Abstract P3846 – Table 1. Age related changes

Age	RVSRs	RVSRe	RVSRl	RVTEI	RVE/A	LVSRs	LVSRe	LVSRl	LVTEI	DTE	E/E'
<40 yrs	−1.22±0.5	1.47±0.38	1.04±0.2	0.41±0.13	1.48±0.46	−1.16±0.2	1.6±0.4	0.94±0.2	0.4±0.1	155±40	6±2
41–55 yrs	−1.26±0.3	1.35±0.4	1.13±0.38	0.42±0.13	1.26±0.27	−1.07±0.2	1.4±0.3	1±0.3	0.4±0.1	184±39	7±2
>56 yrs	−1.34±0.3	1.04±0.6	1.18±0.34	0.52±0.14	1.15±0.25	−1.±0.2	1.1±0.2	1.1±0.2	0.5±0.1	213±59	9±2
P value	ns	0.002	ns	0.004	0.005	ns	0.001	ns	0.017	0.006	0.011

Methods: 91 individuals, without any disease that might affect LV/RV function (46±14 yrs, 19-74 yrs, 60 women) were evaluated by STE, TDI, and conventional echo. They were divided in 3 groups: <40yrs (30), from 41 to 55 yrs (36), and >56 yrs (25). RV systolic function was assessed from TAPSE, FAC, global systolic strain (RVGS) and strain rate (RVSRs); LV systolic function from ejection fraction (EF), global longitudinal strain (LVGS) and strain rate (LVSRs), global radial (RS) and circumferential (CS) strain. Diastolic function was assessed for both ventricles from E/A ratio, DTE, TEI indices, early and late global positive strain rate (SRe, SRI); E/E' ratio was used for LV.
Results: RV diastolic function decreased significantly over 56 yrs (table), without systolic dysfunction. On contrary, LV diastolic dysfunction started earlier, from 40 yrs, also without systolic dysfunction (table). Most parameters of RV and LV diastolic function (LV and RV TEI index, LVSRe, RVSRe, LV DTE and E/E', and RV E/A ratio) correlated with age (all r>0.45, p>0.05). RV diastolic (RVSRe) correlated with LV diastolic (E/E', LVSRe) function. By multiple regression analysis, RVSRe was best predicted by LVSRe (r=0.48, p<0.001).
Conclusion: LV diastolic function was affected earlier by age, from 40 yrs, whereas RV diastolic function was affected later, over 56 years, mainly due to LV diastolic age-related changes; for our groups, systolic function was not affected by age. These findings suggest that ventricular interdependence plays a key role in RV function.

P3847 | BEDSIDE
Right ventricular deformation is determined by right ventricluar dimensions in elite athletes - a 2D speckle tracking echocardiography study

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Purpose: Intense exercise is associated with morphological and functional changes in the heart. There is evolving evidence that the involvement of the right ventricle (RV) in this remodeling is at least proportionate to that of the left ventricle (LV). However right ventricular sport-adaptation is less well characterised, and data reported on RV functional changes in athletes are contradictory. The aims of our study were to assess resting myocardial deformation in the RV of elite athletes by two dimensional speckle tracking echocardiography (STE) and to identify influencing/determining factors of the functional remodelling in the athlete's heart.
Methods: 28 male elite athletes (practicing combined power-endurance sport disciplines) and 13 age matched sedentary volunteers were enrolled. Subjects undervent a complete echocardiography and cardiac MRI examination. Ventricular volumes and mass were determined by CMR, RV global longitudinal strain (GLS) was measured by 2D STE.
Results: In athletes, there was a trend toward reduced RV GLS compared to controls, this difference however was not statistically significant (18±4 vs. 20±3, p=0.33) Athletes displayed significantly larger left and right ventricular volume and mass indices (LVEDVi 117±15 vs 99±11 LVESVi 49±9 vs 40±9 LVMi 87±15 vs 70±6 RVEDVi 123±18 vs 102±9 RVESVi 54±12 vs 42±7 RVMi 31±4 vs 25±1) and the observed morphological remodelling was proportionate in the right and left ventricle. There was no significant difference regarding EF of either ventricle between the two groups (LV 58±4 vs 60±6, p=0.45, RV 57±5 vs 59±5 p=0.48). TAPSE was significantly higher in athletes than in controls (28±4 24±6, p=0.03), however, when indexed to RV major axis diameter the difference was no longer significant (0.4±0.06 vs 0.4±0.3, p=0.6). RV GLS values showed significant correlation with right ventricular dimensions (RV GLS - RVEDVi p=0.03, RV GLS - RVESVi p=0.03).
Conclusions: RV GLS in athletes was reduced compared to controls, although the difference was not statistically significant. RV GLS showed strong negative correlation with right ventricular dimensions, in both groups. Our results are consistent with those reported by Teske et al. who found reduced resting RV deformation only in athletes with RV dilation. The fact that those control subjects who had relatively large right ventricular volume displayed similar RV GLS values to athletes with matching RV size suggests that RV deformation properties do not directly depend on the level of excercise performed by the subject, but rather are secondary consequences of morphological remodelling.

P3848 | BEDSIDE
Reference values of right ventricular longitudinal strain by speckle tracking echocardiography in 219 healthy volunteers

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Purpose: Right ventricular longitudinal strain (RVLS) by speckle-tracking echocardiography (STE) predicts outcome in patients with acute myocardial infarction, heart failure, pulmonary arterial hypertension and in those implanted with left ventricular assistance devices. However, the lack of normative reference values has limited the adoption of RVLS in the clinical routine. We aimed to assess RVLS in normal subjects and its relationship with age, gender and other established parameters of RV function.
Methods and results: RV function was assessed by conventional, STE and three-dimensional echocardiography (3DE) in 219 healthy volunteers (43±14 years, range 18-76; 57% women). Feasibility of RVLS analysis was 75%, while for TAPSE, fractional area change and 3DE ejection fraction it was 98%, 94% and 89% respectively. RVLS at free wall was significantly higher than global (i.e. including both free wall and interventricular septum) RVLS (-29±4% vs -24±3%, p<0.0001). No relationship between age and RV LS was found. RVLS was higher in women than in men (-26±3% vs -24±3% for global RVLS, and -32±5% vs -29.2±4.3% for free wall RVLS, p<0.0001 for both). Segmental values of RVLS for each gender are reported in Table. Global RVLS showed a weak correlation with RV ejection fraction and RV fractional area change (r=0.31 and r=0.39, respectively, p<0.0001). Of note, neither TAPSE, nor tricuspid annular systolic velocity were correlated with RV ejection fraction.

Regional distribution of RV longitudinal

RV longitudinal strain	Men (n=74)	Women (n= 90	p Value
Basal septum (%)	−19.2±2.9	−19.6±3.4	NS
Mid septum (%)	−19.9±2.7	−20.1±3.3	NS
Apical septum (%)	−18.6±5.4	−21.1±5.2	0.004
Apical free wall (%)	−26.7±5.5	−30.4±5.4	<0.0001
Mid free wall (%)	−32.5±5.1	−34.6±5.3	0.01
Basal free wall (%)	−28.4±6.1	−31.1±5.9	NS

Conclusion: This prospective study provides global and regional, gender-specific normative values for RVLS measured by STE in a relatively large cohort of healthy volunteers with a wide age range. These data might support the assessment of RV myocardial deformation in clinical setting.

P3849 | BEDSIDE
Normal ranges of 2D speckle tracking left ventricular segmental longitudinal, radial and circumferential maximum strain post-systolic time delays used for dyssynchrony analysis

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Purpose: Echocardiograhic 2D speckle tracking strain (STS) analysis is used to evaluate left ventricular (LV) dyssynchrony in patients eligible for cardiac resynchronization therapy. However there is no agreement on which strain type (Long, longitudinal; Rad, radial; Circ, circumferential) performs best, and normal values for dyssynchrony (post-systolic time delay, PSTD), for each wall segment within each strain, are lacking. We evaluated physiologic PSTD in a group of normal subjects.
Methods: We screened 70 subjects (age 45±18 y., range 16-85) with normal history, ECG, standard echocardiogram, blood pressure, laboratory data and stress echocardiography using GE Vivid7 or Vivid9 machines with offline analysis on Echopac v12. Maximum peak (%) and time to peak (TTP, ms) 2D speckle tracking longitudinal strain was calculated from the 3 apical views, and radial and circumferential maximum values from LV short axis views at the mitral, papillary and apical levels, using a LV 18 wall segments model. PSTD was measured as the difference between TTP strain (%) and time to end-ejection (from pulsed Doppler LV outflow), taking as reference the beginning of isovolumic contraction (= first positive/negative deflection on the pulsed tissue Doppler mitral annulus velocity tracing).
Results: Mean global maximum Long strain was -21.7±1.9%, and mean Circ strain at base, papillary and apex were respectively -17.5±4.1%, -18.2±3.7% and -25.6±4.6%. The Table shows the mean maximum PSTDs for the 3 strains (means from 18 individual segments): all calculated SDs were below the 76 ms cutoff used for LV dyssynchrony, but all the upper 95% CI of the PSTDs were above the 130 ms cutoff used for LV dyssynchrony. The highest delays were found for the Circ strain of the basal and papillary lateral and posterior segments. Age did not influence significantly PSTDs.

Maximum strain post-systolic time delays

(ms)	Mean	SD	MIn	Max	Range	5% CI	95% CI
Long.	97	3	−2	170	172	35	150
Rad.	83	50	−79	251	330	6	148
Circ.	149	65	15	329	314	60	300

Conclusions: Longitudinal strain shows the lowest and circumferential the highest variability of PSTDs. Although the SD cutoffs appear adequate in order to separate physiologic from pathologic PSTDs, there is overlap when the absolute PSTDs values are used.

P3850 | BEDSIDE
Usefulness of hand-held echocardiography (VScan, GE) in bedside outpatients cardiology consultations in addition to physical examination: preliminary results from a multicentric Italian study

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Aims While patient history taking and physical examination remain the cornerstones of patient evaluation in clinical practice, there has been a decline in the accuracy of the latter. Hand-held echocardiographic devices have recently been introduced and could potentially improve the diagnostic accuracy of clinical examination. The aim of this study was to assess the usefulness of a new miniaturized echocardiographic system to perform bedside echocardiography in initial outpatient cardiology consultations, in addition to physical examination.
Methods and results: One hundred fifty-one patients, referred for initial cardiology outpatient consultations, were studied in 6 Cardiologic Centres in Italy. Each patient was submitted to physical examination followed by VScan (GE Healthcare) assessment. Scanning time, the number of examinations with abnormal results after physical examination and the VScan, and the information obtained by physical examination alone and followed by the VScan (in terms of its importance in reaching a diagnosis, in the necessity of performing routine echocardiography, and in the decision to release the patient from the outpatient clinic) were assessed. The main consultation motives were: dyspnea (28%), chest pain (24%), arrhythmias (19%), shock (5%), syncope (5%), before surgery cardiologic evaluation (25%). The scanning time with the VScan was184±83 seconds. Its use after physical examination led to diagnosis in 106 patients (70%) and to an additional 25 patients (16%) being released from the outpatient clinic. After physical examination followed by VScan assessment, only 37 patients (24%) were sent to the echocardiography lab for further examination. The VScan modified the decision of whether to send a patient to the echocardiography lab, with referral determined by the VScan in 18 patients (11%) and no referral determined by the VScan in 58 patients (29%). The main diagnoses made with VScan were: increase of left and or right ventricular chambers, atrial dilation, left ventricular hypertrophic or dilative remodeling, previous myocardial infarction, low Left Ventricular ejection fraction, mitral or aortic valvular insufficiency or stenosis, pericardial effusion.
Conclusions: The VScan utilization caused a negligible increase in the duration of consultations. It showed incremental value over physical examination, increasing the number of diagnoses, reducing the use of unnecessary routine echocardiography, increasing the number of adequate echocardiographic studies, and determining a large number of releases from the outpatient clinic.

P3851 | BEDSIDE
Impact of age on diastolic function and left atrial volume and function in normal subjects assessed by two-dimensional speckle tracking echocardiography

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Background: Using speckle trackiing echocardiography (STE), emerging attention has been brought to left atrium (LA) which is very complex due to close coupling with left ventricle (LV) and affected by age as well as LV stiffness. However, normal reference in each age of LA volume and function by STE is not elucidated.
Methods: We examined phasic LA emptying function (EF), volume index (LAVI), peak strain and strain rate in 120 normal subjects without cardiovascular disease from teens to eighties by 2D-STE. We estimated pulmonary capillary wedge pressure (ePCWP) as $10.7 - 12.4 \times \log$ (active EF/min LAVI). We measured LV mass index (LVMI), ejection fraction, E/e' and E/A.
Results: There was no difference in LVMI and LV ejection fraction among ages. LA total and passive EF as well as SR at systole and early diastole were decreased with age. LA active EF as well as SR at atrial contraction (ac) was increased associated with increased pre-ac LAVI.
Conclusions: LA reservoir and conduit function were decreased with age associated with impaired LV relaxation in normal subjects. LA booster pump function was increased with age to compensate decreased conduit function associated with increased pre-ac LAVI, suggesting Frank-Starling law and mechanism of homeostasis to keep PCWP within normal until some point after relaxation became impaired in normal elderly.

Abstract P3851 – Table 1

	Teen	Twenties	Thirties	Fourties	Fifties	Sixties	Seventies	Eighties	p(ANOVA)
E/e'	6.3±1.2	6.4±0.7	7.1±1.6	7.2±1.9	7.8±1.5	7.8±0.9	8.2±1.1	9.2±1.9	<0.001
E/A	2.1±0.5	1.7±0.4	1.4±0.3	1.2±0.2	1.0±0.1	1.0±0.2	0.8±0.1	0.7±0.1	<0.001
Maximum LAVI, ml/m^2	34±7	34±6	34±6	34±7	35±5	37±6	37±9	40±8	0.084
Minimum LAVI, ml/m^2	16±4	16±4	16±3	16±4	18±2	20±5	20±5	22±5	<0.001
Pre-ac LAVI, ml/m^2	20±6	20±4	21±4	23±6	25±3	28±6	29±8	32±7	<0.001
LA total EF, %	57±5	54±5	53±3	52±7	49±4	47±6	47±4	46±5	<0.001
LA passive EF, %	42±6	41±6	38±5	31±8	29±7	25±8	23±9	20±5	<0.001
LA active EF, %	22±6	22±4	23±5	28±8	28±5	29±6	30±6	34±6	<0.001
LA peak strain	46±7	39±8	37±7	37±7	34±8	31±7	31±7	29±8	<0.001
Strain rate at systole, s^{-1}	1.8±0.4	1.5±0.5	1.5±0.3	1.4±0.3	1.4±0.3	1.3±0.2	1.3±0.3	1.3±0.4	<0.001
Strain rate at early diastole, s^{-1}	−2.8±0.5	−2.4±0.5	−1.8±0.4	−1.7±0.4	−1.3±0.3	−1.2±0.3	−1.1±0.4	−0.8±0.3	<0.001
Strain rate at ac, s^{-1}	−1.2±0.4	−1.2±0.2	−1.3±0.3	−1.5±0.3	−1.6±0.2	−1.6±0.3	−1.7±0.5	−1.8±0.6	<0.001
ePCWP, mmHg	8.5±2.4	8.8±2.1	8.7±1.5	8.1±2.6	8.2±1.1	8.7±2.3	8.4±2.0	8.2±2.0	0.964

P3852 | BEDSIDE
Normal values of classical and new parameters of right ventricular function in the absence of rejection in the first year post heart transplantation

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Purpose: Our objective is to describe normal values of right ventricular systolic function echocardiographic parameters, evaluated by means of conventional and two-dimensional speckle tracking echocardiography (2DSTE) in the first year after heart transplantation (HT), in the absence of acute cellular rejection.
Methods: From September 1st, 2009 to December 14th, 2010 we performed an exhaustive echocardiographic exam in all transplant recipients during their first post-transplantation year within the same day of the routine endomyocardial biopsies. We selected the exams that were coincident with no acute cellular rejection (grade 0R). Tricuspid annular plane systolic excursion (TAPSE) measured with M-mode and 2DSTE, tricuspid annular lateral systolic velocity measured by Tissue Doppler Imaging (S' wave), right ventricular strain and strain rate, evaluated by means of 2DSTE, were obtained in all of them, and compared with 14 healthy controls.
Results: 32 studies performed 4±3 months after heart transplantation in 14 patients showed absence of acute cellular rejection (grade 0R). The mean age was similar in donors and controls (35±14 versus 35±11, p=0,93) and higher in transplant recipients than in controls (50±15 versus 35±11, p=0,005). Male gender percentage was similar in donors versus controls (85% versus 71%, p=0,41) and in transplanted patients versus controls (93% versus 71%, p=0,14). Right ventricular function parameters in the transplanted group compared to controls were: TAPSE (M-mode) 15,7±2,7 versus 23,5±1,7 (p<0,0005), S' wave 11,8±1,8 versus 15,3±1,9 (p=0,005), TAPSE (2DSTE) 11,0±3,1 versus 21,2±3,6 (p<0,0005), right ventricular strain -25,1±9,2 versus -29,5±6,9 (p=0,29) and right ventricular strain rate -2,2±1,0 versus -2,9±1,7 (p=0,35).
Conclusion: In the first year post-HT, and in the histologically proven absence of rejection, we found significantly lower values of TAPSE measured with M-mode and 2DSTE and S' wave in transplanted patients versus controls, and non-significantly lower values of right ventricular strain and strain rate, evaluated by means of 2DSTE.

P3853 | BEDSIDE
Allometric normative equations for 3D right ventricular size and function: development and validation with equations derived using cardiac magnetic resonance

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Background: The confounding effect of anthropometric factors may limit the capability of imaging methods to rule out Right Ventricular (RV) pathology. We sought: a) to analyze the relationship of RV volumes and function obtained by three-Dimensional Echocardiography (3DE) with age, gender and body size; b) to obtain allometric normative equations for 3DE RV parameters and c) to validate them against those derived by Cardiovascular Magnetic Resonance (CMR).
Methods: RV volumes (end-diastolic, EDV; end-systolic, ESV) and Ejection Fraction (EF) were measured by transthoracic 3DE in 540 healthy adult volunteers,