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Letter to the Editor

Feasibility and accuracy of a routine echocardiographic assessment of right ventricular function

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Abstract

The evaluation of right ventricular (RV) systolic function is important for its clinical and prognostic value but difficult to obtain due to RV complex anatomy. Aims of this study were to evaluate the feasibility of a routine use of RV fractional shortening area (FSA), systolic excursion (TAPSE) and peak systolic velocity (PSV) of tricuspidal annular motion in a large series of cases (900 pts), to determine the values in normal subjects (150) and in patients (750) with different pathologies and to correlate these indexes to clinical and echo-Doppler variables. FSA (50.3±10% vs 54.6±9% $p<0.01$), TAPSE (20.2±5 vs 24.7±4 mm, $p<0.01$) and PSV (16.2±4 vs 20±4 cm/s, $p<0.01$) were lower in patients than in normals, correlated positively to left ventricular ejection fraction and negatively to the pulmonary pressure. The values of 17 mm for TAPSE, 12 cm/s for PSV and 37% for FSA identified patients with high specificity. The values in subgroups of pathological patients were evaluated and compared.

Keywords: Right ventricular performance; Echocardiography; Tissue Doppler

The evaluation of right ventricular (RV) systolic function is very important for its clinical and prognostic value [1–5]. An accurate non-invasive assessment of RV systolic function is however difficult, due to its complex structure and anatomy [6–8].

Several echocardiographic methods have been proposed to rapidly and routinely analyse RV performance: two-dimensional evaluation of fractional shortening area in four-chamber view (FSA) [9], M-mode measurement of tricuspid annular plane systolic excursion (TAPSE) [10,11] and more recently systolic tricuspid annular velocity (PSV) by pulsed tissue Doppler imaging [12–14]. However, in previous studies, these three echo-Doppler parameters have been validated and utilized in small populations.

Aims of the study were to evaluate the feasibility of a routine use of FSA, TAPSE and PSV as measures of RV systolic function in 900 patients, including 750 pathological (PG) and 150 normal subjects (NG) matched for age, referred for transthoracic echocardiography in our laboratory. PG consisted of 235 subjects with coronary artery disease (CAD: 85 inferior and 150 anterior myocardial infarction), 382 valvular disease, 90 dilated cardiomyopathy (CMPD) and 43 systemic hypertension.

Biplane LV ejection fraction (LVEF) was measured by the area-length method and systolic pulmonary pressure (SPP) was obtained non-invasively (echo-Doppler method) [15]. FSA, TAPSE and PSV were compared between the groups (Student's unpaired *t*-test) and correlated to demographic and echocardiographic data (multiple regression analysis).

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FSA, TAPSE and PSV were recorded in all cases in a mean time of 3±1 min. Inter- and intra-observer variabilities were very low for TAPSE (0.24±1.3 and 0.17±1.4 mm, respectively) and PSV (0.15±1.8 and 0.21±1.5 cm/s) and high for FSA (4.22±7% and 1.1±3.9%.), due to a limited definition of the endocardial border in RV lateral free wall and in the apex [16,17]. The three parameters resulted significantly lower in PG (Fig. 1) and despite overlap of values among groups, a cut-off of 17 mm for TAPSE, 12 cm/s for PSV and 37% for FSA identified PG with high specificity (even though with low sensitivity). Our data underline the accuracy of these parameters and in particular of TAPSE and PSV. In fact, we found differences not only between NG and PG, but also in subgroups in which the RV function may be altered as in cases with inferior myocardial infarction [18,19], (Fig. 2). PG was heterogeneous and obviously included cases with normal and abnormal RV performance. CMPD and CAD were associated with the worst right and left ventricular functional parameters. Right functional parameters were lower in these patients in comparison with hypertensives and valvular cases. No significant differences were found between NG and hypertensives in whom a RV dysfunction had probably no reason to be present. However in hypertensives, and not in NG, few cases had a TAPSE lower than 17 mm and PSV lower than 12 cm/s, suggesting a possible silent RV alteration.

A significant and independent positive correlation was found between the RV parameters and LVEF. SPP and AGE were negatively related to TAPSE. Three-main mechanisms characterized RV systolic function: motion of the RV free wall, contraction of spiral muscles which produces systolic basal-apical shortening and interventricular septal motion dependent on biventricular interdependence. Therefore in addition to ventricular function the shape and performance of the RV depend on extrinsic factors such as preload, afterload and LV function. In this regard a negative correlation between systolic pulmonary pressure and TAPSE has been also confirmed. Interestingly only TAPSE correlated to age. This may be due to the altered ventricular longitudinal function which has been correlated to the aging process.

In conclusion a routine quantitative analysis by echocardiography of the RV systolic function is feasible and may accurately discriminate normal from pathological RV function in different pathologies. TAPSE and PSV, more than FSA, may be proposed as useful and rapid methods to

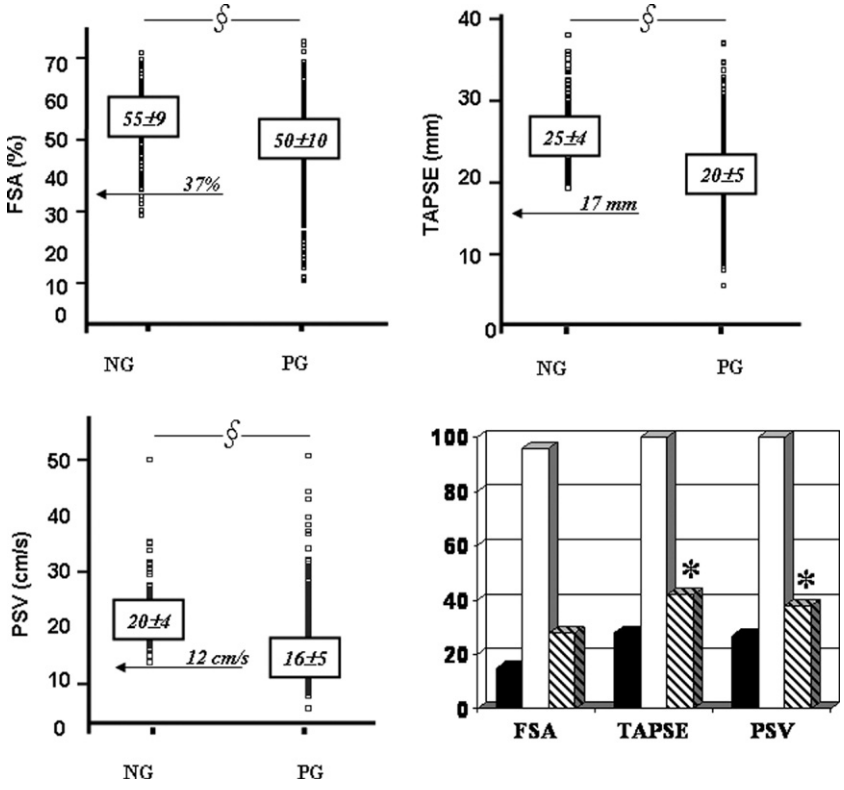

Fig. 1. Distribution of individual values and mean values of right ventricular fractional shortening area (FSA), systolic excursion (TAPSE) and peak systolic velocity (PSV) of tricuspid annular motion in normal subjects and in patients. Arrows show the mean normal values minus 2 SD which represent the lower value of normality for these parameters. Bars show sensitivity (black bars), specificity (white bars) and accuracy (dashed bars) of each parameter. $^{\S}p<0.001$ vs normal group; $^{*}p<0.001$ vs FSA.

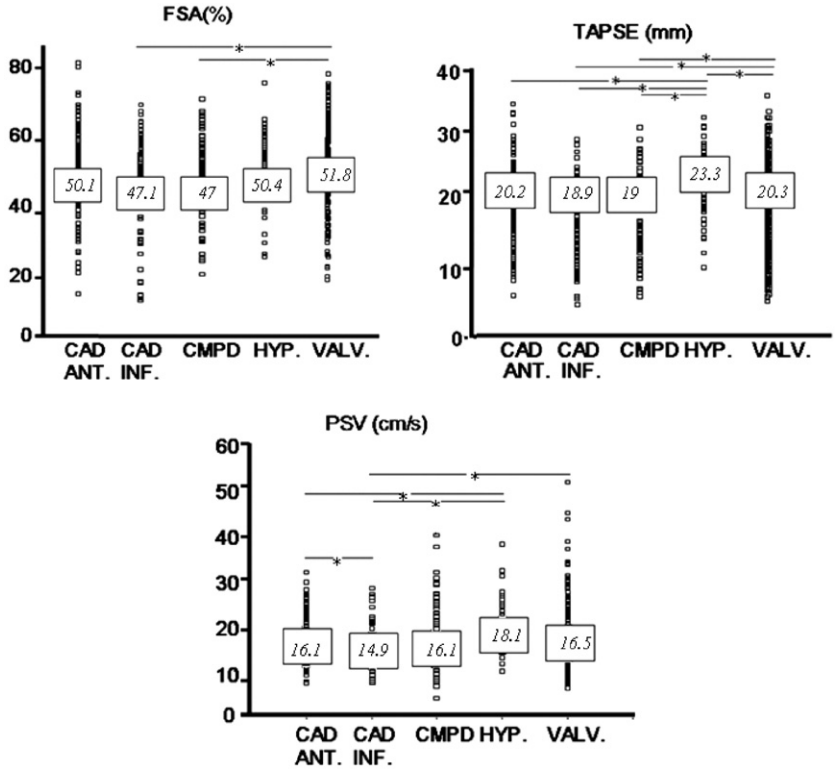

Fig. 2. Distribution of individual values and mean values of right ventricular fractional shortening area (FSA), systolic excursion (TAPSE) and peak systolic velocity (PSV) of tricuspid annular motion in each pathological group. CAD ANT = coronary artery disease with a previous anterior myocardial infarction; CAD INF = coronary artery disease with a previous inferior myocardial infarction; CMPD = dilated cardiomyopathy; HYP = hypertensive patients; VALV = valvular heart disease. *$p<0.01$ between the groups.

be included in the standard transthoracic echocardiographic examination.

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