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THE STUDIES OF DIRECT TWO-DIMENSIONAL MEASUREMENTS, ANATOMICAL M-MODE METHOD, TISSUE VELOCITY IMAGING AND 2D SPECKLE TRACKING IMAGING TECHNOLOGY OF NORMAL MYOCARDIAL BIOMECHANICAL PARAMETERS AND THEIR RELATIONSHIP WITH CARDIAC FUNCTION

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Objectives To investigate the methods of direct two-dimensional measurements, Anatomical M-mode method, Tissue Velocity Imaging and 2D Speckle Tracking technology in normal subject myocardial biomechanical parameters and their relationship with cardiac function, and to find a relatively practical, fast, accurate con the cardiac function.

Methods To randomly select 40 healthy volunteers and to routinely measure the 2D and M-mode-dimensional parameters, and then to collect the dynamic images of apical four-chamber view, three-chamber view, two-chamber view and short axis the level of the mitral annulus, papillary muscle level, apical level for 5 consecutive cardiac cycles by Philips Sonos IE33 and GE Vivid 7 dimension color ultrasound diagnostic apparatus, to acquire the left ventricular biomechanical parameters including length, displacement, velocity, strain, strain rate, rotational angle, torsional angle of systolic and diastolic by using direct two-dimensional measurements, anatomical M-mode method, tissue velocity imaging technology and 2D speckle tracking technology respectively in real-time or off line

Results Direct two-dimensional measurement

The systolic longitudinal strain and longitudinal strain rate in different segments of the left ventricular in normal subject: inferior wall>posterior septal>anterior septal>posterior wall>anterior wall>lateral wall ($P>0.05$); The correlation coefficient between the systolic longitudinal strain, longitudinal strain rate and the LVEF is −0.523 and −0.550 separately. The systolic circumference strain and the circumference strain rate of the endocardial layer is much more than that in the epicardial layer obviously by the short axis view of the left ventricle ($p<0.01$). The systolic circumference strain and the circumference strain rate of the mitral valve level is much more than that of the papillary muscle level and apical level ($p<0.05$).

Anatomical M-mode method

The overall characteristic of the peak systolic radial strain and radial strain rate of the short axis in normal subject is that the free wall is greater than the septal, and there is statistics significance between the septal with inferior wall and posterior wall ($p<0.05$); The correlation coefficient between the systolic radial strain, radial strain rate and the LVEF is 0.533 and 0.495 separately. The overall characteristic of the peak diastolic radial strain and radial strain rate of the short axis in normal subject is the same that the free wall is greater than the septal, and there is statistics significance between the septal with posterior wall ($p<0.05$).

Tissue velocity imaging technology

Comparing with other segments in different wall: the systolic longitudinal strain of the apical segment is much less than the basal segment and the middle segment ($p<0.05$); The early diastolic longitudinal strain of the middle segment>the basal segment>the apical segment. The late diastolic longitudinal strain of the apical segment is less than that of the basal segment and the middle segment ($p<0.05$). The peak velocity of the cardiac cycle is significant decreasing from the basal segment to the apical segment. The correlation coefficient between the systolic longitudinal strain, longitudinal strain rate and the LVEF is −0.562 and −0.550 separately. The correlation coefficient between the diastolic longitudinal strain, longitudinal strain rate and the LV diastolic

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functional parameters E/Em is 0.303 and 0.291 separately. The correlation coefficient between the diastolic longitudinal strain, longitudinal strain rate and the Vp is 0.214 and 0.323 separately.

Two-dimensional speckle tracking technology

The systolic longitudinal strain of the entire segments in the long axis view of the left ventricular is increasing from the basal segment to the apical segment; there is no statistics significance in the peak systolic radial strain between different segments with the same level, but the peak systolic radial strain of the papillary muscle level is more than the mitral annulus level ($p<0.05$). The systolic circumference strain of the septal is more than that of the free wall, and there is statistics significance in some segments ($p<0.05$). The torsion of the left ventricular shows as clockwise at the base of the heart and as counterclockwise at the apex. The torsion of the global cardiac shows as counterclockwise in the cardiac cycle. The absolute value of the correlation coefficients between the systolic strain, strain rate, the left ventricular systolic torsion, the mitral annulus displacement and the LV systolic functional parameters are all more than 0.55.

Conclusions

1. Direct two-dimensional measurement not only can measure the circumference of the endocardial and epicardial layer of systolic and diastolic along short axis, but also can measure the length of the long axis, thus indirectly get the circumference strain and circumference strain rate, longitudinal strain and longitudinal strain rate; this method can be used in the General instrument.
2. Anatomical M-mode echocardiography can freely move M-mode sample line within 360°to the interest area without the limit of angle; this method is suitable for the patient with uncooperative position.
3. Tissue Doppler echocardiography can be used to quantitatively measure the myocardial velocity, acceleration, strain of the local wall directly; it is suitable for evaluating the movement feature of wall by the long axis.
4. The two-dimensional speckle tracking imaging technology can measure the myocardial strain and strain rate of local wall more accurately, and evaluate regional myocardial systolic and diastolic function; the correlation of the parameters and the LVEF measured by the traditional ultrasound method is good, but it require higher equipment

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