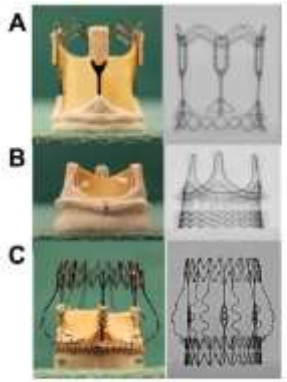

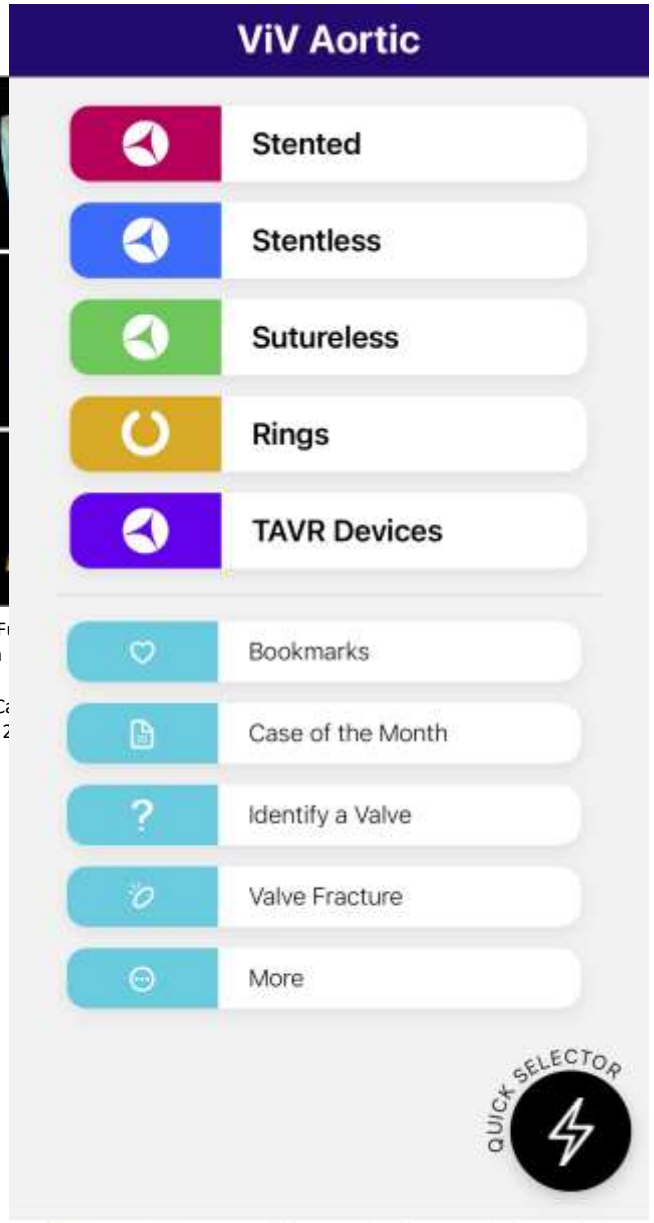

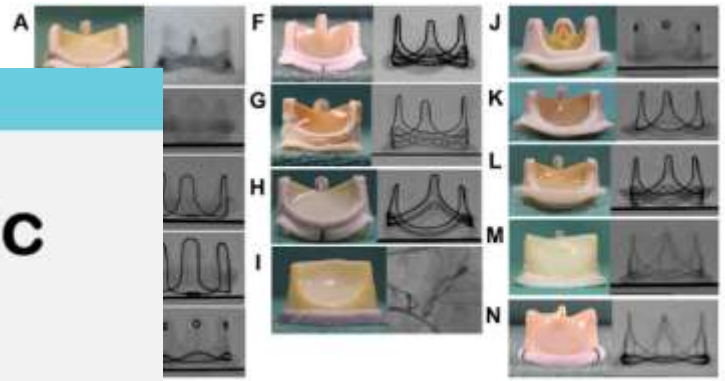

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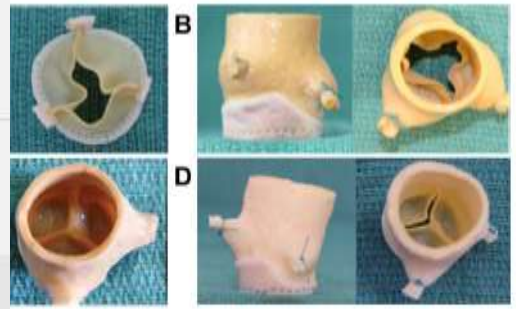

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Valoración funcional de las bioprótesis

Table 4 Essential parameters in the comprehensive evaluation of prosthetic valve function

	Parameters
Clinical information	• Date of valve replacement
	• Type and size of the prosthetic valve
	• Height, weight, body surface area, and body mass index
	• Symptoms and related clinical findings
	• Blood pressure and heart rate
Imaging of the valves	• Motion of cusps, leaflets, or occluder
	• Presence of calcification or abnormal structures on the various components of the prosthesis
	• Valve sewing ring integrity and motion
Doppler assessment of the valve	• Spectral Doppler envelope
	• Peak velocity and gradient
	• Mean pressure gradient
	• Doppler signal velocity time integral (VTI)
	• Doppler velocity index (DVI)
	• Pressure half time in mitral and tricuspid valve
	• Effective orifice area (EOA)
	• Presence, location, and severity of regurgitation
Other imaging data	• LV and RV size, function, and hypertrophy
	• LA and RA size
	• Co-existent valvular disease
	• Estimation of pulmonary artery pressure
Previous post-operative studies, when available	• Comparison of above parameters in suspected prosthetic valvular dysfunction

EOA, effective orifice area; LA, left atrial; LV, left ventricle; RA, right atrial.
Adapted from Zoghbi *et al.*[14]

Patrizio Lancellotti. Recommendations for the imaging assessment of prosthetic heart valves: a report from the European Association of Cardiovascular Imaging endorsed by the Chinese Society of Echocardiography, the Inter-American Society of Echocardiography, and the Brazilian Department of Cardiovascular Imaging. European Heart Journal – Cardiovascular Imaging. 2016 doi:10.1093/ehjci/jew025

Table 4 Echocardiographic evaluation of prosthetic aortic valves

	Parameter
Doppler echocardiography of the aortic valve	Peak velocity/gradient
	Mean gradient
	Contour of the jet velocity; acceleration time
	DVI (DVI = VTI_{LVOT}/VTI_{PrAV})
	EOA
	Presence, location, and severity of regurgitation
Pertinent cardiac chambers	LV size, function, and hypertrophy
Previous postoperative study(ies), when available	Comparison of above parameters is particularly helpful in suspected prosthetic valvular dysfunction

VTI_{PrAV}, VTI through the prosthetic aortic valve.

Zoghbi, W. Guidelines for the Evaluation of Prosthetic Valve Function With Cardiovascular Imaging: A Report From the American Society of Echocardiography Developed in Collaboration With the Society for Cardiovascular Magnetic Resonance and the Society of Cardiovascular Computed Tomography. (J Am Soc Echocardiogr 2024;37:2-63. https://doi.org/10.1016/j.echo.2023.10.004

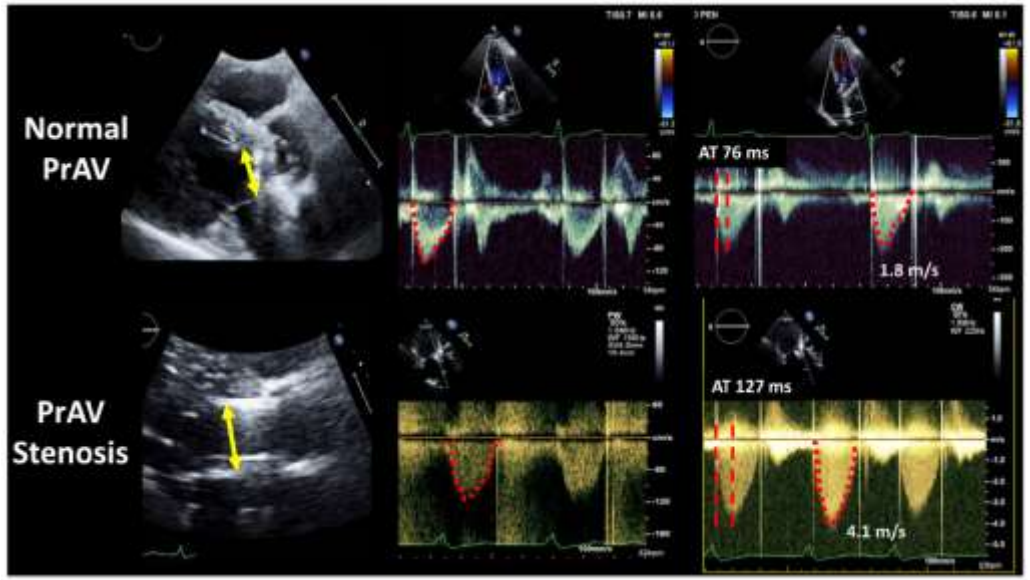
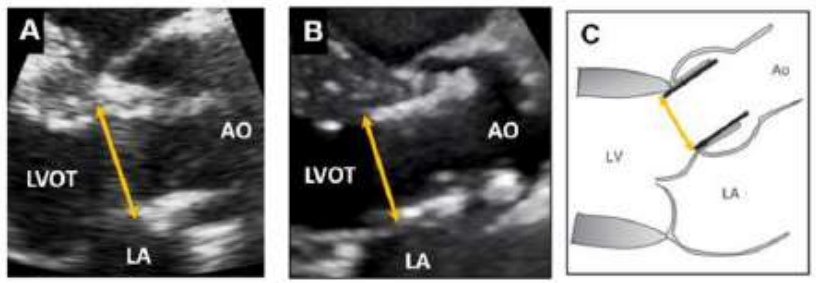
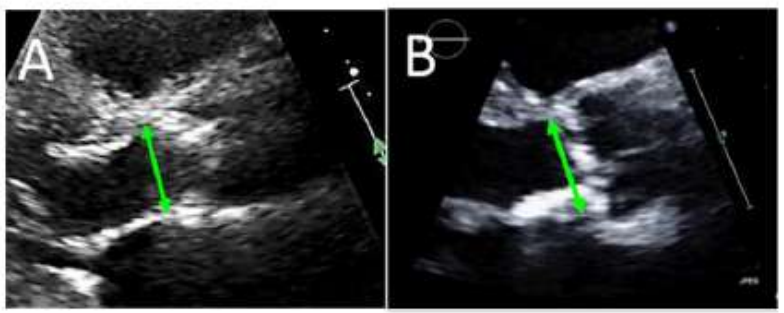


TABLE 1 Recommendations for Doppler Echocardiographic Measurements and Calculations Required to Assess Bioprosthetic Valve Hemodynamic Function

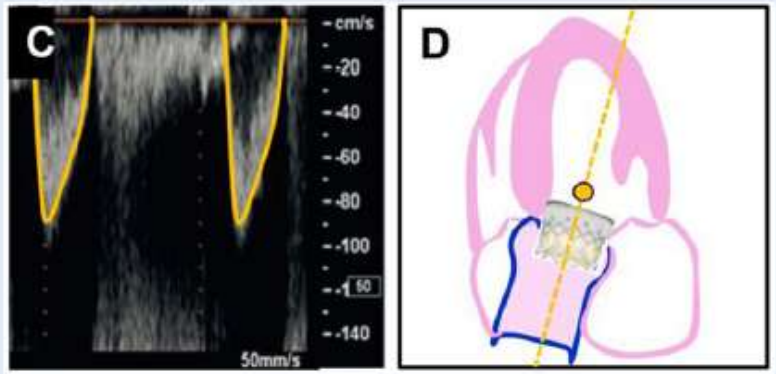
Echocardiographic Parameter	Measurement and Calculation	Caveats and Recommendations
Timing of TTE examinations	Aortic and mitral bioprostheses • Prehospital discharge • Baseline: between 1 and 3 mo • 1 y • Annually beyond 1 y	The assessment of the changes in structure and function of the bioprosthetic valves between the baseline and follow-up TTE is key to allow early detection of BVD. Such assessment requires a comprehensive baseline TTE between 1 and 3 mo postprocedure and routine annual TTE follow-up thereafter.
LVOT diameter by 2D echocardiography for calculation of left ventricular stroke volume: The LVOT diameter is measured from outer to outer edge of the stent or ring just below the sewing ring for surgical bioprostheses (A) or the stent for transcatheter bioprostheses (B and C).	Aortic bioprostheses 	Because the native aortic annulus and prosthetic aortic valve sewing ring remain relatively stable, to reduce interexamination variability in the measurement of AVA and MVA, it is recommended to use as standard whichever of the first FU visit or the baseline postprocedural echocardiogram gives the clearer LV outflow diameter.
The LVOT diameter is measured from inner to inner edge of native structures at or just below the level of the native aortic annulus (A). In the setting of ectopic calcification in the LVOT, annulus, or anterior mitral leaflet, the diameter measurement should ignore this calcium and measure to the base of the anterior mitral valve leaflet (B).	Mitral bioprostheses (native aortic valve)  LVOT Area = 0.785 × (LVOT diameter)^2	

Philipp Blanke. Computed tomography assessment for transcatheter aortic valve in valve implantation: The vancouver approach to predict anatomical risk for coronary obstruction and other considerations. 2016 Society of Cardiovascular Computed Tomography. http://dx.doi.org/10.1016/j.jcct.2016.09.004

LVOT flow velocity by pulsed wave Doppler for calculation of left ventricular stroke volume:

The LVOT velocity is measured by placing the pulsed-wave Doppler sample just apical (ie, proximal) to the ventricular aspect of the prosthesis sewing ring or stent (C and D) in systole.

Aortic bioprostheses

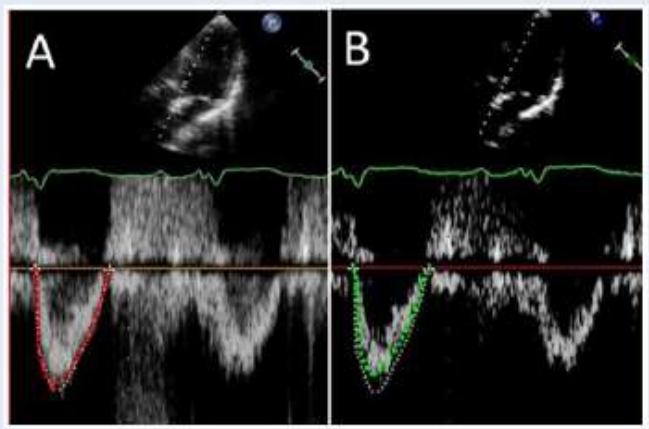


The pulsed wave sample volume should remain apical (or proximal) to the sewing ring or stent frame in systole. Thus, depending on LV function, the diastolic position of the sample volume may appear as much as 1-1.5 cm apical to the systolic position.

Unlike in the setting of a native aortic valve, a closure click is not typically seen because the sample volume remains apical to the bioprosthetic leaflets.

Pulsed wave Doppler of laminar flow just proximal to flow acceleration. The modal velocity should be traced to measure LVOT VTI and not the faint higher velocity profile. (A) (red line) An incorrectly traced Doppler signal. Reducing the gain or increasing the reject will result in a modal velocity profile (green tracing, B).

Aortic and mitral bioprostheses



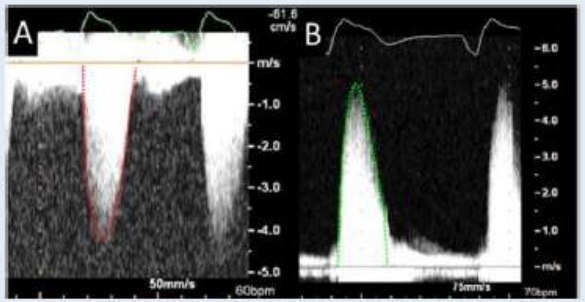
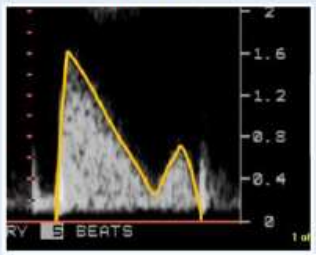
Calculation of Stroke volume

The stroke volume across the aortic valve is calculated by multiplying the LVOT area by the velocity-time integral of the LVOT flow measured by pulsed-wave Doppler.

LVOT SV = LVOT Area × LVOT VTI

Philipp Blanke. Computed tomography assessment for transcatheter aortic valve in valve implantation: The vancouver approach to predict anatomical risk for coronary obstruction and other considerations. 2016 Society of Cardiovascular Computed Tomography. http://dx.doi.org/10.1016/j.jcct.2016.09.004

TABLE 1 Continued

Echocardiographic Parameter	Measurement and Calculation	Caveats and Recommendations
Bioprosthetic valve flow velocity by continuous wave Doppler Continuous wave Doppler performed from any imaging window that obtains the highest velocity, with the densest, most uniform continuous wave spectral profile. Apical windows (A) may not yield a higher velocity than a nonapical window (B, right parasternal window). Peak velocity, mean gradient and aortic VTI are measured. From these measurements, effective AVA and DVI are calculated.	Aortic bioprostheses  Aortic Valve Area = LVOT SV ÷ Aortic VTI Doppler Velocity Index = LVOT VTI ÷ Aortic VTI	Aortic bioprostheses The probe position for acquisition of the peak velocity is most often dependent on patient-specific anatomy; thus, it will not often change unless the position of the prosthesis changes the direction of the main transaortic flow. To reduce interexamination variability in the measurement of AVA, DVI, and mean gradient, it is recommended to use the same window for continuous-wave Doppler interrogation of aortic bioprosthetic valve flow for all baseline and follow-up echocardiograms in a given patient. The aortic DVI decreases with hemodynamic deterioration of aortic bioprosthetic valves.
Continuous wave Doppler derived from the apical 4-chamber view. Peak velocity, mean gradient, and mitral VTI are measured. From these measurements, effective MVA and DVI are calculated.	Mitral bioprostheses  Mitral Valve Area = LVOT SV ÷ Mitral VTI Doppler Velocity Index = Mitral VTI ÷ LVOT VTI	Mitral bioprostheses The LVOT SV can be used as a substitute for mitral SV in the absence of ≥ moderate AR or MR. However peak and mean gradient (as well as velocity time integral) may be affected both by the construct of the valve as well as by the assumptions of the modified Bernoulli equation and thus may reduce the accuracy of the continuity equation in this setting. The mitral DVI increases (vs decreases for aortic DVI) with hemodynamic deterioration of mitral bioprosthetic valves. Both stenosis and regurgitation of mitral bioprostheses result in increase in mitral DVI.

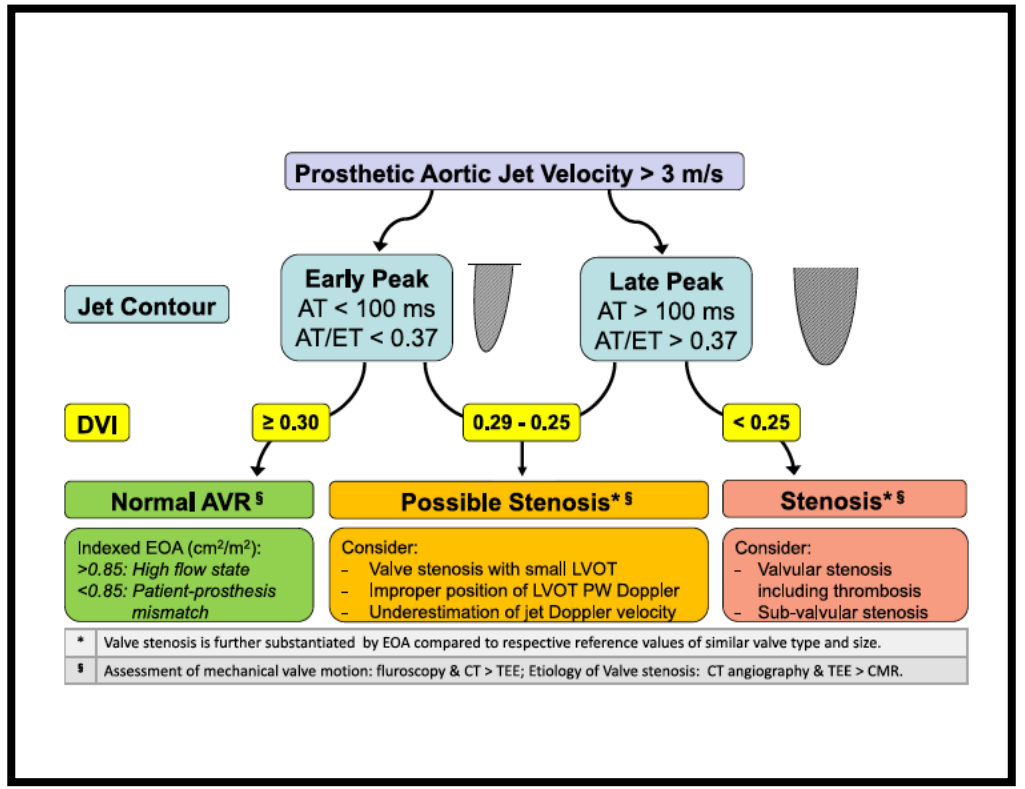
Philipp Blanke. Computed tomography assessment for transcatheter aortic valve in valve implantation: The vancouver approach to predict anatomical risk for coronary obstruction and other considerations. 2016 Society of Cardiovascular Computed Tomography. http://dx.doi.org/10.1016/j.jcct.2016.09.004

2- ETT – Estenosis protésica significativa

Table 5 Doppler parameters of prosthetic valves in the aortic valve position

	Normal	Possible stenosis	Suggests significant stenosis
Appropriate for all prosthetic aortic valves			
Jet velocity contour*	Triangular, early peaking	Triangular to intermediate	Rounded, symmetric
Acceleration time, msec*	<80	80-100	>100
Acceleration time/LV ejection time ratio	<0.32	0.32-0.37	>0.37
Peak velocity, m/sec†‡	<3	3-4	≥4
Specific AVR considerations			
SAVR			
Mean gradient, mm Hg†	<20	20-34	≥35
DVI§¶	>0.35	0.25-0.35	<0.25
EOA§	Reference EOA ± 1 SD	1 SD smaller than reference EOA	2 SDs smaller than reference EOA
TAVI (change from baseline)			
Mean gradient†	Change <10 mm Hg from baseline†	Increase of 10-19 mm Hg from baseline	Increase ≥20 mm Hg from baseline
DVI§¶	Change <0.1 or 20% from baseline‖	Decrease 0.1-0.19 or 20%-39% from baseline‖	Decrease ≥0.2 or ≥40% from baseline‖
EOA§	Change <0.3 cm^2 or 25% from baseline‖	Decrease of 0.3-0.59 cm^2 or 25%-49% from baseline‖	Decrease ≥0.6 cm^2 or ≥50% from baseline‖

AVR, Aortic valve replacement.
Significant stenosis should meet at least one flow-dependent (i.e., velocity and mean gradient) and one flow-independent (i.e., EOA or DVI) parameter.
*This can be affected by LV function and heart rate.
†Flow dependent.
‡Valid with normal stroke volume (50-90 mL) and flow rates (200-300 mL).
§Flow independent.
¶DVI calculated using VTI as in Table 4.
‖Baseline defined as TTE performed under stable hemodynamic conditions.



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Valoración del area efectiva proyectado

Table 7 Normal reference values of effective orifice areas for the prosthetic aortic valves

Prosthetic valve size (mm)	19	21	23	25	27	29
Stented bioprosthetic valves						
Mosaic	1.1 ± 0.2	1.2 ± 0.3	1.4 ± 0.3	1.7 ± 0.4	1.8 ± 0.4	2.0 ± 0.4
Hancock II	–	1.2 ± 0.2	1.3 ± 0.2	1.5 ± 0.2	1.6 ± 0.2	1.6 ± 0.2
Carpentier-Edwards Perimount	1.1 ± 0.3	1.3 ± 0.4	1.5 ± 0.4	1.8 ± 0.4	2.1 ± 0.4	2.2 ± 0.4
Carpentier-Edwards Magna	1.3 ± 0.3	1.5 ± 0.3	1.8 ± 0.4	2.1 ± 0.5	–	–
Biocor (Epic)	1.0 ± 0.3	1.3 ± 0.5	1.4 ± 0.5	1.9 ± 0.7	–	–
Mitroflow	1.1 ± 0.2	1.2 ± 0.3	1.4 ± 0.3	1.6 ± 0.3	1.8 ± 0.3	–
Trifecta	1.4	1.6	1.8	2.0	2.2	2.4
Stentless bioprosthetic valves						
Medtronic Freestyle	1.2 ± 0.2	1.4 ± 0.2	1.5 ± 0.3	2.0 ± 0.4	2.3 ± 0.5	–
St Jude Medical Toronto SPV	–	1.3 ± 0.3	1.5 ± 0.5	1.7 ± 0.8	2.1 ± 0.7	2.7 ± 1.0
Prima Edwards	–	1.3 ± 0.3	1.6 ± 0.3	1.9 ± 0.4	–	–
Mechanical valves						
Medtronic-Hall	1.2 ± 0.2	1.3 ± 0.2	–	–	–	–
St Jude Medical Standard	1.0 ± 0.2	1.4 ± 0.2	1.5 ± 0.5	2.1 ± 0.4	2.7 ± 0.6	3.2 ± 0.3
St Jude Medical Regent	1.6 ± 0.4	2.0 ± 0.7	2.2 ± 0.9	2.5 ± 0.9	3.6 ± 1.3	4.4 ± 0.6
MCRI On-X	1.5 ± 0.2	1.7 ± 0.4	2.0 ± 0.6	2.4 ± 0.8	3.2 ± 0.6	3.2 ± 0.6
Carbomedics Standard and Top Hat	1.0 ± 0.4	1.5 ± 0.3	1.7 ± 0.3	2.0 ± 0.4	2.5 ± 0.4	2.6 ± 0.4
ATS Medical[a]	1.1 ± 0.3	1.6 ± 0.4	1.8 ± 0.5	1.9 ± 0.3	2.3 ± 0.8	–

Effective orifice area is expressed as mean values available in the literature. Further studies are needed to validate these reference values.
[a]For the ATS medical valve, the label valve sizes are 18, 20, 22, 24, and 26 mm. High velocities are common in size 19 or 21 prostheses. Adapted with permission from Ref. 7.

Patrizio Lancellotti. Recommendations for the imaging assessment of prosthetic heart valves: a report from the European Association of Cardiovascular Imaging endorsed by the Chinese Society of Echocardiography, the Inter-American Society of Echocardiography, and the Brazilian Department of Cardiovascular Imaging. European Heart Journal – Cardiovascular Imaging. 2016 doi:10.1093/ehjci/jew025

MPP vs Obstrucción

Table 3. Echocardiographic findings to differentiate between structural and non-structural valve deterioration in the presence of high transprosthetic gradients.

Normal function	PPM	Obstruction
Normal valve structure and motion	Normal valve structure and motion	Abnormal valve structure and motion
VPeak <3 m/s, MeanG <20 mmHg	VPeak >3 m/s, MeanG >20 mmHg	VPeak >3 m/s, MeanG >20 mmHg
EOA >1 cm^2; DVI ≥0.35	EOA >1 cm^2; DVI 0.25-0.34	EOA variable; DVI <0.25
EOA within normal range	EOA normal	EOA reduced
EOAi >0.85 cm^2/m^2	EOAi ≤0.85 cm^2/m^2	EOAi ≤0.85 cm^2/m^2
Increase in MeanG <10 mmHg and decrease in EOA <0.3 cm^2 during follow-up	Increase in MeanG <10 mmHg and decrease in EOA <0.3 cm^2 during follow-up	Increase in MeanG ≥10 mmHg and decrease in EOA >0.3 cm^2 during follow-up

DVI: Doppler velocity index; EOA: effective orifice area; EOAi: indexed effective orifice area; MeanG: mean gradient; PPM: prosthesis-patient mismatch; Vpeak: peak velocity

Giuseppe Tarantini. Transcatheter aortic valve implantation in degenerated surgical aortic valves. State of the art by EuroIntervention. 2021. https://eurointervention.pcronline.com/doi/10.4244/EIJ-D-21-00157

MPP - Obstrucción

Table 12 **Imaging criteria or the identification and quantitation of prosthesis-patient mismatch**

	Mild or not clinically significant	Moderate	Severe
Aortic prosthetic valves			
Indexed EOA (projected or measured)			
BMI <30 kg/m^2	>0.85	0.85–0.66	≤ 0.65
BMI ≥ 30 kg/m^2	>0.70	0.70–0.56	≤ 0.55
Measured EOA vs. normal reference value[a]	Reference $\pm$ 1SD	Reference $\pm$ 1SD	Reference $\pm$ 1SD
Difference (reference EOA − measured EOA) (cm^2)[a]	<0.25	<0.25	<0.25
Valve structure and motion	Usually normal	Usually normal	Usually normal

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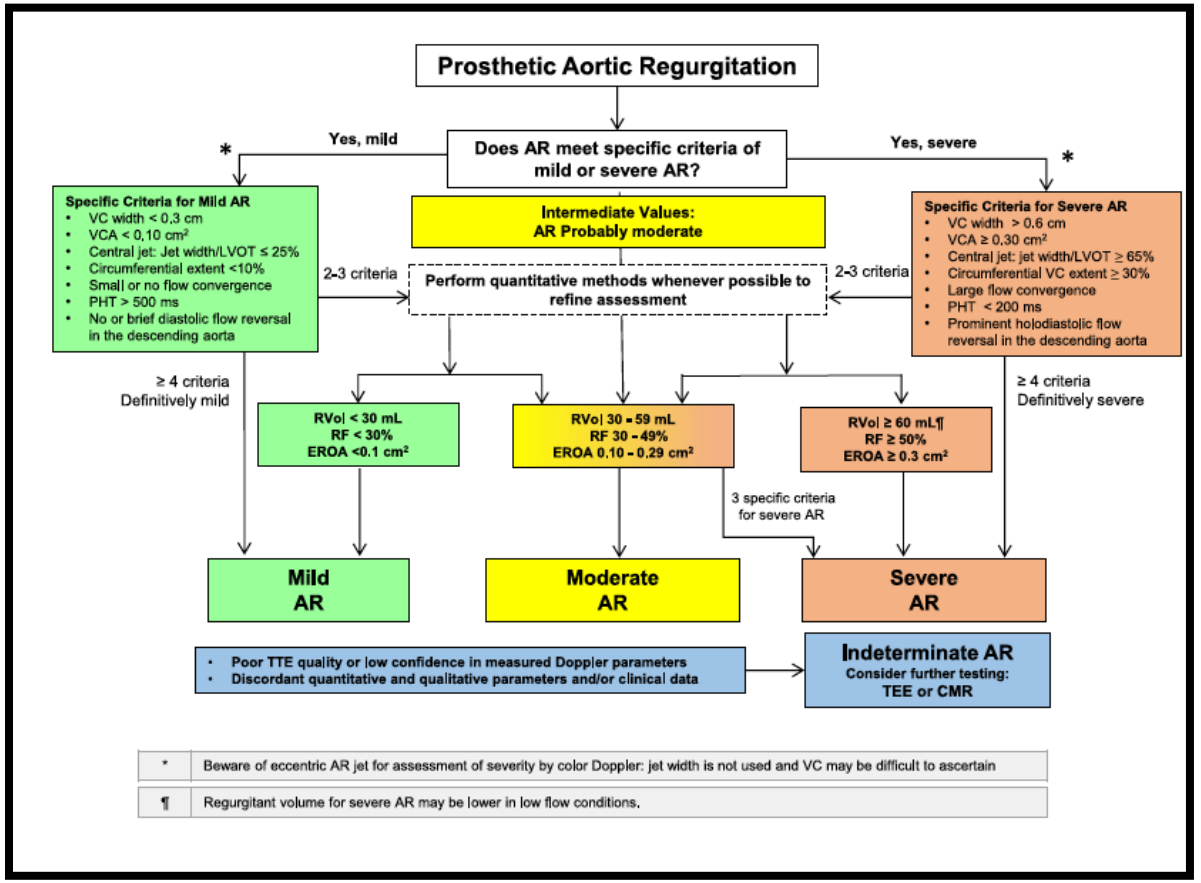
2- ETT – Insuficiencia protésica significativa

Table 8 Parameters for evaluation of the severity of prosthetic aortic valve regurgitation

Parameters	Mild	Moderate	Severe
Valve structure and motion			
Mechanical or bioprosthetic	Usually normal	Abnormal*	Abnormal*
Structural parameters			
LV size	Normal†	Normal or mildly dilated†	Dilated†
Doppler parameters (qualitative or semiquantitative)			
Jet width in central jets, % LVOT diameter, (CD)‡	Narrow (≤25%)	Intermediate (26%-64%)	Large (≥65%)
VC width, cm (CD)	<0.3	0.3-0.6	>0.6
VC area, cm^2 (2D/3D CD)§	<0.10	0.10-0.29	≥0.30
Circumferential extent of PVL, % (CD)¶‖	<10	10-29	≥30
Jet density (CW)	Incomplete or faint	Dense	Dense
Jet deceleration rate (PHT), msec (CW)#	Slow (>500)	Variable (200-500)	Steep (<200)
Diastolic flow reversal in the descending aorta (PW)	Absent or brief early diastolic	Intermediate	Prominent, holodiastolic
Doppler parameters (quantitative)			
Regurgitant volume, mL/beat	<30	30-59	≥60
Regurgitant fraction, %	<30	30-50	≥50



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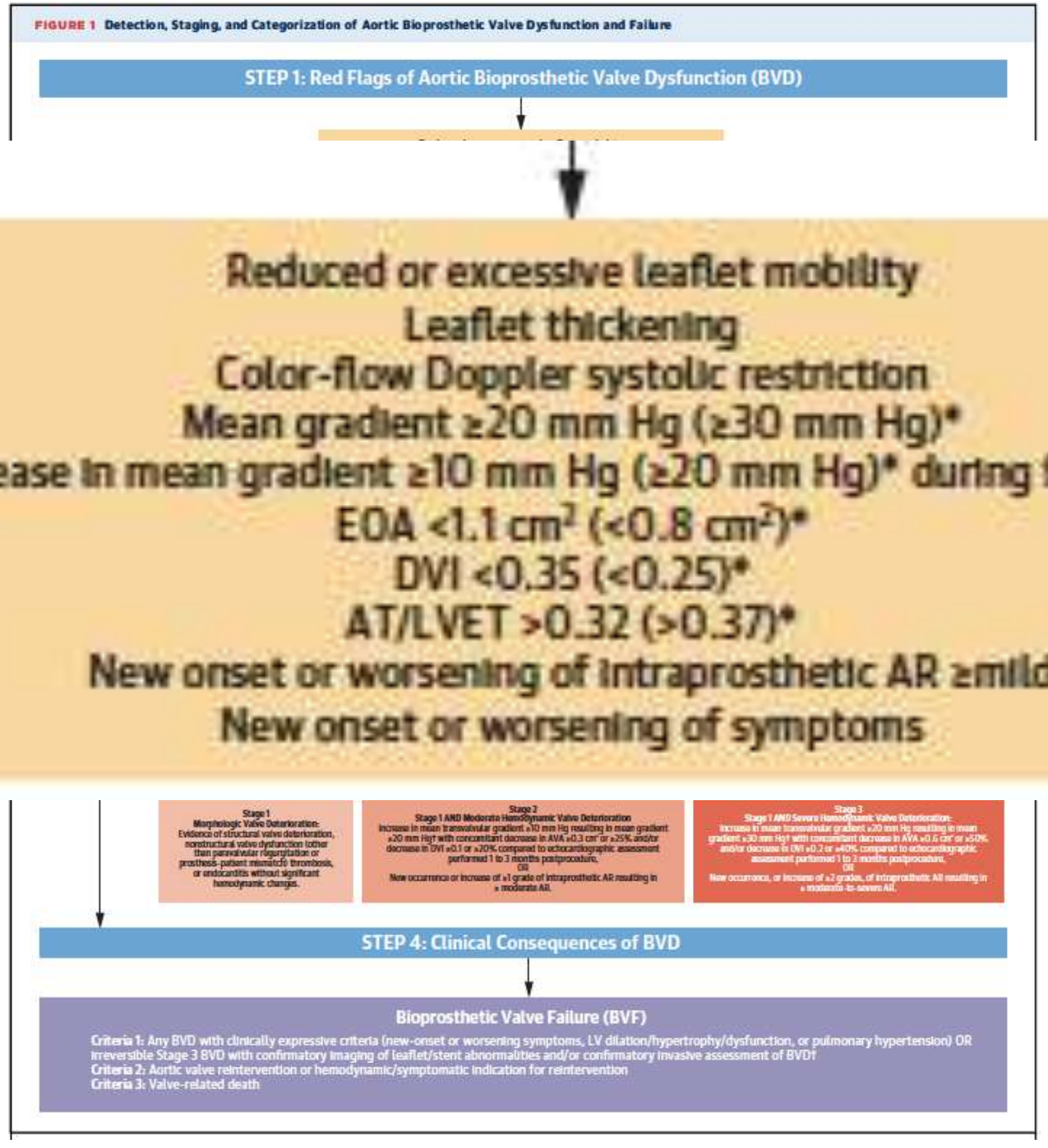
Algoritmo



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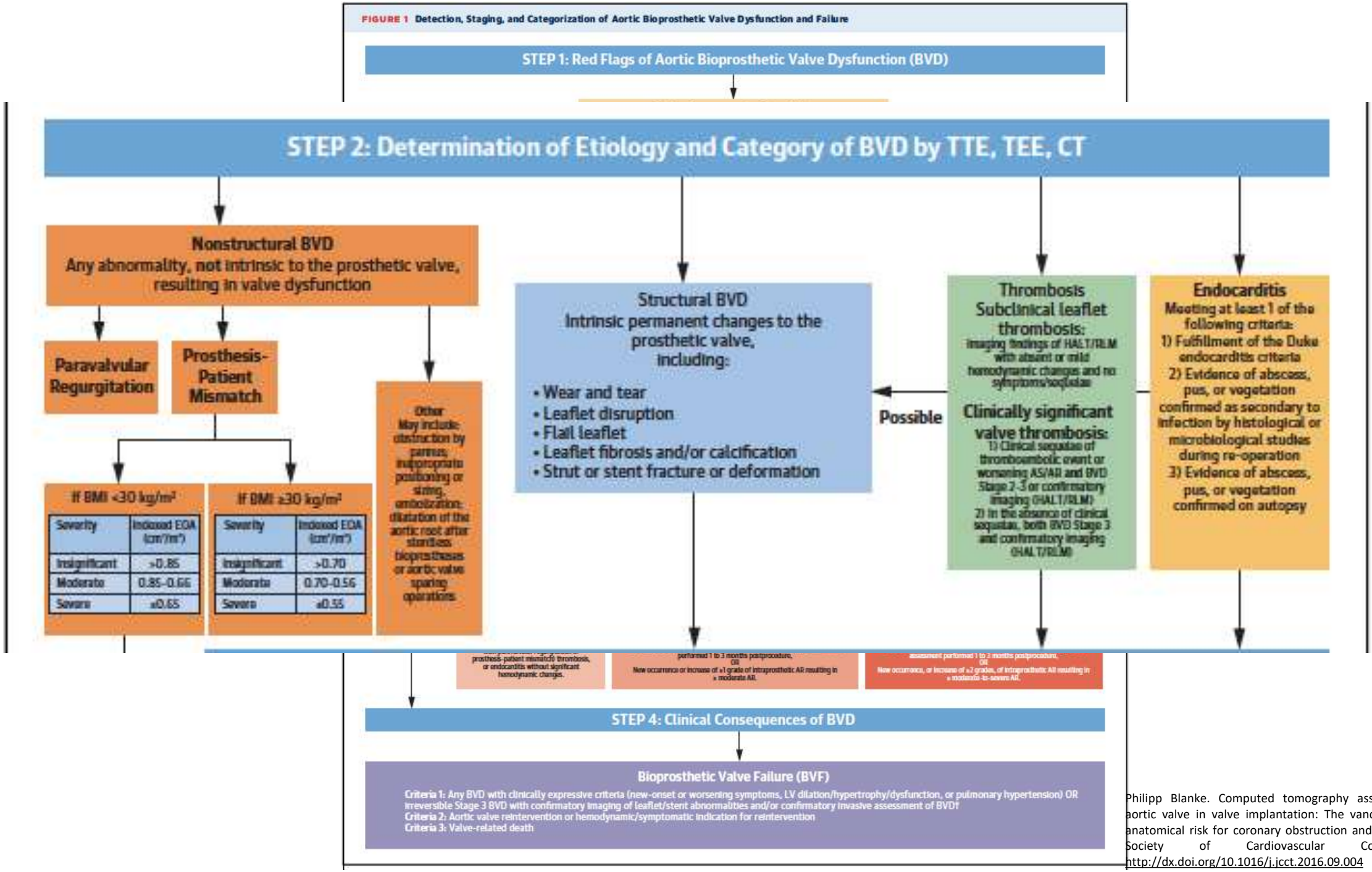

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Tipo de disfunción valvular protésica

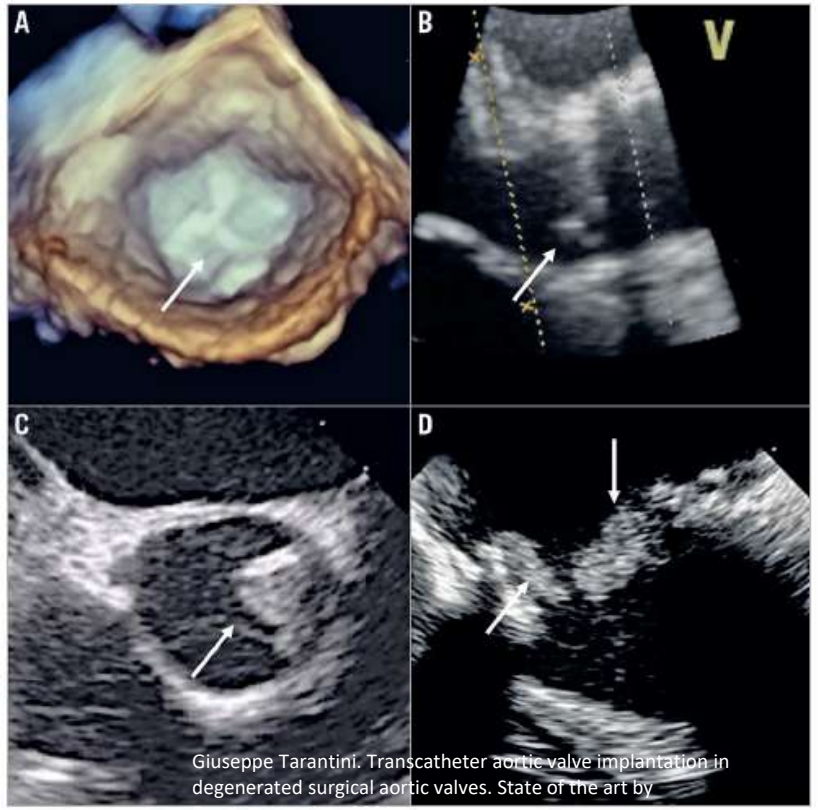

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TABLE 3 Multimodality Imaging of Morphological Abnormalities of Valve Leaflets or Stent for Determination of the Type of Bioprosthetic Valve Dysfunction

	Prosthesis-Patient Mismatch	Valve Thrombosis	Pannus	Valve Endocarditis	Structural Valve Deterioration
TTE/TEE	Normal valve leaflet morphology and mobility	Diffuse or focal hypo-echogenic leaflet thickening (>2 mm) of at least 1 leaflet	Dense fixed hyper-echogenic tissue involving periannular region or sewing ring	Presence of vegetation(s)	Diffuse or focal hyper-echogenic leaflet thickening (>2 mm) of at least 1 leaflet
		Normal or reduced leaflet mobility	Normal leaflet morphology	Valve leaflet thickening	Reduced mobility and/or torn/avulsed/perforated leaflets
		Paucity (restriction) of color Doppler transvalvular flow	Leaflet mobility may be normal or abnormal	Possible torn/avulsed/perforated leaflets or reduced leaflet mobility	Paucity (restriction) of color Doppler transvalvular flow
				Paravalvular complications: abscess, pseudo-aneurysm, fistula, dehiscence	
Multidetector CT					
Noncontrast CT	No leaflet calcification	No leaflet calcification	No leaflet calcification	No leaflet calcification	Leaflet calcification
Contrast-enhanced CT	Normal leaflet morphology and mobility	Hypo-attenuated leaflet thickening (HALT)	Hypodense semicircular or circular structure along and beneath the valve ring/stent	Paravalvular complications: vegetations, abscess, pseudo-aneurysm, fistula, dehiscence	Calcific or noncalcific hyper-dense leaflet thickening affecting leaflet motion
		Hypo-attenuation affecting leaflet motion (HAM) (possible)			
		Reduced leaflet motion (RLM) (possible)			Reduced leaflet motion (RLM) (possible)
Nuclear imaging					
^{18}F-NaF PET/CT	No ^{18}F-NaF uptake at the level of the bioprosthetic valve leaflets [a]	Increased ^{18}F-NaF uptake at the level of the bioprosthetic valve leaflets (possible)[a]	Unknown	Increased ^{18}F-NaF uptake at the level of the bioprosthetic valve leaflets (possible)	Increased ^{18}F-NaF uptake at the level of the bioprosthetic valve leaflets (possible)[a]
^{18}F-FDG PET/CT	No increased ^{18}F-FDG uptake at the level of the valve or paravalvular region[a]	Unknown	Unknown	Increased ^{18}F-FDG uptake at the level of the bioprosthetic valve and paravalvular region	No increased ^{18}F-FDG uptake at the level of the bioprosthetic valve or paravalvular region[a]

[a]For research use.

^{18}F-FDG = 18F-fluorodeoxyglucose; CT = computed tomography; PET = positron emission tomography; TEE = transesophageal echocardiography; TTE = transthoracic echocardiography.

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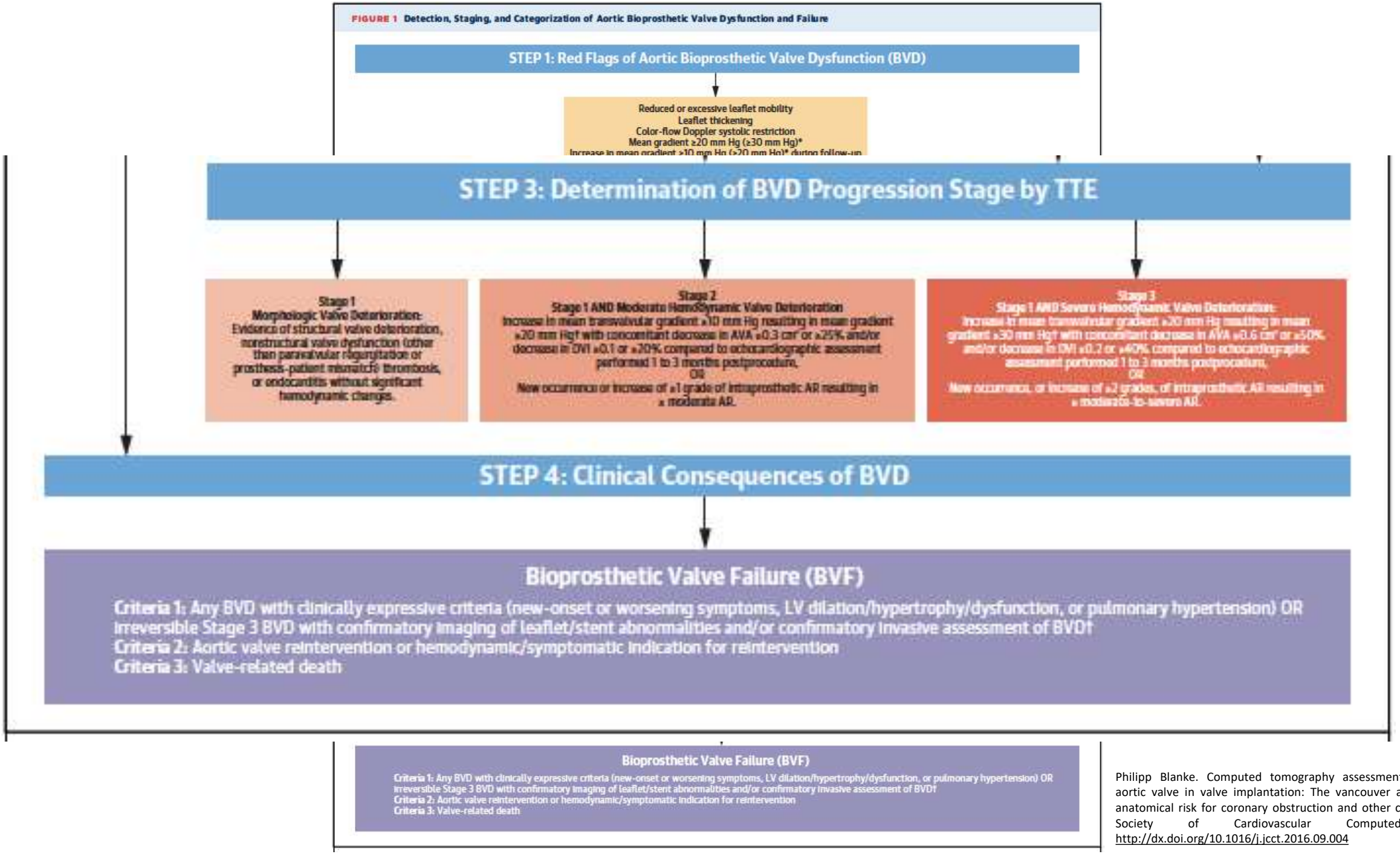

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Mecanismo de disfunción de la bioprótesis aórtica y estadíos:

- Deterioro valvular estructural
- Disfunción valvular no estructural
  - Regurgitación paravalvular
  - Mismatch prótesis-paciente
- Trombosis valvular
- Endocarditis

Table 2. Proposed definition of structural valve deterioration (SVD) – European Association of Percutaneous Cardiovascular Interventions (EAPCI) endorsed by ESC and EACTS (2017).

	Echocardiographic findings
Stage 0 (no SVD)	Normal valve morphology and function
Stage 1 (morphological SVD)	Intrinsic permanent structural changes to the prosthetic valve (leaflet integrity or structure abnormality, leaflet function abnormality, strut/frame abnormality)
Stage 2 (moderate haemodynamic SVD)	Mean transprosthetic gradient ≥20 mmHg and <40 mmHg Mean transprosthetic gradient ≥10 and <20 mmHg change from baseline Moderate intraprosthetic aortic regurgitation, new or worsening (>1+/4) from baseline
Stage 3 (severe haemodynamic SVD)	Mean transprosthetic gradient ≥40 mmHg Mean transprosthetic gradient ≥20 mmHg change from baseline Severe intraprosthetic aortic regurgitation, new or worsening (>2+/4) from baseline

Valve Academic Research Consortium (VARC) – 3 criteria

Desafíos y limitaciones ViV-TAVI

- Mala posición
- Mismatch prótesis-paciente – Gradientes residuales elevados
- Oclusión coronaria

Table 4. Characteristics to consider when evaluating a patient for redo surgical aortic valve replacement (SAVR) versus valve-in-valve (ViV) transcatheter aortic valve implantation (TAVI).

Characteristics	Redo SAVR favoured	TAV-in-SAV favoured
Patient		
Low/intermediate surgical risk	✔	
High/extreme surgical risk		✔
Age ≥80		✔
Young age (<75) where valve durability is important	✔	
Concomitant diseases needing surgical intervention	✔	
Significant paravalvular leak not amenable to percutaneous closure	✔	
Patient preference	✔	✔
Surgical valve		
Small size where severe PPM cannot be addressed	✔	
Large size without severe PPM		✔
Balloon valve fracture feasible and low risk		✔
Severe PPM when balloon valve fracture is not feasible or high risk	✔	
Anatomic		
High risk of coronary obstruction	✔	
High risk of THV malposition	✔	
High risk of aortic root injury	✔	
Favourable coronary anatomy		✔
Calcified aortic root or hostile chest		✔

PPM: prosthesis-patient mismatch; THV: transcatheter heart valve

Giuseppe Tarantini. Transcatheter aortic valve implantation in degenerated surgical aortic valves. State of the art by EuroIntervention. 2021. https://eurointervention.pcronline.com/doi/10.4244/EIJ-D-21-00157

1- ¿Cómo predecir estenosis residual?

Table 8. Correlates of residual stenosis after ViV TAVI.

Before valve-in-valve
Stenosis as the baseline mechanism of failure
Preprocedural severe prosthesis-patient mismatch
Stented surgical valve
Small surgical valve (internal diameter ≤20 mm)
During valve-in-valve
Intra-annular transcatheter heart valve
Deep transcatheter heart valve position
Lack of bioprosthetic valve ring fracture
After valve-in-valve
Leaflet thrombosis
Prosthesis-patient mismatch
Structural valve deterioration

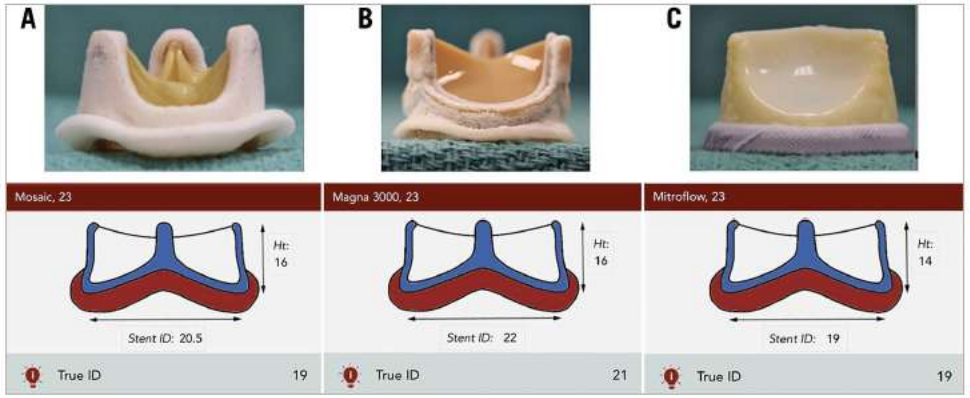

Figure 2. *Examples of stented surgical aortic valves. A) 23 mm Mosaic® porcine valve (Medtronic). B) 23 mm Magna 3000 pericardial valve (Edwards Lifesciences). C) 23 mm Mitroflow externally mounted pericardial valve (LivaNova PLC), where the manufacturer labelled size, stent and true internal diameters are different*

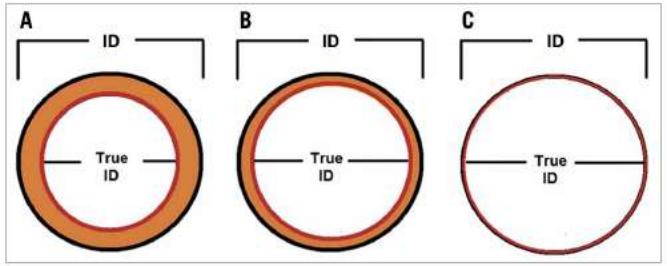

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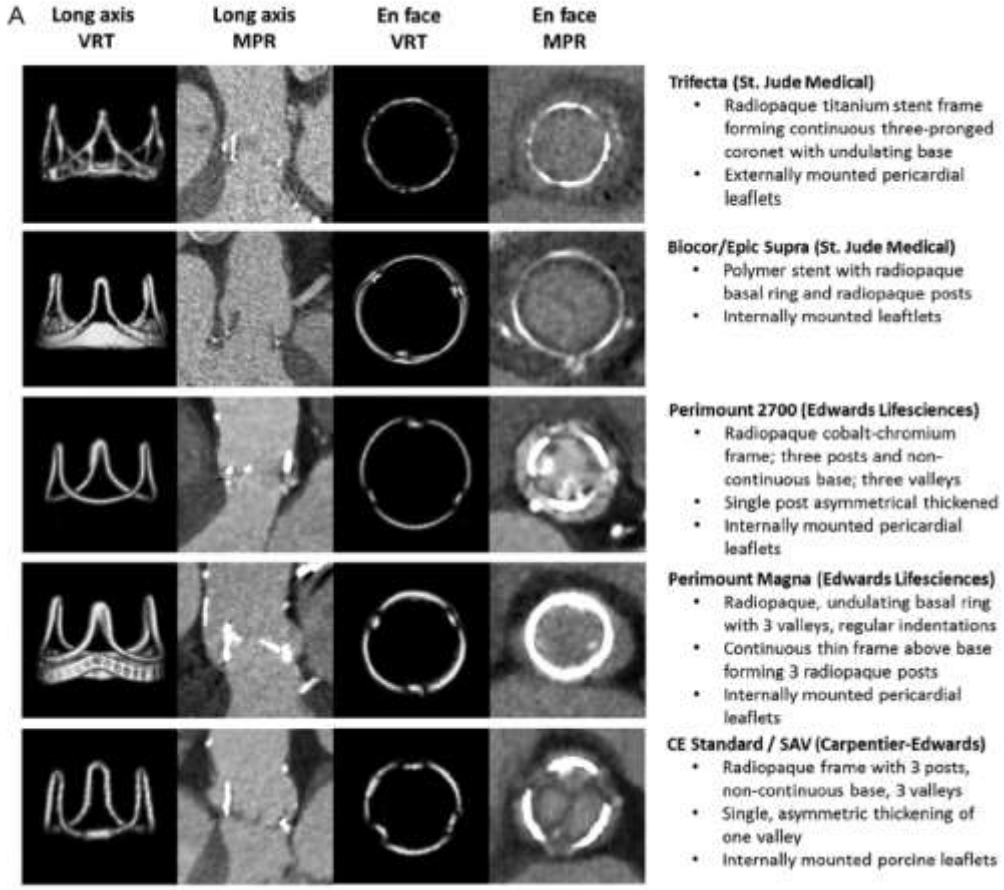
Table 7 Doppler parameter criteria of aortic valve and mitral valve PPM

	Normal	Moderate	Severe
Aortic EOA*	• >0.85 cm^2/m^2 if BMI < 30 kg/m^2 • >0.70 cm^2/m^2 if BMI ≥ 30 kg/m^2	• 0.85-0.66 cm^2/m^2 if BMI < 30 kg/m^2 • 0.70-0.56 cm^2/m^2 if BMI ≥ 30 kg/m^2	• ≤0.65 cm^2/m^2 if BMI < 30 kg/m^2 • ≤0.55 cm^2/m^2 if BMI ≥ 30 kg/m^2

Zoghbi, W. Guidelines for the Evaluation of Prosthetic Valve Function With Cardiovascular Imaging: A Report From the American Society of Echocardiography Developed in Collaboration With the Society for Cardiovascular Magnetic Resonance and the Society of Cardiovascular Computed Tomography. (J Am Soc Echocardiogr 2024;37:2-63. https://doi.org/10.1016/j.echo.2023.10.004

TAC – ViV TAVI - Identificar la bioprótesis y medir el diámetro interno



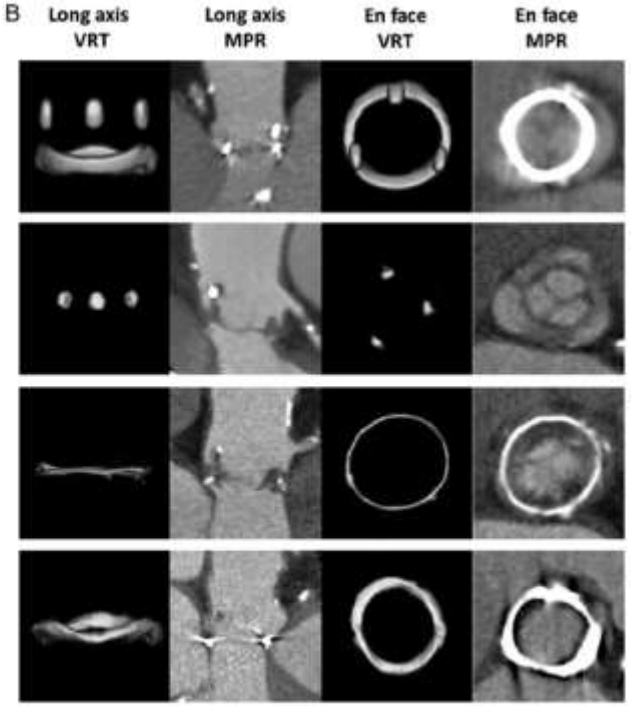
Trifecta (St. Jude Medical)
- Radiopaque titanium stent frame forming continuous three-pronged coronet with undulating base
- Externally mounted pericardial leaflets

Biocor/Epic Supra (St. Jude Medical)
- Polymer stent with radiopaque basal ring and radiopaque posts
- Internally mounted leaftlets

Perimount 2700 (Edwards Lifesciences)
- Radiopaque cobalt-chromium frame; three posts and non-continuous base; three valleys
- Single post asymmetrical thickened
- Internally mounted pericardial leaflets

Perimount Magna (Edwards Lifesciences)
- Radiopaque, undulating basal ring with 3 valleys, regular indentations
- Continuous thin frame above base forming 3 radiopaque posts
- Internally mounted pericardial leaflets

CE Standard / SAV (Carpentier-Edwards)
- Radiopaque frame with 3 posts, non-continuous base, 3 valleys
- Single, asymmetric thickening of one valley
- Internally mounted porcine leaflets



Hancock (Medtronic)
- 'floating' radiopaque markers at top of radiolucent stent posts
- Undulating, radiopaque sewing ring
- Internally mounted porcine leaflets

Mosaic (Medtronic)
- 'floating' radiopaque markers at top of radiolucent stent posts
- Radiolucent sewing ring
- Internally sutured porcine leaflets

Soprano (Sorin)
- Radiolucent stent posts
- Thin, radiopaque basal sewing ring with single focal thickening
- Internally mounted pericardial leaflet

Mitroflow (Sorin)
- Radiolucent stent posts
- Radiopaque sewing ring with often asymmetric valleys/peaks
- Externally mounted leaflets
- suprannular

Fig. 6. A – Reference images for identification of stented SAVs: Part 1 (radiopaque base and radiopaque posts): Provided images for each SAV included long axis and en face volume rendered technique (VRT) images and long axis and en face multiplanar reformats (MPRs). **B – Reference images for identification of stented SAVs: Part 2 (partially radiopaque or radiopaque markers)**: Provided images for each SAV included long axis and en face volume rendered technique (VRT) images and long axis and en face multiplanar reformats (MPRs).

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TAC – ViV TAVI – Riesgo de oclusión coronaria

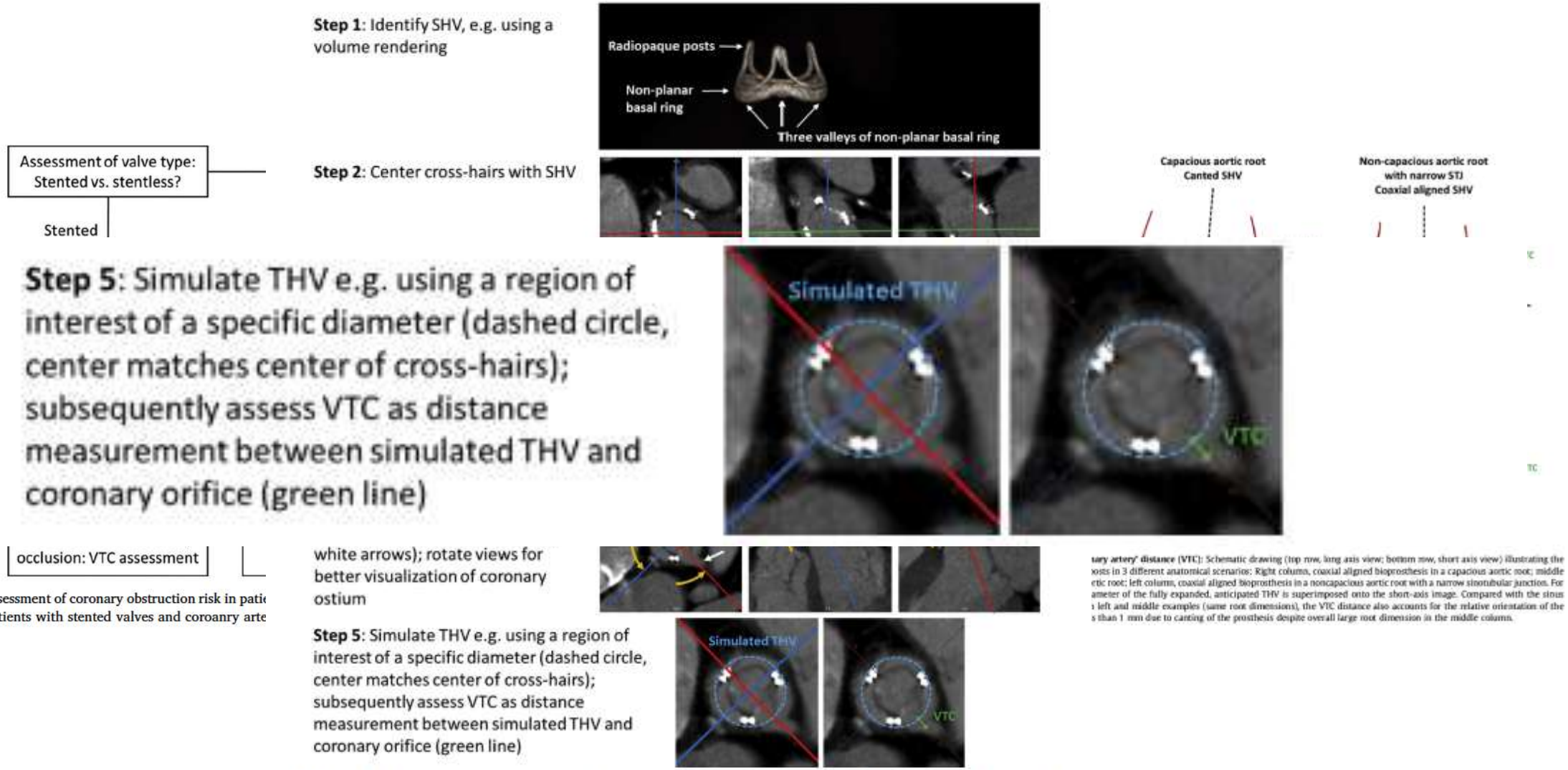

Fig. 10. Workflow for assessment of coronary obstruction risk in patie
should be assessed in patients with stented valves and coroanry arte

sary artery' distance (VTC): Schematic drawing (top row, long axis view; bottom row, short axis view) illustrating the osts in 3 different anatomical scenarios: Right column, coaxial aligned bioprosthesis in a capacious aortic root; middle etic root; left column, coaxial aligned bioprosthesis in a noncapacious aortic root with a narrow sinotubular junction. For ameter of the fully expanded, anticipated THV is superimposed onto the short-axis image. Compared with the sinus s left and middle examples (same root dimensions), the VTC distance also accounts for the relative orientation of the s than 1 mm due to canting of the prosthesis despite overall large root dimension in the middle column.

Fig. 2. Workflow for prediction of anatomical risk of coronary artery obstruction in ViV procedures depending on valve type and level of coronary artery orifices: For stented SHVs, VTC assessment is only required if the coronary artery orifices are located at or below the tip of the stent posts. For sutureless SHVs a traditional coronary height/SoV-width assessment is performed.

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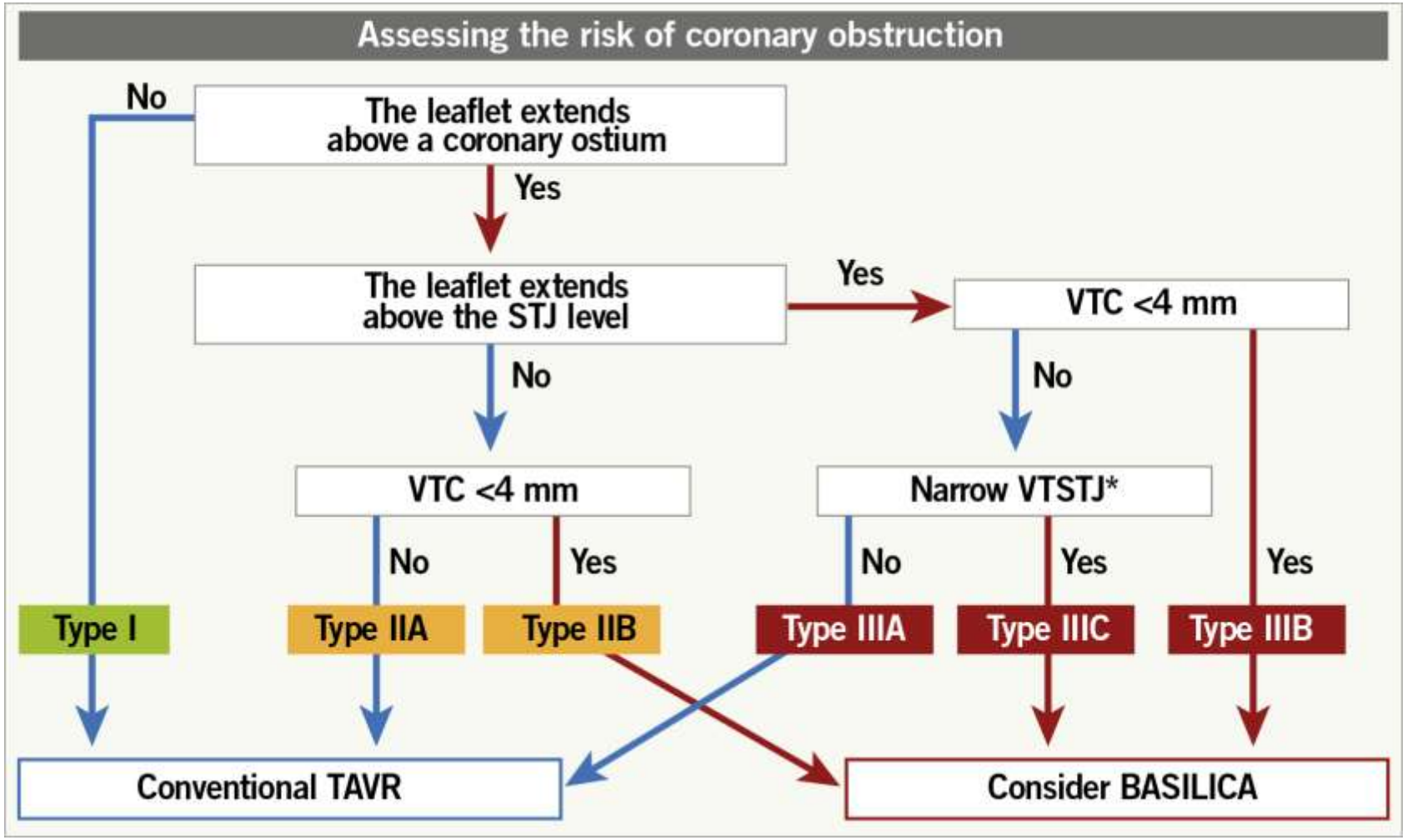
Riesgo de oclusión coronaria



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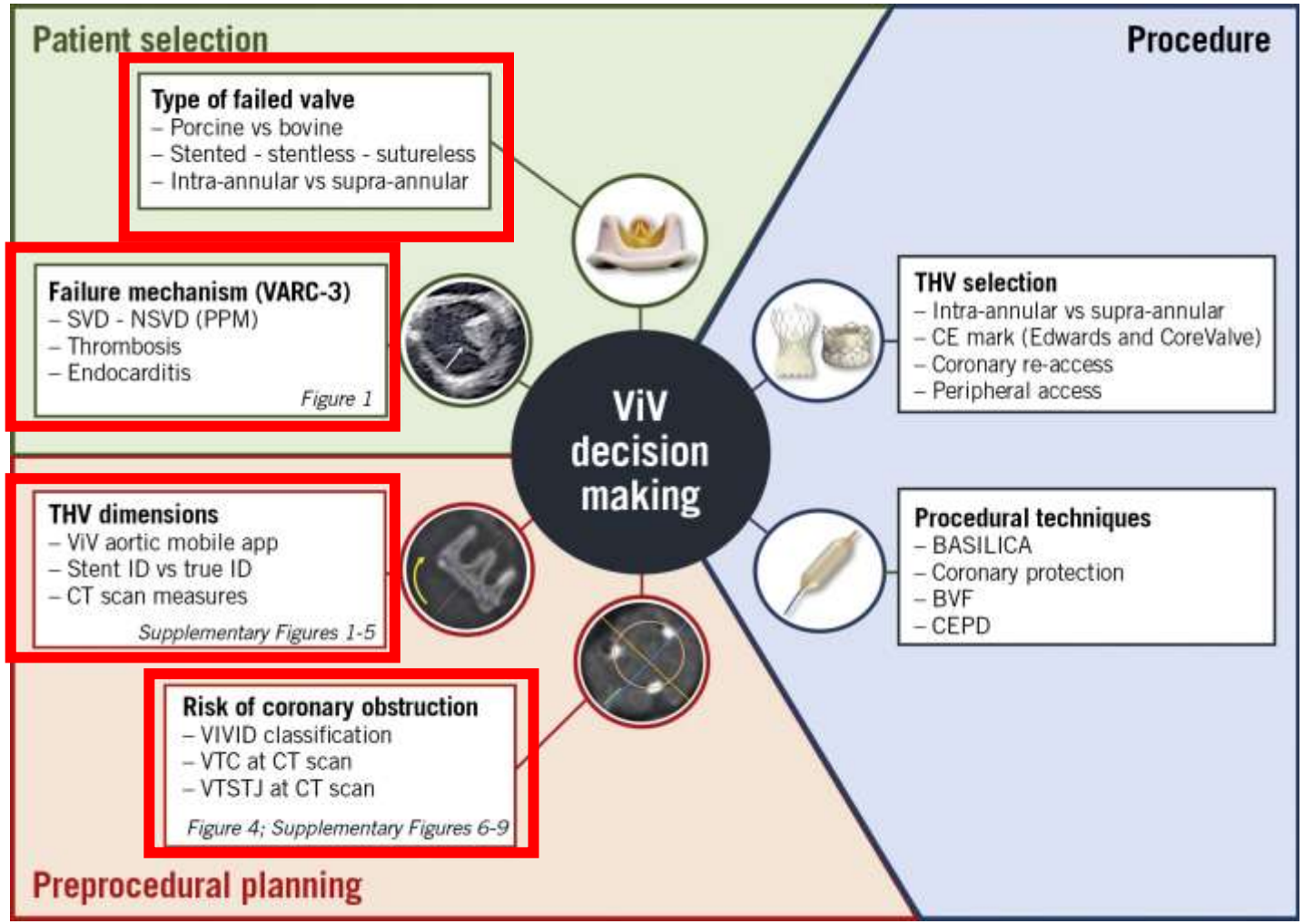
Valoración por imágenes de la prótesis aórtica para ViV-TAVI



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Evaluación de la función protésica por imágenes

Muchas gracias

Dr. Sebastián Robaina