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To explore the differences of left ventricular regional systolic and diastolic function in different segments so as to find new parameters reflecting the blood supply status of myocardium, to assess immediate change of left ventricular regional systolic and diastolic function before and after PCI therapy in segments deficit with blood supply.**Methods:** 25 CAD patients (13 male, 12 female, average age is 59.84±10.37) were enrolled in our study. All the patients underwent coronary angiography and PCI therapy. Echocardiography: IE-33, Philips echo machine with X5-1 transducer was used. Patients were in left recumbent position and ECG was attached. Images of apical four, two-chambers and long-axis view were obtained. Clips were recorded in 3 consecutive heart beat. CMQ technique was performed 1 day before the PCI therapy and 2 days after the therapy. Data processing: The myocardial segments were classified into three groups, normal segments (stenosis ≤50%), confounding segments (50% < stenosis ≤70%) and ischemic segments (stenosis > 70%) according to the degree of supply vessel stenosis. The segmental systolic peak strain (Ss), the time to peak strain (T) and early diastolic peak velocity (Ve) were measured among the three groups before the PCI. Ss, T and Ve were also compared before and after PCI therapy in abnormal segments (ischemic segments and confounding segments).Software SPSS (version 16.0) was used for statistical analysis. All the results are expressed as mean±standard deviation (SD). Differences among three groups were tested by one-way ANOVA , and the differences of parameter before and after PCI surgery were done by Paird- t test. All tests were 2-sided and P <0.05 was considered significant.**Results:** General states:There are 419 segments with satisfactory image suitable to analyze, 175 normal segments, 59 confounding segments and 185 ischemic segments. Compared to normal segments, the absolute value of Ve decreased in confounding and ischemic segments ($p<0.05$), while there was a tendency for T to prolong in the latter two groups before PCI therapy. Compare to normal segment, Ss tends to increase in confounding segments, so it is also with ischemic group when comparing with confounding segments. But Ss is significantly increased in ischemic group than normal group($p<0.01$). Compared to pre- PCI period, there was no significant difference in Ss and Ve after PCI surgery ($p=0.917,0.822$), but T was significantly shortened after the PCI therapy in ischemic segments ($p=0.004$). **Conclusion:** CMQ(cardiac motion quantification) technique might be a promising tool to identify segments wall motion abnormality with different blood supply status and evaluate PCI therapy for better diagnosis and prognosis.

CMQ(cardiac motion quantification); CAD(coronary artery disease); PCI(percutaneous coronary intervention); LV(left ventricle); Ss(systolic strain); T(time to Ss-reflect regional systolic function); Ve(peak early diastolic velocity- reflect diastolic function)

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Ischemia is the basic pathophysiological change of coronary artery disease(CAD). Coronary artery disease (CAD; also atherosclerotic heart disease) is the result of the accumulation of atheromatous plaques within the walls of the coronary arteries that supply the myocardium (the muscle of the heart) with oxygen and nutrients. It is sometimes also called coronary heart disease

(CHD)[1]. CAD is the leading cause of death worldwide. Ischemic myocardium can be impaired in different ways as well as in different extents, including morphology, function, metabolism and etc. Left ventricular function and regional myocardial function have intimate relationship with the patient's prognosis. Therefore, quantitative assessment of the regional LV function accurately and sensitively may play an important clinical role, for it can show reliable evidences for the diagnosis, therapy and prognosis in CAD's patients[2]. The LV can be divided into segments which can be described on the basis of coronary artery territories. This allows the prediction of the artery involved when a regional wall motion abnormality is detected .At present, the study of regional ischemic myocardial function is still mainly focused on the abnormal wall motion, left ventricular contractile abnormalities can be an important manifestation of coronary artery disease. These wall motion changes may represent ischemia or infarction of myocardium. Quantifying the extent of regional wall motion abnormality may aid in determining the myocardial effects of coronary artery disease[3]. It would also simplify analysis of wall motion changes after diagnostic and therapeutic interventions and would permit comparison of different imaging techniques to assess their diagnostic accuracy. Over the last decades, echocardiography has developed to be an established non-invasive imaging technique, widely available for cardiovascular investigation[4]. Determination of myocardial function is vital for the clinical evaluation of cardiovascular diseases. Altered cardiac function can be detected with echocardiography as regional myocardial wall motion abnormalities, changes in left ventricular volumes and global left ventricular dysfunction[5].Over the last three decades Echocardiography has covered huge milestones to improve the diagnostic and therapeutic interventions beginning from simple 2-dimensional to 3D format that was first reported in 1960. More than a decade later, investigators began to obtain 3D ultrasound images of the heart, In the early 1990s, von Ramm and colleagues developed the first real-time 3D (RT3D) echocardiographic scanner, capable of acquiring volumetric data at frame rates sufficient to depict cardiac motion which were later developed into tissue-Doppler, strain rate imaging, magnetic resonance imaging and speckle tracking echocardiography to quantify the regional myocardial functions[6]. The echo community has put a lot of efforts in guidelines and standardization in left ventricular function assessment. The development of 3-D echocardiography has improved the reproducibility and accuracy to determine left ventricular regional functions and ejection fraction, compared with two dimensional echocardiography.

CMQ(cardiac motion quantification) is a new technique which may provide more information about the cardiac movement as well as the perfect tool for the assessment of LV regional functions[7]. Comparing with previously used techniques such as strain rate imaging (SRI) and velocity vector imaging (VVI), CMQ technique can trace the transmural myocardial motion instead of endocardiun, which is much more accurate and realistic. The software measures displacement of the different sections of the cardiac wall, and calculates velocity, strain and strain rate, in their radial and longitudinal or circumferential components[8]. Cardiac Motion Quantification (CMQ) increases the accuracy of LV function and wall motion measurement. It includes a suite of quantification methods based on speckle tracking or border detection technologies. The new CMQ speckle tracking algorithm makes strain analysis a useful tool in assessing presence and extent of LV disease. It includes multiple strain and strain rate parameters, including longitudinal strain. Motion estimation in echocardiography has been and continues to be an active area of research. Analysis of myocardial strain with echocardiography provides accurate and localized measures to evaluate regional myocardial functions.

Our study included 25 CAD patients (13 male, 12 female, average age is 59.84±10.37) of ischemic heart disease. We prospectively selected 25 consecutive patients with stable angina in whom elective PCI procedures were performed. All patients had stable clinical conditions. Although patients' screening was consecutive, recruitment was random according to the need for comprising a wide span of possible LV quantification values and including patients with a variety of regional wall motion abnormalities (apical, inferior, anterior, with LV aneurysm). All the patients were collected clinical history, including age, gender, height, weight, waist circumference, alcohol and tobacco history, coronary heart disease history, history of HTN, diabetes mellitus, history of dyslipidemia, arrhythmia history, medication history, family history, women asked the menstrual obstetrical history. All the patients gave informed consent before participation in the stud who were then examined with CMQ technique between December 2010 and April 2012 in the echocardiographic department of Cardiac Medicine in Shandong Qilu hospital, Jinan China. The protocol was followed according to the rules of the local medical ethics committee, and informed consent was obtained from all patients before the procedure. All patients underwent standard left heart catheterization and coronary angiography via the radial or femoral approach. Coronary angiograms were obtained after the administration of intracoronary nitroglycerin just before and immediately after PCI.

CMQ technique was performed 1 day before the PCI therapy and 2 days after the therapy. IE-33, Philips echo machine was

used and X5-1 transducer were used, the patients were in left recumbent position and ECG were attached. All patients had indication of Ischemic disease and were classified according to their myocardial status into three segments before treatment. normal segments (stenosis ≤50%), confounding segments (50% < stenosis ≤70%) and ischemic segments (stenosis > 70%) according to the degree of supply vessel stenosis. The segmental systolic peak strain (Ss), the time to peak strain (T) and early diastolic peak velocity (Ve) were measured among the three groups before and after the PCI[8]. Regional function evaluation of the left ventricle (LV) performed analyzing the motion of a predefined set of ventricle segments. LV was divided into 17 segments following the recommendations of the American Society of Echocardiography , based on the coronary arteries that irrigate each segment. Then system plotted time curves of the different parameters, data were also provide in tables automatically. Curve values and tables were displayed and saved for later processing. Software SPSS (version 16.0) was used for statistical analysis. All the results are expressed as mean±standard deviation (SD). Differences among three groups were tested by one-way ANOVA , and the differences of parameter before and after PCI surgery were done by Paird- ttest. All tests were 2-sided and P <0.05 was considered significant.

There are 419 segments with satisfactory image suitable to analyze, 175 normal segments, 59 confounding segments and 185 ischemic segments. To evaluate the left ventricular regional functions all these segments were compared among three parameters respectively before and after PCI that are Ss, T, Ve .To evaluate the left ventricular regional functions all these segments were compared among three parameters respectively before and after PCI that are Ss ,T and Ve. Group 1,2 and 3 refers to ischemic , confounding and normal, As Group 3 is a normal group so we counted it as a control group for to compare with the remaining two groups which were ischemic and confounding .Compared to normal segments, the absolute value of Ve decreased in confounding and ischemic segments ($p<0.05$), while there was a tendency for T to prolong in the latter two groups before PCI therapy. Compare to normal segment, Ss tends to increase in confounding segments, so it is also with ischemic group when comparing with confounding segments. But Ss is significantly increased in ischemic group than normal group($p<0.01$). Compared to pre- PCI period, there was no difference in Ss and Ve after PCI surgery ($p=0.917,0.822$), but T was significantly shortened after the PCI therapy in ischemic segments ($p=0.004$).

In the present study, we validated a novel method for rapid assessment of LVEF using WMSI(wall motion score index). Our method is based on the concept that each segment of the LV contributes to systolic LV cavity reduction, and therefore to global EF, and does not rely on LV volumes estimation. Accuracy of WMSI method was satisfactory when compared with real-

Table1 Description of left ventricular regional functions

Characteristics	Goup1(n=185)	Group2(n=59)	Group3(n=175)
Ss	-12.81319±7.85107	-14.0717±7.65966	-16.3913±8.71171*
T	4.702± 91.32982	3.797± 95.02273	3.883± 89.99528*†
Ve	-2.4025± 1.450383	-2.52032± 1.450383	-3.34667± 2.045355*

The groups values what we commonly see as Mean±SD *P <0.05 versus group †P<0.05 versus group2

Table2 Description of Ss and T and Ve for abnormal groups pre- and post- PCI

Characteristics	Pre-PCI(n=211)	Post-PCI(n=211)	P value
Ss	-12.9225± 7.62765	-12.8612± 7.9448	0.917
T	411± 90.6024	386± 102.206	0.004
Ve	-2.48± 1.4507	-2.57± 1.4662	0.822

This table also shows the difference of the index pre- and post- PCI, this was done by paired T test.

time 3D method (i.e. reliability of WMSI method).A variety of quantitative techniques for the evaluation of global and regional LV function have been used in an attempt to overcome the subjective nature of visual interpretation of LV dynamics. RWM has been commonly assessed using Tissue Doppler imaging, which is limited by its angle dependence. Recently, STE, which is angle-independent, has been found useful in quantifying regional LV function, using parameters such as myocardial strain and LV motion patterns ,and dyssynchrony [9]. However, 2D-STE is intrinsically limited by its 2D nature, because it can only track motion occurring within the imaging plane, This inability affects the accuracy of the displacement vector estimates and thus of the derived indices of RWM. the new 3D-STE technique is sensitive enough to: (1) quantify differences in motion patterns between different LV levels, which, unlike the 2D-STE methodology, can be assessed by analyzing a single dataset; and (2) accurately separate normal and abnormal segments using multiple quantitative indices. Two limitations of the 3D-STE technique are the relatively low temporal and spatial resolution, both affecting the accuracy of endocardial tracking and leading to suboptimal

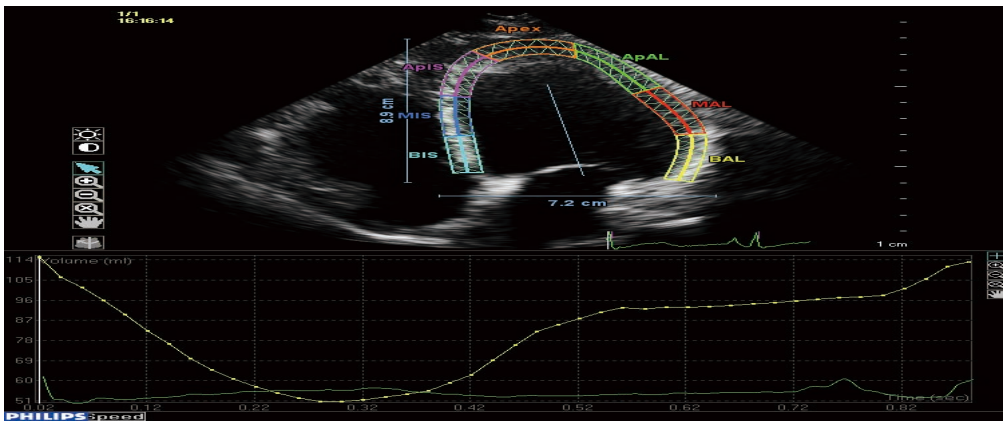

Fig.1 show left ventricular segmentation

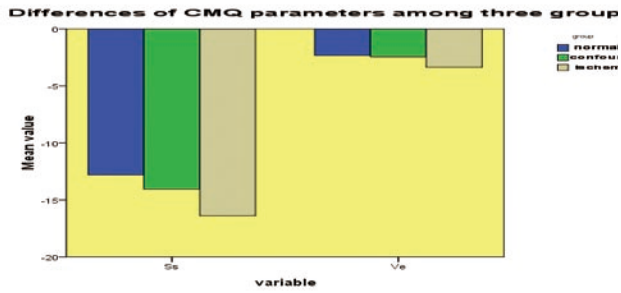

Fig.2 shows the differences of CMQ parameters (Ss,Ve)among different groups which are normal,ishemic and confounding groups

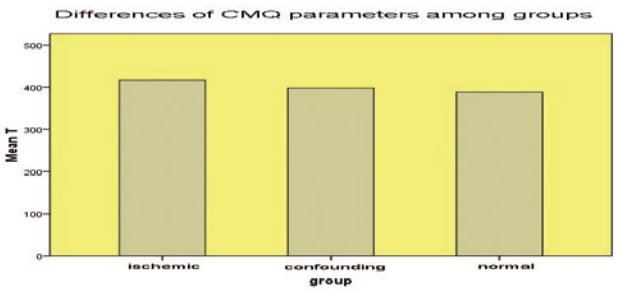

Fig.3 This figure compares the difference of CMQ parameter (Mean T) among three different groups

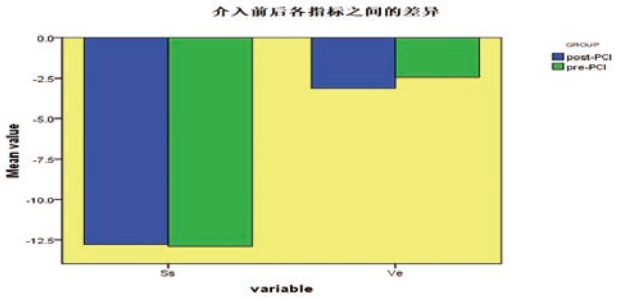

Fig.4 This figure compares the CMQ parameters (Ss,Ve) differences before and after PCI.

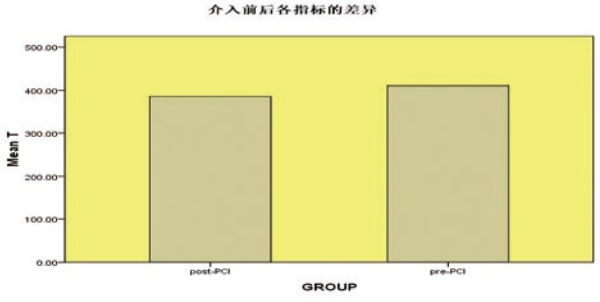

Fig.5 manifests Mean T value difference among different groups before and after PCI.

results in a considerable proportion of segments. Since the 1970s, echocardiography has been used for the evaluation of LV regional wall motion during infarction and ischemia. It is recognized that echocardiography can overestimate the amount of ischemic or infarcted myocardium, as wall motion of adjacent regions may be affected by tethering, disturbance of regional loading conditions, and stunning. Therefore, wall thickening and motion should be considered. Moreover, it should be remembered that regional wall motion abnormalities may occur in the absence of coronary artery disease. It is recommended that each segment should be analyzed individually and scored on the basis of its motion and systolic thickening. During the last decades, echocardiographic methods and techniques have improved and expanded dramatically. The golden standard method as we use in our present study to measure the regional functions of the heart by applying wall motion scoring index is CMQ technique. according to this technique Myocardial motion is computed using a frame to frame non-rigid registration technique on the whole sequence.

CMQ(cardiac motion quantification) technique is an excellent method to explore the differences of left ventricular regional systolic and diastolic function in different segments so as to find new parameters reflecting the blood supply status of myocardium and to assess immediate change of left ventricular regional systolic and diastolic function before and after PCI therapy in segments deficit with blood supply. so CMQ(cardiac motion quantification) technique might be a promising tool to identify the wall motion abnormalities in ischemic patients especially coronary artery diseased patients[7] .Thus CMQ appears to be an excellent tool for making early and better diagnosis by predicting the different extents of artery occlusion and ischemic staging.It can help in better screening and early diagnosis coronary heart disease that can lead to early and better treatment with good prognosis.

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