Results: In comparison to the iMVR group, pre-surgery echocardiographic findings in the cTVr group demonstrated higher mean TR severity grade (1.22 versus 2.03, respectively, $p<0.0001$) and higher mean pulmonary hypertension (45 and 54 mmHg, respectively, $p<0.020$). Long-term echocardiography parameters (median 1752 days IQR 1484, 3126) demonstrated that 72% of patients in the cTVr group regressed their TR severity grade compared to 28% of patients in the iMVR group (<0.0001). Moreover, 6.5% of patients in the cTVR group compared to 28% of patients in the iMVR group increased their TR severity grade (p=0.02) (Figure 1).
Conclusion: The addition of TV repair during MVR for rheumatic heart disease is associated with a significant decrease of late TR.

P1586
Accuracy of conventional and 3D echo-derived indices of right chamber and tricuspid annulus size to predict severe functional tricuspid regurgitation

D. Muraru[1], A.C. Guta[2], K. Addetia[3], D. Genovese[1], R. Ochoa-Jimenez[4], F. Veronesi[5], P. Aruta[1], C. Palermo[1], A. Prado[6], G. Sammarco[1], R. Tenaglia[1], S. Iliceto[1], R.M. Lang[3], L.P. Badano[1]. *[1]University of Padua, Department of Cardiac, Thoracic and Vascular Sciences, Padua, Italy; [2]University of Medicine and Pharmacy Carol Davila, Bucharest, Romania; [3]University of Chicago Medicine, Heart & Vascular Center, Chicago, United States of America; [4]University of Medical Sciences, San José, Costa Rica; [5]University of Bologna, Department of Electrical, Electronic and Information Engineering, Bologna, Italy; [6]Private Center of Cardiology, Tucuman, Argentina*

Right chamber dilation is considered among the supportive signs for severe functional tricuspid regurgitation (FTR). However, the thresholds for right ventricular (RV) and right atrial (RA) size in the guidelines have been derived from healthy subjects and have not been validated in FTR pts.
Purpose: To assess the accuracy of conventional and 3D echo-derived indices of right chamber and tricuspid annulus (TA) size to predict severe FTR.
Methods: A total of 182 pts with FTR of various etiologies (left heart disease, pulmonary arterial hypertension, permanent atrial fibrillation) and severities (35% moderate, 36% severe) were enrolled in two academic centers. End-diastolic RV volume (RVEDV), maximal RA volume (RAV max) and TA area in mid-systole (MS) and end-diastole (ED) by 3D echocardiography, as well as conventional measures of RV and RA size were obtained. Severe FTR was defined by $\geq$2 parameters: (1) coaptation defect; (2) vena contracta $\geq$7; (3) PISA radius >9 mm; (4) hepatic vein systolic flow reversal.
The first "definition group" (n=93) was used to select the optimal cut-off values to predict severe FTR, which were validated prospectively in a separated "validation group" (n=89). ROC curve analysis was used to compute area under curve (AUC), sensitivity and specificity.
Results: The two groups were similar in age, gender and FTR etiology (p=NS for all). In the overall population, 3D RAV max (AUC 0.78), TA MS area (AUC 0.71) and TA ED area (AUC 0.68) discriminated better than 3D RVEDV (AUC 0.61) pts with severe FTR. RA and TA size had better sensitivity than RV size to predict severe FTR (Table). 3D TA area was more specific than diameters. RV diameter was more specific than volumes or area.

Table 1

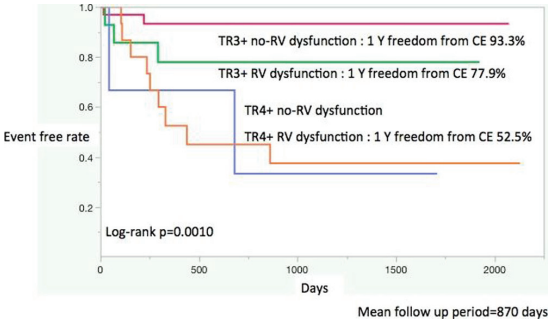
	Optimal cut-off	AUC	Sensitivity	Specificity
3D TA MS area (cm^2/m^2)	6.5	0.75	82	66
3D TA ED area (cm^2/m^2)	7.9	0.71	82	62
2D TA MS diameter (mm)	36	0.72	89	50
2D TA ED diameter (mm)	40	0.71	78	47
3D RVEDV (ml/m^2)	75	0.56	56	61
2D RVEDA (cm^2)	20	0.63	64	58
2D RV basal diameter (mm)	45	0.74	64	68
3D RAV max (ml/m^2)	74	0.77	73	62
2D RA area (cm^2)	33	0.70	71	65

Conclusions: This is the first prospective study validating thresholds of conventional and 3D parameters of right chamber and TA size for identifying pts with severe FTR.

P1587
Clinical outcome of isolated tricuspid regurgitation on stable heart failure

Y. Kato, M. Amaki, Y. Hamatani, A. Okada, H. Takahama, T. Hasegawa, Y. Sugano, H. Kanzaki, S. Yasuda, C. Izumi. *National Cerebral and Cardiovascular Center Hospital, Cardiology, Osaka, Japan*

Background: Severity of tricuspid regurgitation (TR) is known to associate with poor prognosis in isolated TR. However, severity of TR grading can change according to patient's stage of Heart failure (HF). Moreover, effect of right ventricular (RV) function on prognosis of isolated TR is unclear.
Methods: Between 2012 and 2017, 409 consecutive patients with more than moderate to severe ($\geq$3+) isolated TR (without left ventricular dysfunction, left sided valve disease, history of cardiac surgery, pulmonary hypertension and congenital heart disease) with minimally symptoms were recruited. Of those, 64 patients with multiple confirmation of moderate to severe TR were enrolled. HF hospitalization and sudden cardiac death considered cardiac events (CE). RV function measured with fractional area change (FAC).
Results: Patient background showed no differences between CE and non-CE groups. Percentage of the presence of TR4+ (75.0 vs. 14.6%), RV dysfunction defined as FAC<34% (68.7 vs. 35.4%), dilated inferior vena cava (87.5 vs. 50.0%) were significantly higher in CE than non-CE group (all, $p<0.05$). CE increased as the severity of TR worsened and presence of RV dysfunction increased (one year event free survival rate; TR3+ vs. TR4+ = 91 vs. 52%, non-RV dysfunction vs. RV dysfunction = 89 vs. 67%, both $p<0.05$). Kaplan-Mayer curve revealed, TR4+ with and without RV dysfunction was associated with highest clinical event risks. In TR3+, patients without RV dysfunction had better annual event free survival rate than that with RV dysfunction (93 vs. 78%) (Figure).



Event Free Survival Rate

Conclusions: Severe isolated TR itself is associated with high CE, whereas in moderate to severe TR, RV dysfunction could distinguish follow-up event.

P1588
Importance to identify the cause of tricuspid regurgitation by 3-dimensional echocardiography in heart failure patients after cardiac implantable electronic device implantations

Y. Seo, M. Yamamoto, T. Machino-Ohtsuka, T. Ishizu. *University of Tsukuba, Ibaraki, Japan*

Background: In patients with cardiac implantable electronic devices (CIEDs) implantations including implantable cardioverter defibrillator (ICD) and/or cardiac resynchronization therapy (CRT), moderate to severe tricuspid regurgitation (TR) occurs at a significantly higher rate. In contrast, exacerbations of functional TR are a relatively common comorbidity in HF patients at decompensated status independent of CIEDs implantations.
Therefore, we hypothesized the causes of TR might be varied in decompensated HF patients with CIEDs, although a lead of CIEDs induced tricuspid valve (TV) dysfunction has been focused as a cause of TR. Then, this study aimed to evaluate the changes of TV morphology and the routes of leads on TV using 3-dimensional (3D) echocardiography through clinical courses after CIEDs implantations.
Methods: In 205 patients with newly implanted ICD and/or CRT devices, 51 hospitalized patients due to decompensated HF were enrolled. No patients had moderate to severe TR before CIEDs implantations. 3DE examinations were performed at immediately after CIEDs implantations, admission due to decompensated HF, and chronic phase after HF hospitalization, respectively. Using an offline software for 3D echocardiography (TomTec Imaging System, Germany), anterior-posterior (AP) length, septal-lateral (SL)length, area, and height of TV were measured.
Results: Among 51 hospitalized patients, worsened TR from trivial or mild to moderate to severe level were observed in 29 patients. As shown in Table, TV area, right ventricular basal dimension, AP length, and SL length were significantly larger in patients with worsened TR compared to patients without significant TR even at immediately after CIEDs implantations. In 29 patients with worsened TR, 15 patients were diagnosed as lead induced TR at decompensated HF hospitalizations. In remaining 14 patients, worsened TR was diagnosed as functional TR, because device leads were positioned at tricuspid annulus between

	No worsened TR (n=22)		Worsened TR (n=29)					
			Functional (n=14)			Lead induced (n=15)		
	Immediately after implantation	Hospitalization	Immediately after implantation	Hospitalization	follow-up	Immediately after implantation	Hospitalization	follow-up
TR grade none	18	17	11	0	4	4	0	0
mild	4	5	3	3	8	11	0	0
moderate	0	0	0	7	2	0	6	3
severe	0	0	0	4	0	0	9	12
RV base, mm	29.4 ± 4.4	28.7 ± 3.9	33.0 ± 4.9*	35.4 ± 5.7	34.1 ± 4.9	35.5 ± 6.1*	37.3 ± 6.0	36.5 ± 4.1
TV area, cm^2	7.4 ± 2.1	7.2 ± 1.7	12.6 ± 2.7*	16.3 ± 3.6*#	12.9 ± 2.5	15.6 ± 3.8*	18.5 ± 4.0*†	19.8 ± 3.5†
A-P, mm	31.2 ± 5.4	29.8 ± 4.1	36.5 ± 4.0*	39.8 ± 5.3*#	35.5 ± 4.8	40.7 ± 6.6*	43.1 ± 5.8†	42.3 ± 5.1†
S-L, mm	30.9 ± 4.9	31.6 ± 4.5	40.7 ± 3.9*	46.2 ± 5.2*#	39.1 ± 5.3	44.5 ± 6.4*	48.6 ± 5.5†	47.3 ± 5.7†
TV height, mm	5.1 ± 2.5	4.6 ± 1.9	4.5 ± 2.1	3.7 ± 1.5#	4.9 ± 2.0	4.2 ± 2.6	3.8 ± 2.7	4.5 ± 2.2

RV=right ventricle; A-P=anterior-posterior length; S-L=septal-lateral length
*p<0.05 vs. no worsened TR group at same timing,
#p<0.05 vs. immediately after implantation and follow-up of same group
† p<0.05 vs. immediately after implantation of same group

Table. Changes of TV morphology and TR

leaflets, and TV dysfunction caused by leads were not revealed. The TV area, AP length, and SL length were more increased compared to immediately after implantations in both worsened TR groups. However, TR was improved to mild level in 12 patients with functional TR at chronic phase after HF hospitalizations accompanied with TV reverse-remodeling. In contrast, TR levels were more worsened in patients with lead induced TR, in whom 8 patients were treated with TV repair and/or lead relocations.
Conclusions: In patients with CIEDs implantations, this study revealed two mechanisms of worsened TR i.e. functional TR and mechanical TV dysfunction caused by CIEDs leads, in which basal TV remodeling may be a common risk of TR. In contrast, since the clinical courses clearly differ between two mechanisms, the identification of TR cause by 3D echocardiography is so helpful to decide on a course of treatment.

P1589
Right atrial volume is the major determinant of tricuspid annulus area in healthy subjects and in patients with functional tricuspid regurgitation due to various etiologies

D. Muraru[1], K. Addetia[2], D. Genovese[1], A.C. Guta[3], R. Ochoa-Jimenez[4], P. Aruta[1], F. Veronesi[5], V. Mor-Avi[2], M. Previtero[1], V. Guida[6], K. Nguyen[1], S. Iliceto[1], R.M. Lang[2], L.P. Badano[1]. *[1]University of Padua, Department of Cardiac, Thoracic and Vascular Sciences, Padua, Italy; [2]University of Chicago Medicine, Heart & Vascular Center, Chicago, United States of America; [3]University of Medicine and Pharmacy Carol Davila, Bucharest, Romania; [4]University of Medical Sciences, San José, Costa Rica; [5]University of Bologna, Department of Electrical, Electronic and Information Engineering, Bologna, Italy; [6]Italian Institute for Auxology IRCCS, Milan, Italy*

Background: Tricuspid annulus (TA) dilation and subsequent development of functional tricuspid regurgitation (FTR) are considered to be predominantly determined by right ventricular (RV) remodeling. However, the relative impact of right atrial (RA) and RV volumes on TA size in FTR are still poorly understood.
Purpose: We sought to explore the determinants of TA area and its relationship with RV and RA volumes in normal heart and in FTR of different etiologies and severities.
Methods: We enrolled 225 patients (60±24 years, 59% women) with FTR due to various etiologies (left heart disease - LHD, pulmonary hypertension - PH, permanent atrial fibrillation - AF, and Tetralogy of Fallot with severe pulmonary regurgitation - ToF), and in 214 healthy volunteers (43±16 years, 54% women) enrolled in two academic centers from Europe and US. RV end-diastolic volume (EDV), and RA maximal volume were measured using 3D echocardiography. TA area was quantified in mid-systole with previously validated prototype 3D software. Pulmonary arterial systolic pressure (PAPS) and left ventricular (LV) volumes and function were also collected. Stepwise linear regression was used for multivariable analysis. The following univariable correlates of TA area ($p<0.05$) were included in the model: age, gender, body surface area, RV EDV, RA maximal volume, PAPS, and LV ejection fraction.
Results: In the patient groups, there were 37% pts with mild FTR, 31% with moderate and 32% with severe FTR. TA area was more closely correlated with RA volumes than with RV volumes in both healthy subjects and in patients with FTR, irrespective of etiology (Table). Multivariable analysis depicted that RA maximal volume was the most important determinant of TA area, accounting for 39% (normals) and 47% (FTR) of TA variance. Body size and gender (8% and 2% of TA variance in normals), as well as RVEDV and body size (7% and 2% of TA variance in FTR pts) were also independently correlated with TA area ($p<0.001$).

Table. Correlations of TA area

	Controls (n=214)	FTR (n=225)	LHD (n=52)	PH (n=64)	AF (n=66)	ToF (n=43)
RA maximal volume	0.62	0.72	0.76	0.50	0.74	0.70
RV EDV	0.47	0.45	0.69	0.45	0.49	0.48

Data represent Pearson R coefficients ($p<0.001$ for all).

Conclusion: RA volume emerged as the major determinant of TA size in healthy subjects and in patients with FTR, suggesting that the RA, and not RV enlargement, appears to be the main determinant of TA dilation irrespective of cardiac rhythm. These findings might have implications for patient selection and the timing of tricuspid repair procedures.

P1590
Percutaneous systemic av-valve repair for the treatment of severe tricuspid regurgitation in patients with congenitally corrected transposition of the great arteries

P.M. Rumpf, O. Tutarel, J. Michl, A. Frangieh, A.M. Kasel, H. Kaemmerer, H. Schunkert, A. Kastrati, P. Ewert, I. Ott. *Deutsches Herzzentrum Technische Universitat, Munich, Germany*

Background/Introduction: Edge to edge percutaneous mitral valve repair is relatively safe and well-tolerated for high risk surgical patients with severe mitral regurgitation. Congenitally corrected transposition of the great arteries (ccTGA) with discordance at the atrioventricular and the ventriculoarterial level occurs in approximately 0.5–1% of congenital heart defects with. The systemic atrioventricular valve is prone to become progressively incompetent during the second to fifth decades of life due to dilatation and dysfunction of the morphologically right systemic ventricle.
Purpose: Because of high predicted surgical risk in these patients, we evaluated feasibility and safety of percutaneous edge-to-edge repair of severe regurgitation of the tricuspid valve (TR) in systemic av-valve position in patients with ccTGA using the Mitra Clip system (Abbott Vascular, Santa Clara, CA, USA).
Methods: All patients were rejected for surgical treatment of severe TR by the heart team. Associated anatomic abnormalities were 1 situs inversus totalis and 1 dextrocardia. The procedures were performed via venous femoral access under general anesthesia with the guidance of transesophageal echocardiography. TR classification was performed according to modified guidelines of American Society of Echocardiography and graded from +1 to +4. Transthoracic and transoesophageal examinations were performed pre-procedurally and transthoracic echocardiography was performed before discharge and after 30 days.
Results: Between 06/2016 and 01/2018 6 patients were included (46+11 years, 50% male). Percutaneous repair of the tricuspid valve in systemic av-valve position was successful in all patients. On average 2+0.5 Mitraclips were implanted with a reduction to TR<II <br follow-up. day 30 at observed was infarction myocardial or stroke embolization, MitraClip reintervention, therapy, valve surgical death, No patients. all in <II follow-up classification NYHA 83%. /> Conclusion: In patients with ccTGA and severe systemic TR and high surgical risk percutaneous edge to edge valve repair is feasible and safe and can be a valuable treatment option.

P1591
Novel transcatheter repair system for the treatment of severe tricuspid regurgitation

J. Hausleiter[1], T. Ruf[2], K. Connelly[3], E. Ho[3], D. Braun[1], E. Schulz[2], M. Nabauer[1], R.S. Von Bardeleben[2], N. Fam[3]. *[1]University Hospital of Munich, Department of Cardiology, Munich, Germany; [2]Johannes Gutenberg University Mainz (JGU), Mainz, Germany; [3]St. Michael's Hospital, Toronto, Canada*

Background: Transcatheter edge-to-edge repair of severe tricuspid regurgitation (TR) has been shown to be a feasible and safe treatment option for selected patients at prohibitive operative risk. Large tricuspid leaflet coaptation gaps and severe leaflet tethering represent challenging anatomic conditions that may limit the efficacy of transcatheter repair techniques. The purpose of this first-in-man experience was to investigate the procedural feasibility of the novel PASCAL transcatheter repair system (Edwards Lifesciences, Irvine, CA, USA) which incorporates a spacer and enables independent leaflet grasping to overcome some of the mentioned anatomic challenges.
Methods and results: Nine patients with severe symptomatic TR were treated with the PASCAL system in a compassionate use program at 3 sites. All patients suffered from severe right sided heart failure (NYHA III-IV) due to severe TR and were deemed inoperable by the institutional heart teams. The procedures were performed via the right femoral vein under general anesthesia using transesophageal echocardiographic guidance. Procedural success was defined as reduction of at least one TR grade. If simultaneous grasping of two tricuspid leaflets was not achievable due to a large coaptation gap and/or severe leaflet tethering, the system allowed for independent leaflet grasping – usually the anterior or posterior tricuspid leaflet first, followed by grasping of the septal leaflet.
Treated patients (age: 78±6 yrs) were considered to be at intermediate surgical risk (EuroScore II: 6±7). One procedure remained unsuccessful primarily due to difficult imaging conditions (no device placed); in the remaining 8 patients a total of 14 PASCAL devices (2 devices/patient in 6 patients; 1 device/patient in 2 patients) were placed in the tricuspid valve; 8 in the anterior-septal and 6 in the postero-septal position. A successful procedure with TR reduction by one grade was achieved in 8 patients. Applying a 5 grade scheme, the mean tricuspid regurgitation grade was reduced from 3.9±1.0 to 1.8±0.5 without relevant increase in tricuspid gradients (mean gradient 1.2±0.8 mmHg). Independent leaflet grasping was applied for 12 of 14 PASCAL devices to overcome large coaptation gaps and leaflet tethering.
During in-hospital stay, a single leaflet device attachment was observed in one patient, which was managed conservatively. No other complications were observed during or following the procedure. Of note, we did not observe pericardial effusions, TR worsening or acute worsening of right ventricular function.
Conclusions: Severe TR with large leaflet coaptation gaps can be successfully treated in selected patients with the use of the novel transcatheter PASCAL repair system, which incorporates a spacer and enables independent leaflet grasping in challenging tricuspid anatomies. A 30-day clinical follow-up will be presented.

P1592
Acute and short-term results of transcatheter treatment of severe tricuspid regurgitation using the Edge-to-Edge-repair system

D. Braun, M. Orban, M. Nabauer, A. Englmaier, D. Roesler, T. Stocker, C. Hagl, S. Massberg, J. Hausleiter. *Ludwig-Maximilians University, Munich, Germany*

Background: Tricuspid regurgitation (TR) is associated with significant morbidity and mortality. There is a clinical need for interventional treatment strategies for patients ineligible for cardiac surgery.
Purpose: To evaluate the acute and short-term results of transcatheter edge-to-edge TR repair.