above and below the hepatic veins (mean: 9.5 ± 5.1°) widely varied (range: 4.4°-18.4°) and might influence the final landing zone and the risk of valve migration and residual leak (figure 1G). The presence of celiac plexus fibers surrounding the IVC was identified in the cadaveric model (figure 2E) and might explain the common presence of temporary radiated pain often detected in the next few hours after IVC prosthesis implant due to overexpansion. Several morphological patterns of IVC were identified and have been schematically depicted in figure 1H and figure 2). There was wide variability in the length of the Eustachian valve, leading to poorly contrasted IVC despite repeat CT in 3 patients (9.4%), suggesting a greater value of echocardiography for IVC prosthesis sizing if a long Eustachian valve is present.

Preliminary positive results with dedicated devices have promoted high expectations on the results of the ongoing TRICUS study (NCT04141137). Our results highlight the relevance of CT measurements (above other imaging techniques) for optimal procedural planning. Moreover, the success of CAVI alternatives lies not only in the device chosen, but also in correct identification of relevant parameters of the anatomy and physiology to predict the risk of complications and efficacy, respectively.

In conclusion, according to our imaging analysis, TricValve might be preferred over Tricento in a large proportion of cases due to short distance to hepatic veins (HV) but Tricento could be a better alternative in patients with excessive tapering of SVC or marked angulation of the IVC as both increase the risk for valve leakage or embolization.

FUNDING

None to declare.

CONFLICTS OF INTEREST

I.J. Amat-Santos is proctor for Products & Features.

Sandra Santos-Martínez,[a] Alfredo Redondo,[a,b]
Isabel San José Crespo,[c] Teresa Sevilla,[a,b] Hans R. Figulla,[d]
and Ignacio J. Amat-Santos[a,b,*]

[a]*Departamento de Cardiología, Hospital Clínico Universitario, Valladolid, Spain*
[b]*Centro de Investigación Biomédica en Red de Enfermedades Cardiovasculares (CIBERCV), Spain*
[c]*Departamento de Anatomía y Radiología, Facultad de Medicina, Universidad de Valladolid, Valladolid, Spain*
[d]*University Hospital, Friedrich Schiller University Jena, Jena, Germany*

* Corresponding author:
E-mail address: ijamat@gmail.com (I.J. Amat-Santos).

REFERENCES

1. Topilsky Y, Maltais S, Medina J, et al. Burden of Tricuspid Regurgitation in Patients Diagnosed in the Community Setting. *JACC Cardiovasc Imaging.* 2019;12:433–442.
2. Figulla HR, Kiss K, Lauten A. Transcatheter interventions for tricuspid regurgitation, heterotopic technology: TricValve. *EuroIntervention.* 2016;12:Y116.
3. Aparisi Áaue, Amat-Santos IJ, Serrador A, et al. Current clinical outcomes of tricuspid regurgitation and initial experience with the TricValve system in Spain. *Rev Esp Cardiol.* 2020;73:853–854.

https://doi.org/10.1016/j.rec.2021.01.009

Prognostic value of 3D area strain in moderate or severe aortic regurgitation with preserved ejection fraction

Valor pronóstico del área de strain *3D en insuficiencia aórtica moderada o grave con fracción de eyección conservada*

To the Editor,

Aortic regurgitation (AR) is a highly-prevalent valve disease in our setting. Surgery is indicated in cases of clinical deterioration or worsening of parameters on 2-dimensional (2D) echocardiography.[1] Patients with AR may remain asymptomatic for decades, so early detection of subclinical deterioration may improve outcomes.[1] Myocardial deformation parameters on 3-dimensional (3D) imaging represent a promising tool that provides additional information besides left ventricular ejection fraction (LVEF), integrating ventricular geometry from a single apical window, but its usefulness in AR is not yet known.

Between March 2013 and July 2014, we carried out a prospective single-center observational cohort study of consecutive patients with at least moderate AR (≥ III/IV) and LVEF > 55%. The patients were asymptomatic and did not meet the classic criteria for surgery. The study was approved by the ethics committee at our hospital.

We performed 2D echocardiography and 3D assessment of ventricular strain and determined global longitudinal strain (GLS), global circumferential strain (GCS), global radial strain (GRS), and global area strain (GAS) using a Vivid E9 scanner (General Electric Vingmed Ultrasound, Norway) and the software EchoPAC (4DAutoLVQ-EchoPAC BT12, General Electric Vingmed Ultrasound). The same operator performed all studies, meaning that intraobserver and interobserver reproducibility could not be assessed. The primary outcome was the composite of cardiovascular death, hospitalization for heart failure (HF), or ventricular dysfunction during follow-up with LVEF < 50% or symptoms attributable to the valve lesion such as deterioration in New York Heart Association (NYHA) functional class, syncope, or angina recorded in the clinical notes.

The study included 31 patients (mean age, 61 ± 18 years; 74.2% were male), 61.3% had a tricuspid aortic valve and 16 (51.6%) had grade IV AR. Up to July 2019, cardiac surgery was indicated in 12 patients (38.7%), all of whom had grade IV AR. The indication was based on clinical deterioration in 7 patients (4 with HF, 3 with NYHA deterioration), worsening ventricular function in 2, and a combination of clinical and echocardiographic factors in 3 (LVEF + NYHA). All hospitalizations for HF met the criteria for surgery. No patients died from cardiovascular causes.

The study was repeated in asymptomatic patients who did not undergo surgery, at 6 months in 17 patients and at 1 year in 10. No significant differences were observed in any of the 3D strain parameters when baseline echocardiogram was compared with those at 6 and 12 months.

Table 1 shows the comparison according to incidence of the composite outcome. Regarding 3D strain, the only parameter associated with the composite event was GAS. After study of the diagnostic yield using the ROC curve, the optimal cutoff point was a

Table 1

Data at baseline and compared according to incidence of composite event

Variable	Total (n = 31)	Event		
		No (n = 19)	Yes (n = 12)	*P*
Age, y	61.61 ± 18.46	58.94 ± 17.51	65.83 ± 19.89	.320
Male	23 (74.2)	15 (78.94)	8 (66.66)	.676
Height, cm	166.52 ± 9.64	168.53 ± 7.42	163.33 ± 12.05	.199
Weight, kg	70.48 ± 13.23	72.37 ± 11.66	67.50 ± 15.46	.327
Hypertension	24 (77.4)	12 (63.15)	12 (100)	.026*
Diabetes	1 (3.2)	1 (5.26)	0 (0)	1
Dyslipidemia	13 (41.9)	8 (42.10)	5(41.66)	.981
Lung disease	4 (12.9)	3(15.78)	1 (8.33)	1
Renal failure	3 (9.7)	1 (5.26)	2 (16.66)	.543
2D echocardiography				
Systolic blood pressure, mmHg	137.97 ± 21.59	136.63 ± 23.12	140.27 ± 19.51	.664
Diastolic blood pressure, mmHg	69.37 ± 13.92	69.68 ± 14.14	68.82 ± 14.18	.873
Heart rate, bpm	72 ± 15.29	71.21 ± 14.78	73.36 ± 16.79	.717
LV end-diastolic diameter, mm	5.54 ± 0.88	5.40 ± 0.80	5.77 ± 0.99	.291
LV end-systolic diameter, mm	3.29 ± 0.75	3.24 ± 0.76	3.36 ± 0.77	.663
LV end-diastolic volume, μL	154.16 ± 46.25	144.42 ± 33.38	169.57 ± 59.89	.143
LV end-systolic volume, μL	44.46 ± 20.74	40.97 ± 19.36	50.00 ± 22.50	.245
LVEF Simpson, %	64.84 ± 6.83	66.54 ± 1.62	62.14 ± 5.70	.080
TAPSE, mm	2.49 ± 0.46	2.52 ± 0.48	2.43 ± 0.45	.718
Ascending aorta	3.4 ± 0.55	3.41 ± 0.58	3.39 ± 0.53	.929
Sinotubular junction	3.05 ± 0.55	2.97 ± 0.56	3. 18 ± 0.52	.341
Sinuses of Valsalva	3.47 ± 0.591	3.34 ± 0.13	3.70 ± 0.51	.117
Vena contracta	0.55 ± 0.13	0.56 ± 0.13	0.66 ± 0.06	.011
E/e	12.05 ± 4.81	11.42 ± 4.18	14.35 ± 7.22	.161
AR pressure half-time	535.08 ± 323.94	578.84 ± 381.19	465.79 ± 199.69	.353
Tei index	0.21 ± 0.89	0.20 ± 0.09	0.21 ± 0.08	.821
3D echocardiography				
End-diastolic volume, μL	125.03 ± 50.01	121.75 ± 41.99	130.24 ± 62.36	.653
End-systolic volume, μL	57.9 ± 26.685	41.84 ± 19.12	54.22 ± 30.83	.177
EF, %	62.06 ± 5.97	63.49 ± 5.20	59.81 ± 6.36	.095
GLS	−16.96 ± 2.53	−17.63 ± 2.36	−15.91 ± 2.53	.066
GCS	−20.77 ± 4.13	−21.68 ± 3.59	−19.33 ± 4.67	.125
GRS	54.54 ± 12.06	57.89 ± 11.20	49.25 ± 11.88	.050*
GAS	−32.64 ± 4.80	−34.21 ± 4.39	−30.16 ± 4.52	.020*
Outcome				
Death	4 (12.9)	1 (5.26)	3 (25)	.272

AR, aortic regurgitation; GAS, global area strain; GCS, global circumferential strain; GLS, global longitudinal strain; GRS, global radial strain; LV, left ventricle; LVEF, left ventricular ejection fraction; TAPSE, tricuspid annular plane systolic excursion.

Values are expressed as No. (%) or mean ± standard deviation.

* Statistically significant.

GAS >-32, with 75% sensitivity and 73.7% specificity, area under the curve = 0.76 (*P* = .05), and C statistic = 0.64.

The only significant predictors of events in the univariate analysis were vena contracta and GAS > −32. Both were introduced into a multivariate Cox proportional hazards model with backwards stepwise selection with no significant differences found.

The Kaplan-Meier curves showed differences in event-free survival when GAS > −32 (figure 1). Inclusion of a higher number of cases of grade IV AR (at baseline, 51.6%; final, 64.5%) could explain the greater risk of events than in the literature.

In our study, the GAS in AR identifies patients with greater probability of needing surgery, before deterioration in LVEF, which may help improve prognosis. To the best of our knowledge, this study is the first to evaluate a 3D ventricular mechanical parameter, GAS, as an independent predictive factor in patients with asymptomatic AR who do not meet the criteria for surgery.

Two features that could explain why GAS would provide more information than 2D strain studies are that the images are acquired in the same echocardiographic plane evaluating the same cardiac cycle and that acquisition of this parameter is only reproducible with 3D technology.[2–4] GAS reflects change in subendocardial area based on information on longitudinal and circumferential shortening measured simultaneously, which provides better predictive power than if measured separately, even with a lower number of patients.

The prognostic value of GAS has been demonstrated in other clinical contexts, although reference values vary according to the different echocardiographic equipment and authors.[3,4] In patients with asymptomatic severe mitral regurgitation and preserved EF, a GAS > -41.6% has been found to be predictive of worse outcomes (hazard ratio = 4.41; *P* = .004).[5]

In conclusion, GAS is the ventricular function parameter that best predicts this composite outcome, even better than the

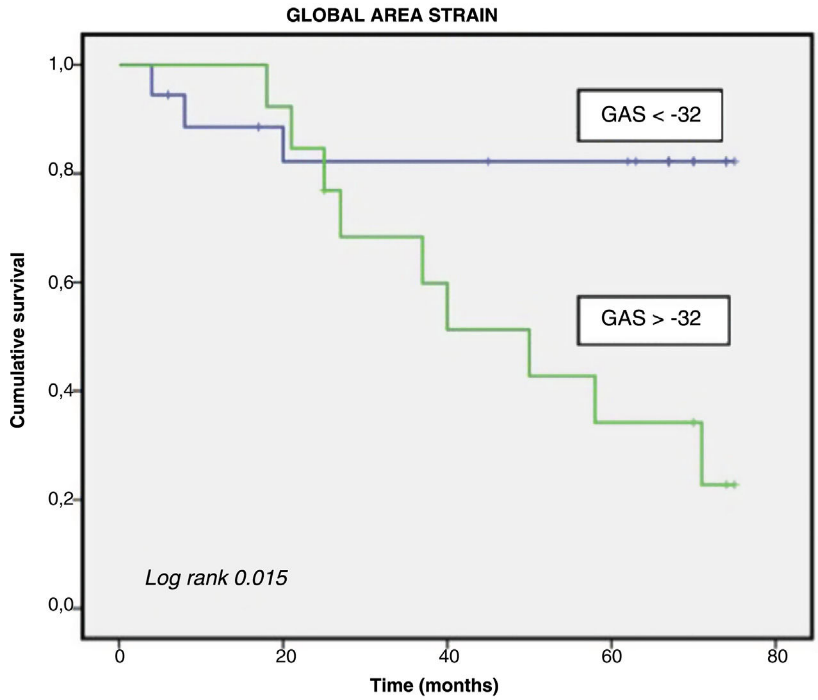

Figure 1. Kaplan-Meier survival curve according to GAS. A GAS > –32 was associated with a significantly lower event-free survival in patients with asymptomatic grade > III aortic regurgitation and LVEF > 55%. GAS, global area strain; LVEF, left ventricular ejection fraction.

parameter that is usually used, LVEF. Determination of GAS does not vary during follow-up of patients who remain asymptomatic and do not meet criteria for surgery.

Acknowledgements

We thank Dr Pedro Caravaca Pérez for his thorough review of the manuscript and his suggestions.

Laura Morán Fernández,[a,*] Eduardo Casas Rojo,[b]
Ana García Martín,[b] José Luis Moya Mur,[b]
Covadonga Fernández Golfin,[b] and José Luis Zamorano Gómez[b]

[a]*Departamento de Cardiología, Hospital Universitario 12 de Octubre, Madrid, Spain*
[b]*Departamento de Cardiología, Unidad de Imagen, Hospital Universitario Ramón y Cajal, Madrid, Spain*

* Corresponding author:
E-mail address: lauramoranfernandez@gmail.com
(L. Morán Fernández).

REFERENCES

1. Falk V, Baumgartner H, Bax JJ, et al. 2017 ESC/EACTS Guidelines for the management of valvular heart disease. *Eur J Cardiothorac Surg.* 2017;52:616–664.
2. Wen H, Liang Z, Zhao Y, Yang K. Feasibility of detecting early left ventricular systolic dysfunction using global area strain: A novel index derived from three-dimensional speckle-tracking echocardiography. *Eur J Echocardiogr.* 2011;12:910–916.
3. Pérez de Isla L, Millán M, Lennie V, et al. Area strain: umbrales de normalidad de un nuevo parámetro en sujetos sanos. *Rev Esp Cardiol.* 2011;64:1194–1197.
4. Casas Rojo E. 3D-wall motion tracking: measuring myocardial strain with 3D. In: Casas Rojo E, Fernandez-Golfin C, Zamorano J, eds. In: *Manual of 3 D Echocardiography.*. New York: Springer, Cham; 2017. http://dx.doi.org/10.1007/978-3-319-50335-6_6.
5. Casas-Rojo E, Fernández-Golfin C, Moya-Mur JL, et al. Area strain from 3 D speckle-tracking echocardiography as an independent predictor of early symptoms or ventricular dysfunction in asymptomatic severe mitral regurgitation with preserved ejection fraction. *Int J Cardiovasc Imaging.* 2016;32:1189–1198.

https://doi.org/10.1016/j.rec.2021.01.018

ECG patterns of typical and atypical advanced interatrial block: prevalence and clinical relevance

Prevalencia y relevancia clínica de los tipos de bloqueo interauricular avanzado típico y atípico

To the Editor,

The concept of interatrial block (IAB), established by consensus in 2012, is defined as prolonged P wave duration (≥ 120 ms) due to delayed transmission of the sinus impulse through the region of the Bachmann bundle.[1] IAB is classified as partial (P wave ≥ 120 ms) or advanced (P wave ≥ 120 ms with biphasic morphology in the II-III-aVF leads). Atypical patterns of advanced IAB have been described, but their frequency and clinical significance are unknown.[2] The aims of this study were to determine the prevalence of the various IAB patterns (partial, typical advanced, and atypical advanced) in the general population,[3] in centenarians,[4] in patients with heart failure,[5] and in