Short Communication

# New Non-Invasive Index for Combined Systolic and Diastolic Ventricular Function

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Although there are many parameters for either systolic or diastolic function, it is known that ventricular systolic and diastolic dysfunction coexist to a considerable degree[1]. Thus, an assessment of combined systolic and diastolic function may better reflect the 'global' function of the heart rather than the isolated evaluation of either systolic or diastolic function in patients with ventricular dysfunction. Isovolumetric contraction time (ICT) and isovolumetric relaxation time (IRT) are important considerations in the assessment of systolic and diastolic myocardial function, be-

cause calcium influx and efflux secondary to ATP utilization occurs during these periods.

Here, I propose a conceptually new, easily measured index for 'global' systolic and diastolic myocardial performance, defined as the sum of ICT and IRT divided by ejection time (**Fig. 1**). The rationale for this new index of ventricular dysfunction lies in the fact that this index encompasses important periods of systolic contraction, ejection, and diastolic relaxation. The sum of ICT and IRT can easily be obtained by noninvasive conventional Doppler echocardiography. For example, in the right-sided heart, it is derived by subtracting pulmonary ejection time from the interval between cessation and onset of tricuspid inflow. Similarly, it is obtained by subtracting aortic ejection time from the interval between cessation and onset of mitral inflow in the left-sided heart.

As ventricular dysfunction results in the prolongation of both ICT and IRT, and in the abbreviation of ejection time[2], this new index is increased in patients with ventricular dysfunction. In preliminary studies, measurement of this new index was easy, reproducible, and had a narrow range of values in subjects with normal right and left ventricular function ($n=35$; index of right-sided heart 0.29 ± 0.06, index of left-sided heart 0.37 ± 0.05). The value of this index is significantly increased in patients with right ventricular dysfunction such as right ventricular infarction or right ventricular dysplasia and cor pulmonale ($n=32$; 0.67 ± 0.20 vs normal subjects, $p<0.001$) and in patients with severe ischemic left ventricular dysfunction or idiopathic dilated cardiomyopathy ($n=33$, 0.92 ± 0.22 vs normal subjects,
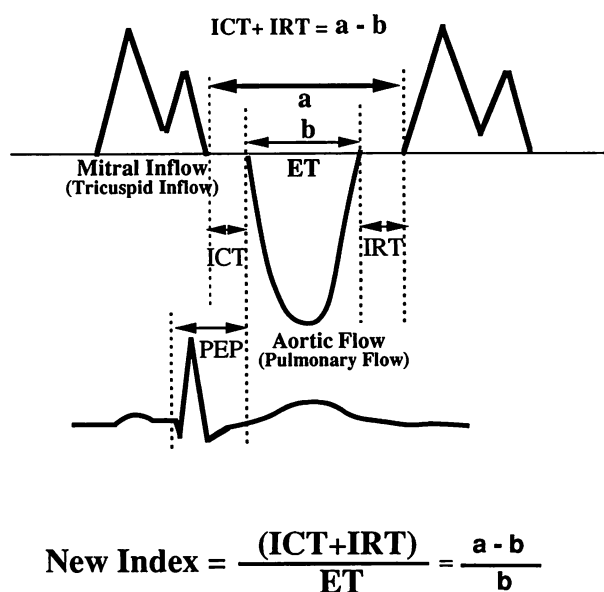
$$\text{New Index} = \frac{(\text{ICT}+\text{IRT})}{\text{ET}} = \frac{a - b}{b}$$

Fig. 1 Schema of Doppler time intervals

The new index, (ICT + RT)/ET, is measured by (a-b)/b, where a is the interval between cessation and onset of the mitral or tricuspid inflow, and b is the aortic or pulmonary ejection time (ET). ICT = isovolumetric contraction time; IRT = isovolumetric relaxation time; PEP = pre-ejection period.

$p < 0.001$). There was no overlap of values between normal subjects and patients with right or left ventricular dysfunction.

This new index combines systolic and diastolic function and could be widely applicable to characterize right and left ventricular function non-invasively. The assessment of right ventricular function has been difficult and challenging as compared with left ventricular function. Therefore, there is an intense clinical need for a simple and reliable measure of the right ventricular function in patients with right-sided heart disease. Using this index, right ventricular function can be easily and non-invasively measured. This index appears to be superior to any other current measurements for the assessment of right ventricular function.

This index promises to be a sensitive indicator of 'global' right and left ventricular myocardial function in various myocardial diseases including ischemic heart disease, idiopathic cardiomyopathy and congenital heart disease.

Reference

1) Grossman W: Diastolic dysfunction and congestive heart failure. Circulation 1990; **81** : III-1–III-7
2) Weissler AM, Harris WS, Schoenfeld CD: Systolic time intervals in heart failure in man. Circulation 1968; **37** : 149–159