

THE EFFECT OF SUCCESSFUL ELECTIVE PERCUTANEOUS CORONARY INTERVENTION ON LEFT VENTRICULAR FUNCTIONS ASSESSED WITH TISSUE DOPPLER IMAGING METHOD

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Perkütan koroner girişim (PKG) ile reperfüzyon sağlanması sistolik ve diyastolik fonksiyonları düzeltebilmektedir. Doku Doppler inceleme (DDİ) ile sol ventrikülün bölgesel sistolik ve diyastolik fonksiyonu kantitatif olarak değerlendirilebilmektedir. Bu çalışmada koroner arter hastalığı olan hastalarda iskeminin miyokardiyal fonksiyonlar üzerine yaptığı etkilerin DDİ ile değerlendirilmesi ve başarılı PKG'nin bu fonksiyonlar üzerine etkilerinin araştırılması amaçlandı.

Çalışmaya başarılı elektif PKG yapılan 41 hasta (29 erkek, 12 kadın, yaş ort: 56.0±7.3) alındı. Hastalar PKG yapılan arterin lokalizasyonuna göre 3 gruba ayrıldı: Sol ön inen koroner arter (Grup 1), sirkumfleks koroner arter (Grup 2) ve sağ koroner arter (Grup 3). Tüm hastalar rutin ekokardiyografik inceleme ve DDİ ile değerlendirildi. Ekokardiyografik incelemeler PKG'den hemen önce, PKG'den 24 saat sonra ve 3 ay sonra yapıldı.

INTRODUCTION

Regional wall motion abnormalities are frequently seen in coronary artery disease (CAD) and diastolic function is impaired before systolic dysfunction in these patients^{1,2,3}. Reperfusion with percutaneous coronary intervention (PCI) has been shown to improve the left ventricular systolic and diastolic functions^{4,5}. However, duration of recovery period after the PCI is incompatible^{5,6,7,8}. Changes in regional ventricular functions may appear before alteration of global ventricular functions in CAD. Hence, evaluation of regional systolic and diastolic functions is important for early diagnosis⁵. Tissue Doppler imaging (TDI) is a new technique that allows assessing quantitatively the global and regional ventricular systolic and diastolic function.

The aim of the present study was to determine the effects of elective and successful PCI on left ventricu-

lar functions by using TDI method.

PKG sonrası 24. saat ve 3. ayda global sistolik ve global diyastolik fonksiyonda değişme saptanmadı. PKG sonrası 24. saatte yalnızca Grup 1 hastalarda bölgesel S dalga hızında anlamlı artış saptandı (p=0.004). PKG sonrası 3. ayda ise tüm gruplarda S dalgasında artış eğilimi olmasına rağmen başlangıca göre anlamlı artış saptanmadı (p>0.05). Bölgesel diyastolik fonksiyonlarda 24. saatte hiçbir grupta düzelme olmazken 3. ayda Grup 1 ve Grup 2 hastalarında düzelme gözlemlendi.

Elektif başarılı PKG'de 3 ay sonra yalnızca bölgesel diyastolik fonksiyonlar düzeltilmektedir. Global sistolik ve diyastolik fonksiyonlar ve bölgesel sistolik fonksiyon 3. ayda değişmemektedir.

Anahtar Kelimeler: Perkütan koroner girişim, Doku Doppler, Sol ventrikül fonksiyonu

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METHODS

Patients: Forty-one patients (29 male, 12 female, mean age: 56.0±7.3) who underwent elective PCI for one major coronary artery in our institution were included into the study. Patients with any of following criteria were excluded from the study: hypertrophic, restrictive and dilated cardiomyopathy, atrial fibrillation, previous coronary revascularization, valvular heart disease, congenital heart disease, moderate or severe left ventricular systolic dysfunction (ejection fraction < 40%). Written informed consent was obtained from all patients and Local Ethical Committee approved the study.

Patients were divided into three groups according to coronary artery PCI performed; Group 1 (left anterior descending artery, n=13), Group 2 (circumflex artery, n=14) and Group 3 (right coronary artery, n=14).

Echocardiography: Routine echocardiographic examinations and TDI were performed with Acuson Sequoia C 256 (Mountain View, California) ultrasono-

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Table 1: Demographic characteristics of patients

	Group 1	Group 2	Group 3
Age (years)	58.5±7.1	53.5±4.6	56.2±9.0
Sex (M/F)	7/6	11/3	11/3
Hypertension (%)	5 (38.5)	3 (21.4)	5 (35.7)
Diabetes mellitus (%)	0 (0.0)	3 (21.4)	2 (14.3)
Smoking (%)	4 (30.8)	7 (50.0)	8 (57.1)
Family history (%)	4 (30.8)	3 (21.4)	5 (35.7)
Hypercholesterolemia (%)	4 (30.8)	7 (50.0)	8 (57.1)
Previous myocardial infarction (%)	3 (23.1)	5 (35.7)	6 (42.9)
Body mass index (g/m ²)	28.3±3.0	26.3±3.4	27.8±2.3

graph in all patients. All echocardiographic examinations were done before PCI and 24th hour and 3rd month after PCI.

Routine echocardiographic examinations: Echocardiographic techniques and calculations of cardiac dimensions were performed in accordance with the recommendations of The American Society of Echocardiography⁹. Left ventricular ejection fraction (EF) was calculated by using modified Simpson's technique.

Left ventricular transmitral filling velocities at the tips of the mitral valve leaflets were recorded from the apical four chamber view by using pulsed wave Doppler echocardiography (PWD). Peak transmitral early diastolic flow velocity (Em wave), peak transmitral late diastolic flow velocity (Am wave), deceleration time (DT) and isovolumic relaxation time (IVRT) were measured.

Tissue Doppler Imaging: Tissue Doppler imaging was performed in the apical 4-chamber view, apical 2-chamber view and parasternal long axis. A Doppler velocity range of -20 to 20 cm/s was selected. Pulsed wave TDI sample volume was placed in 16 segments. Three major velocities were recorded: peak myocardial systolic (S wave), peak myocardial early diastolic (E wave) and peak myocardial late diastolic (A wave) velocities. The peak systolic and diastolic velocities were measured at a sweep speed of 50 mm/s.

Evaluated segments in Group 1 patients were mid septum, apical septum, basal anterior septum, mid anterior septum, basal anterior, mid anterior and apical anterior myocardial segments; those in Group 2 patients were basal lateral, mid lateral and basal posterior myocardial segments; those in Group 3 patients were basal septum, basal inferior, mid inferior and apical inferior myocardial segments.

Percutaneous coronary intervention (PCI): General Electric Medical System, Advantix LC DX HILINE, (1994, BUC, Fransa) was used for balloon angioplasty and coronary stenting according to the stan-

dard technique, as previously described¹⁰. The procedure was considered successful if the residual stenosis in the target lesion was less than 30% and major complication did not occur after PCI. Coronary stenting was done in 26 patients due to suboptimal dilatation or coronary dissection.

Statistical analysis: All calculations were performed with Statistical Package for the Social Sciences 10.0 (SPSS 10.0) program. Continuous variables between groups were compared with the one-way ANOVA test. Categorical variables were tested with the chisquare test. For continuous variables, comparisons between baseline and follow-up were performed with paired samples t test. A value of p <0.05 was considered to be statistically significant.

RESULTS

Clinical characteristics: PCI was successful in all patients and any major complication did not occurred in hospital period. TIMI 3 flow was obtained in all patients. PCI was performed left anterior descending artery (LAD) in 13 patients, circumflex artery (CX) in 14 patients and right coronary artery (RCA) in 14 patients. Three patients in Group 1, 5 patients in Group 2 and 6 patients in Group 3 had previous myocardial infarction. Demographic variables of groups were similar (Table 1).

Echocardiographic findings: According to baseline, we did not observe any significant changes in cardiac chamber dimensions, ejection fraction and mitral flow PWD variables at 24th hour and 3rd month follow-up in all groups (Table 2).

In Group 1, S wave velocity were significantly increased (p=0.004), E and A wave velocities were not changed at 24th hour. A wave velocity were significantly reduced (p=0.02), but there were no significant changes in S and E wave velocities at 3rd month in Group 1 patients (Table 3).

In Group 2, there was no alteration in S, E and A wave velocities at 24th hour. Both E and A wave velocities were reduced at 3rd month in Group 2.

Table 2: M-Mode and mitral flow PW Doppler parameters of groups

Groups	Baseline	24 th hours	3 rd month
ESD	2.9±0.6	3.0±0.4	2.9±0.6
EDD	4.6±0.7	4.7±0.6	4.9±0.7
EF	65.4±5.5	65.6±4.3	68.9±8.8
Em	0.70±0.20	0.72±0.16	0.73±0.12
Am	0.67±0.24	0.66±0.15	0.65±0.13
DT	211.0±39.7	218.9±61.3	205.2±33.0
IVRT	94.9±17.9	95.8±56.3	89.5±22.0
ESD	3.3±0.8	3.1±0.7	3.3±1.1
EDD	5.0±0.7	4.9±0.6	5.1±0.9
EF	64.2±11.4	67.6±10.2	64.0±14.2
Em	0.67±0.17	0.67±0.19	0.63±0.18
Am	0.74±0.19	0.71±0.13	0.78±0.24
DT	211.6±54.3	219.1±44.4	202.9±76.2
IVRT	103.8±37.3	97.6±32.3	106.0±42.1
ESD	3.1±0.3	3.1±0.3	3.1±0.2
EDD	5.0±0.3	4.9±0.3	5.2±0.4
EF	68.5±3.9	67.2±5.3	68.9±2.4
Em	0.66±0.12	0.65±0.19	0.67±0.09
Am	0.73±0.12	0.72±0.13	0.73±0.11
DT	236.6±74.3	227.8±72.3	229.4±43.8
IVRT	114.1±17.8	98.4±26.9	95.6±22.7

ESD: Left ventricular endsystolic diameter, EDD: Left ventricular enddiastolic diameter, EF: Ejection fraction, Em: Peak transmitral early diastolic flow velocity, Am: Peak transmitral late diastolic flow velocity, DT: Deceleration time and IVRT: Isovolumic relaxation time.

In Group 3, there were no significant changes in S, E and A wave velocities at both 24th hour and 3rd month.

DISCUSSION

Ejection fraction is the most important predictor of survival in patients with CAD and reperfusion may improve survival with protection of EF^{4,6,11}. Ischemia has two diverse effects on viable myocardial tissue; hibernating and stunning. Revascularization or optimal anti-ischemic treatment improves the contractility in hibernating myocardial tissue, whereas those may improve contractility days to months later in stunning myocardium. Recovery period in stunning myocardium depends on previous myocardial reserve, heart rate, duration of restoring blood flow and a lot of unknown factors^{11,12,13}. For this reason, different results have been reported about recovery period in EF after the PCI in previous studies^{4,6,14,15}. Schmidt et al¹⁵. reported that improvement of left ventricular systolic function with PCI may be established after 3 days to 6 months. We observed non-significant propensity of increase in EF at 24th hour and 3rd month follow-up with successful PCI. Failing the improvement of EF at 3rd month may depend on stunning myocardium or silent restenosis in our

study.

It has been previously established that diastolic function is impaired before systolic dysfunction in patients with CAD^{1,2,3}. Improvement of compliance may indicate reduction of myocardial ischemia after the PCI, but this improvement arises in late period, not early^{16,17,18}. We could not establish significant changes in global diastolic function at both 24th hour and 3rd month follow-up.

Wall motion abnormality is one of the most important markers of myocardial ischemia. Both global and regional left ventricular systolic and diastolic functions may impair during ischemia^{1,2,3,16}. It is known that reperfusion with PCI or coronary artery by-pass surgery can improve regional systolic and diastolic functions^{4,5}. Pulsed wave TDI is a new technique that allows assessing quantitatively the global and regional ventricular systolic and diastolic function^{20,21,22}. It has been shown that myocardial velocities reduce, even it is nearly 0 mm/s, during PCI and myocardial velocities increase over the basal value early period after the PCI^{5,22}. Although there are several studies which investigate the changes in regional myocardial velocities with TDI in early period after PCI, only a few studies has researched those in late period^{15,6,22}. Strotman et al⁵.

Table 2: Tissue Doppler imaging variables of patients

Groups	Baseline	24 th hours	P*	3 rd month	P**
S	109.2±21.8	130.0±25.1	0.004	118.5±17.0	0.1
E	116.3±25.5	116.8±15.0	0.9	122.2±15.2	0.4
A	132.4±22.9	131.8±21.6	0.9	117.5±20.6	0.02
S	119.6±26.6	119.1±32.4	0.9	130.3±33.9	0.2
E	129.8±32.9	143.4±33.0	0.09	148.9±45.9	0.03
A	137.8±31.2	134.3±31.6	0.7	118.6±26.6	0.03
S	94.3±13.8	104.6±30.0	0.3	100.4±12.4	0.2
E	104.8±13.6	98.3±20.2	0.3	111.8±12.9	0.1
A	133.3±18.7	148.4±40.6	0.1	126.0±15.4	0.2

S: Peak myocardial systolic velocity, E: Peak myocardial early diastolic velocity, A: Peak myocardial late diastolic P* = Baseline vs. 24th hours, P ** = Baseline vs. 3rd month

detected a significant increase in regional myocardial systolic velocity at after PCI 24th hour in CAD patients with critical stenosis. They also reported that regional myocardial systolic velocity had propensity of reduction in 3rd month in those patients. We observed improvement in regional myocardial systolic velocity at 24th hour only in Group 1 patients. The benefit at 24th hour was not shown at 3rd month in that group. We did not detect significant increase in regional myocardial systolic velocity at 3rd month in all groups, but there were propensity of increase in those as compared basal values. There was no routine angiographic control in our study protocol at 3rd month. Hence, we could not evaluate the early restenosis at 3rd month. In addition, restoring TIMI-3 flow with PCI not always provide adequate perfusion in tissue level. The most important reasons of impaired reperfusion after successful PCI are microvascular spasm, distal embolisation, insitu thrombosis and stunning myocardium¹².

Previously, regional diastolic function could not be evaluated quantitatively^{5,23,24,25}. Pulsed wave TDI is a new and reliable technique that allows assessing quantitatively the regional ventricular diastolic function. Regional diastolic function is impaired before electrocardiographic evidence of ischemia or angina pectoris during acute ischemia^{2,23,24}. Derumeaux et al²². reported that regional diastolic function is impaired during PCI and improves after PCI. Although there are several studies which investigate to changes in regional diastolic function in early period after PCI^{18,19,22}, we could not any study which researched those in late period after PCI in literature. We detect impairment in regional diastolic function in both Group 1 and 2 at 3rd month. But we could not observe any impairment in regional diastolic function, like regional systolic function, in Group 3. Forty-three

percent of Group 3 patients had previous myocardial infarction. Hence, stunning may play an important role in inadequate response to successful PCI in Group 3.

CONCLUSION

Only regional diastolic function is improved at 3rd month after elective and successful PCI. Global systolic and diastolic functions and regional systolic function are not changed at 3rd month.

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