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Effect of cardiac rehabilitation on left atrial functions in patients with acute myocardial infarction

Évaluation des effets de la réadaptation cardiaque sur le fonctionnement de l'oreillette gauche dans des cas d'infarctus aigu du myocarde

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Abstract

Background. – The objective of this study was to analyze the effects of cardiac rehabilitation (CR) on the atrial function of patients with acute myocardial infarction (AMI) who had been successfully revascularized through percutaneous coronary intervention (PCI).
Methods. – Forty-two AMI patients having undergone CR were enrolled in this observational study. Assessments were performed before and after 6 weeks of CR. Left atrial strain analysis was carried out by two-dimensional speckle tracking echocardiography. Left ventricular ejection fraction (LVEF) was measured by the biplane Simpson's method. Pulsed-wave Doppler at the tip of mitral valve leaflets enabled us to measure early (E) and late (A) diastolic filling velocities, deceleration time (DT) of early filling velocity and isovolumic relaxation time (IVRT). Left ventricle tissue velocity was measured by tissue Doppler imaging of the lateral mitral annulus (e') and E/e' was subsequently calculated. Ratio of E/e' to left atrium (LA) peak strain was used to estimate LA stiffness.
Results. – Following CR, LVEF ($P = 0.010$), LA strain ($P < 0.001$) and LA stiffness ($P = 0.013$) all showed improvement, while other parameters remained unchanged.
Conclusion. – Post-AMI cardiac rehabilitation and revascularization by PCI might have favourable effects on LA function.

Keywords: Cardiac rehabilitation; Left atrium; Diastolic function; Acute myocardial infarction

Résumé

Objectif. – Le but de cette étude consistait à observer les effets de la réadaptation cardiaque (RC) sur le fonctionnement de l'oreillette de patients victimes d'un infarctus aigu du myocarde (IAM) qui avaient été revascularisés avec succès à l'aide d'une intervention coronarienne percutanée (ICP).
Méthodes. – Quarante-deux patients victimes d'un IAM et bénéficiant de la RC ont participé à l'étude. L'analyse de la déformation (*strain*) de l'oreillette gauche a été effectuée par l'échocardiographie bidimensionnelle du *speckle tracking* (suivi du déplacement spatial des marqueurs acoustiques naturels). La fraction d'éjection ventriculaire gauche (FEVG) a été mesurée en utilisant la méthode de Simpson biplan. Le Doppler pulsé aux extrémités des valves de valvule mitrale nous a permis de mesurer les vitesses de remplissage diastolique précoce (P) et tardif (T), le temps de décélération (TD) de la vitesse de remplissage précoce et le temps de relaxation isovolumique (TRIV). La vélocité du tissu du ventricule gauche (VG) a été mesurée par l'imagerie Doppler tissulaire de l'anneau mitral latéral (e') et le ratio E/e' a été calculé. Le calcul du ratio E/e' par rapport à la déformation maximale de l'oreillette gauche (OG) a permis d'estimer la rigidité de l'OG ($\text{Rigidité}_{\text{déformation}}$).
Résultats. – Il y avait des différences significatives dans les mesures de fraction d'éjection (FE), dont une nette amélioration a été observée ($p = 0.010$) suite à la RC. Le volume du VG, par contre, est resté inchangé ($p = 0.091$). Quant à la déformation de l'OG, la RC a apporté une amélioration significative ($p = 0.000$). Bien qu'il n'y eût pas de changement significatif dans le ratio E/e', une diminution significative de la rigidité de l'OG a été observée ($p = 0.013$). Enfin, la RC n'apportait pas de modification du temps de décélération (TD) ou du temps de relaxation isovolumique (TRIV).

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Conclusion. – La réadaptation cardiaque suite à un infarctus du myocarde à la phase aiguë et la revascularisation par ICP peuvent influer favorablement sur le fonctionnement de l'oreillette gauche. En fonction de cette réadaptation, la réduction des anomalies de l'OG est également susceptible de réduire la tachyarythmie atriale et, a fortiori, de faire baisser les taux de mortalité toutes causes confondues.

Mots clés : Réadaptation cardiaque ; Oreillette gauche ; Fonction diastolique ; Infarctus aigu du myocarde

1. English version

1.1. Introduction

Atherosclerotic cardiovascular disease (CVD) is now the leading cause of death worldwide; it is on the rise and has become a true pandemic that respects no borders [21]. CVD was responsible for 42% of all deaths below 75 years of age in European women and for 38% of all deaths at 75 years in men [7]. Results from the Multinational MONItoring of trends and determinants in CArdiovascular disease (MONICA) project indicated a heterogeneous trend in CVD incidence in the 1980s to the 1990s in Europe [25]. However, results from recent reports do suggest that mortality and morbidity from CVD is levelling, especially in younger adults [8,27].

There is overwhelming evidence that comprehensive cardiac rehabilitation (CR) is associated with a reduction in both cardiac mortality (26–36%) and total mortality (13–26%) [13]. CR is also associated with a reduction in morbidity, namely recurrent myocardial infarction and a 28–56% reduction in costly unplanned readmissions [3,4,12]. CR improves functional capacity and perceived quality of life whilst also supporting early return to work and the development of self-management skills [29]. These benefits make CR one of the most clinically and cost-effective therapeutic interventions in cardiovascular disease management [16–18,26].

Atrial fibrillation (AF) is the most common arrhythmia treated in clinical practice and approximately 33% of arrhythmia related hospitalizations are for AF. It is associated with a five-fold increase in the risk of stroke and two-fold increase in the risk of all cause of mortality [14]. Patients with left atrial abnormalities have a higher paroxysmal atrial tachyarrhythmias incidence than normal, including AF [5]. Because the left atrium (LA) size or volume is a powerful predictor of cardiovascular outcomes, it can be used as a biomarker in various cardiac diseases [2,24].

Atrial infarction can be seen in up to 10% of patients with acute myocardial infarction and it is frequently accompanied by atrial arrhythmias [23]. Electrical remodelling of the atria appears to be a key determinant for maintenance of atrial tachyarrhythmias. Normal LA function is important in maintaining adequate cardiac performance.

The aim of this study was to observe the effect of CR on the left atrial function of patients with acute myocardial infarction (AMI) and successfully revascularized by percutaneous coronary intervention (PCI) which predicts the risk of atrial arrhythmias, therefore, cardiovascular outcomes.

1.2. Study design

The lower-risk patients following an AMI were enrolled this study. Individuals with AMI and successfully revascularized by PCI participated in CR program four weeks after the event. Echocardiography was performed to all patients before and after CR. The high risk individuals have: exercise test limited to less than 5 metabolic equivalents (METs), marked exercise-induced ischemia, severely depressed left ventricular (LV) function (ejection fraction [EF] less than 30%), decrease in systolic blood pressure of greater than 15 mmHg with exercise, survivor of sudden cardiac arrest, patients with severe ventricular arrhythmias and uncontrolled supraventricular arrhythmias, patients with devices such as pacemakers and defibrillators, patients with unstable concomitant medical problems such as diabetes prone to hypoglycemia were not included in the study.

Every attempt was made to recognize the potential effects of the factors: age, precardiac event, physical capacity, LV dysfunction, residual myocardial ischemia, skeletal muscle performance, non-cardiac illness, autonomic function such as diabetic neuropathy, peripheral vascular status, pulmonary status, other systemic illnesses, especially orthopedic problems limiting flexibility and locomotion on functional capacity in order to minimize risk of the individualized reconditioning program.

This study complied with the Declaration of Helsinki, was approved by the ethics committee of the Kartal Kosuyolu Education and Research Hospital, and each patient gave written consent before CR.

1.3. Cardiac rehabilitation

Exercise training is the principal component of CR, since it results in increased peak exercise capacity, which is usually expressed in METs (metabolic equivalents). CR programme was performed to the participants with an integrated multidisciplinary team consisting of qualified and competent practitioners, led by a clinical coordinator. Phase 2 of a cardiac rehabilitation program was initiated based on the result of the exercise testing, and the exercise prescription was individualized. The minimum frequency for exercising to improve cardiovascular fitness was 5 times weekly during the 6 weeks. Patients allowed 30–60 minutes for each session, which includes a warm-up of at least 10 minutes. The final 10 minutes of cool-down period involved muscular stretching. The cool-down period is very important. Gradual cool-down prevents ventricular arrhythmias, which may