Efficacy of Telecardiology in improving the results of Cardiac Rehabilitation after acute myocardial infarction

Efficacia della Telecardiologia nel migliorare i risultati della Riabilitazione Cardiologica dopo IMA

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Background: This study was addressed to verify if Telecardiology (TC) improves the results of Cardiac Rehabilitation in patients following a home-based Cardiac Rehabilitation Program (CRP) after acute myocardial infarction (AMI).

Materials and Methods: We studied three groups of patients after AMI: Group A (control group): 15 patients, who followed a standard in-hospital CRP of 3 weekly sessions of 2 months duration; Group B (study group): 15 patients, who were enrolled in a home-based CRP of similar duration and were monitored by TC with the aid of an ecg-device (Sorin Life Watch CG 6106); Group C (second control group): 15 patients, who followed a home-based CRP without ecg-monitoring by TC. All patients performed a symptom-limitted exercise testing at the beginning of the CRP. Psychometric data (STAI-Y1, STAI-Y2, BDI) were also evaluated. At the end of the CRP all patients underwent repeated exercise testing and psychometric evaluation.

Results: TC applied to the home-based CRP was associated with a good compliance to the program. Compared to Group C, in Group B we observed an increase of maximal heart rate, exercise duration, maximal work-load, and an improvement of anxiety, a trend to reduction of depression, and an improvement of quality of life. These results were very similar to Group A patients following a hospital-based CRP. Conclusions: TC improves compliance, functional capacity and psychological profile of patients undergoing a home-based CRP, compared to patients enrolled in a home-based CRP without ecg-monitoring by Telecardiology.

Keywords: cardiac rehabilitation, telecardiology, myocardial infarction.


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Introduction

Comprehensive Cardiac Rehabilitation includes a series of interventions aimed at improving functional recovery and quality of life after acute myocardial infarction (AMI) [1-4]. Several studies have shown that a comprehensive program of Cardiac Rehabilitation (CR), that includes physical training, psychological intervention, behavioural and pharmacological interventions impacting on risk factors for atherosclerosis (stop-smoking, control of hypertension and diabetes, reducing LDL cholesterol) is successful in reducing mortality and morbidity after AMI, and also in improving functional capacity, psychological profile and quality of life [5-9]. The ideal length of the program should be at least 8 weeks, with subsequent follow up. One of the main problems of CR is, however, the difficulty of its application to the whole population of AMI, often due to logistic problems impeding the patient to reach the hospital to follow a 8 week outpatient program under cardiological supervision. These patients often continue at home an exercise program given at discharge, but, due to few contacts with the referring hospital, lose the beneficial effects of CR at medium-long term. Telecardiology may at least in part reduce these logistic problems through the utilization of devices, nowadays widely applied in several areas of cardiology, allowing patients to maintain contact and feedback with the referring hospital even at home [10-13]. The aim of this study was to assess the efficacy of telecardiology in improving adhesion to exercise prescription, functional capacity and psychological profile of patients following a home-based Cardiac Rehabilitation Program (CRP) after AMI.

Materials and Methods

Patient population

Patient population was composed of 45 patients, subdivided in three subgroups, who were similar in...
demographic characteristics and clinical presentation (table 1). All patients had survived a recent AMI within the last 8 days. We excluded patients with heart failure, residual myocardial ischemia, severe ventricular arrhythmias, atrial fibrillation, disability or cognitive compromise. Patients were subdivided in 3 subgroups: group A (control group): 15 patients, who followed a standard in-hospital 8-weeks CRP with 3 weekly sessions, monitored by a cardiologist; Group B (study group): 15 patients, who couldn’t follow an in-hospital CRP because of logistic problems, and were enrolled in a 8-weeks home-based CRP with telecardiology monitoring; Group C (second control group): 15 patients who also couldn’t follow a hospital-based CRP, and who followed a home-based CRP without ecg-monitoring by telecardiology. Group B and C were enrolled if they had a cyclette available at home.

Study Protocol

Before initiating CRP all patients underwent clinical examination, routine non invasive cardiologic tests and a symptom-limited exercise test. At the beginning of the CRP they also filled a questionnaire to evaluate their psychological status: anxiety through STAI-Y1 (State anxiety) and STAI-Y2 (trait scale of anxiety inventory), depression through BDI (Beck Depression Inventory) and quality of life through MOS/SF-36 (Medical Outcomes Study 36-Item Short-Form Health Survey). Standard CRP included exercise training, functional and prognostic evaluation, risk factors assessment, educational and behavioural intervention, pharmacologic control, as indicated in the International Guidelines [1]. The exercise program followed by group A patients consisted in 3 weekly out-patient sessions of 30 min cycling at a work load of 75% of peak heart rate (HR) reached at exercise stress test performed before the onset of exercise training. Patients of group B and C received instructions to follow a home based training similar to that followed in hospital by group A patients. They were instructed to exercise 3 times/week for 30 min on their cyclette at home, and were instructed to measure their HR to achieve the target HR (about 75% of peak HR achieved at baseline exercise stress test). A simple recording-transmitting ecg-device (Sorin Life Watch CG 6106) was given to Group B patients. Thanks to this system it was possible to monitorize the ecg of patients during home-based exercise program. This device was connected to the body with electrodes and allowed ecg recording at baseline and during exercises. Thereafter, the ecg was transmitted to a Call Center by home-telephone and subsequently sent to our Center by e-mail in a few minutes time. The training sessions were performed in days and hours predetermined and agreed with each patient. Patients were seen after two months, at the end of the exercise program, for re-evaluation of clinical state, and for repetition of psychometric evaluation and of a symptom-limited exercise testing.

Results

No patient of Group B was lost at follow-up, while in groups A and C we lost two patients at follow-up. None of the patients of group B needed hospitalization during follow-up while in Group A and group C two patients required hospitalization. In Group B patients we observed an improvement of cardiovascular functional capacity at the end of CRP, with an increase in peak exercise HR, exercise duration, and peak exercise work-load (p<0.05, Pre-CR vs Post-CR; p<0.01) (table 2). Similar improvement were observed in Group A (p<0.05, Pre-CR vs Post-CR), but not in Group C patients (p=ns, Pre-CR vs Post-CR) (table 2). Table 3 shows the results of psychological status evaluation and suggests that in group B there was an improvement of state anxiety and a trend to a reduction of depression, compared to Group C patients. The evaluation of parameters reflecting quality of life (MOS/SF-36) showed no modification in 8/15 patients and an improvement in 2/15 patients in group B, while there was a worsening in 7/15 patients and an improvement in 1 patient in group C (p<0.05).

Discussion

Cardiac Rehabilitation aims at facilitating physical, psychological and emotional recovery after AMI [1]. This is achieved through hospital-based comprehensive programs including exercise training, patient education and counselling, optimal pharmacological treatment, and psychological intervention. Meta-analyses of the effectiveness of

Table 1. - Demographic and clinical characteristics of study patients

<table>
<thead>
<tr>
<th></th>
<th>Group A n = 15</th>
<th>Group B n = 15</th>
<th>Group C n = 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (M±SD)</td>
<td>54±8</td>
<td>60±6</td>
<td>58±6</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>133±26</td>
<td>128±18</td>
<td>131±21</td>
</tr>
<tr>
<td>Diabetes</td>
<td>5/15</td>
<td>3/15</td>
<td>3/15</td>
</tr>
<tr>
<td>Smokers</td>
<td>12/15</td>
<td>12/15</td>
<td>10/15</td>
</tr>
<tr>
<td>Total Cholesterol (mg/dl)</td>
<td>196±24</td>
<td>194±27</td>
<td>200±28</td>
</tr>
<tr>
<td>AMI anterior</td>
<td>12/15</td>
<td>11/15</td>
<td>13/15</td>
</tr>
<tr>
<td>PCTA</td>
<td>13/15</td>
<td>13/15</td>
<td>12/15</td>
</tr>
<tr>
<td>LVEF (%)</td>
<td>35±6</td>
<td>31±9</td>
<td>34±8</td>
</tr>
<tr>
<td>Onset of Cardiac Rehabilitation (day from AMI)</td>
<td>7</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>
these programs suggest that they can achieve a reduction in cardiac mortality of 20-26% over a 1-3 year time [2-4]. CRP are also associated with improvement in aerobic capacity [14], reduction of risk profile [15], improvement in lipoprotein patterns [5], psychological status and quality of life [16-18]. It is clear that many patients who could benefit from cardiac rehabilitation are not enrolled in these programs due to both service and patient factors. Enrolment rates for Cardiac Rehabilitation have been reported to range from 15-59% [19]. Many services concentrate on relatively low risk, white middle aged patients, while women [20, 21] and elderly are less likely to be included [22-24]. Poor recruitment is also related to service factors, such as the availability and accessibility of a program [25], the strength of a physician’s recommendation to attend [26-28] and treatment by a general physician, rather than a cardiologist. Patient factors include the reported feeling amongst the elderly and women that they will be out of place [29] and beliefs about whether their illness was amenable to cure or control [30]. Socio-demographic factors such as deprivation [31], level of education [32] and spouse involvement [33, 34] are also significant predictors of enrolment. Of those patients who do attend hospital Cardiac Rehabilitation the dropout rates from exercise programs range from 20% in the first three months to 50% at 6 months to a year [35]. Smokers, patients who have had more that one myocardial infarction [36, 37], and women are more likely to drop out [38]. Therefore it is important to device new strategies to improve patients enrolment in CRP in order to extend their benefits also to patients unable to attend hospital sessions for logistic or other reasons. One possibility is offered by the prescription of a home-based CRP, allowing patients to follow physical training in their home environment. However, it is also equally important to ensure complete and continued patients adhesion to suggested home-based programs. Trials comparing home-based Cardiac Rehabilitation programmes to usual care (patients not enrolled in Cardiac Rehabilitation) have reported significantly greater improvements in exercise capacity, systolic blood pressure and lower anxiety in the patients participating in home rehabilitation compared to the controls at follow-up [39]. Eight randomised controlled trials comparing home-based to supervised centre-based CRP have been published [40-47]. These studies report similar improvements in exercise capacity, systolic blood pressure or serum cholesterol at follow-up between the home and centre-based groups. The present study shows that patients following home-based CRP had similar benefits of patients following hospital-based programs. In our experience, a home-based exercise prescription without TC monitoring was not successful in improving CRP end-points. In our population the motivations to follow prescribed exercise training at home was not enough to sustain an 8 week home-based program, but the addition of a simple ecg device such that used in our study was sufficient to achieve the same results of hospital-based CRP.

In conclusion, TC improved compliance and results of a home-based CRP, in particular functional capacity and psychology profile, compared to patients enrolled in a home-based CRP without ecg-monitoring by TC. TC is helpful improving adhesion to home-based Cardiac Rehabilitation in those patients unable to attend in-hospital program for logistic reasons. The possibility to extend this model of assistance out of hospital could enhance enrolment in CRP and allow the application of its benefits to a large number of patients after AMI.

<table>
<thead>
<tr>
<th>GROUP A (n=15)</th>
<th>GROUP B (n=15)</th>
<th>GROUP C (n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-CR</td>
<td>Post-CR</td>
<td>Pre-CR</td>
</tr>
<tr>
<td>Exercise duration (min)</td>
<td>3.6±1.2</td>
<td>4.6±2.2*</td>
</tr>
<tr>
<td>Heart Rate max (% max predicted)</td>
<td>65±9.2</td>
<td>82±8.8*</td>
</tr>
<tr>
<td>Max-work load (Watts)</td>
<td>94±16.4</td>
<td>112±22.4*</td>
</tr>
</tbody>
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* p<0.05; Group A (Pre-CR vs Post-CR) and Group B (Pre-CR vs Post-CR).
** p<0.01; Group A (Post-CR) vs Group B (Post-CR).

<table>
<thead>
<tr>
<th>GROUP A (N=15)</th>
<th>GROUP B (N=15)</th>
<th>GROUP C (N=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-CR</td>
<td>Post-CR</td>
<td>Pre-CR</td>
</tr>
<tr>
<td>STAI-Y1</td>
<td>39±5</td>
<td>36±6</td>
</tr>
<tr>
<td>STAI-Y2</td>
<td>34±5</td>
<td>35±7</td>
</tr>
<tr>
<td>BDI</td>
<td>15±5</td>
<td>16.4±3</td>
</tr>
</tbody>
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* p<0.05, Group B Pre-CR vs Post-CR.
TELECARDIOLOGY IN CARDIAC REHABILITATION

Riassunto

Introduzione: Scopo del seguente lavoro è verificare se la Telecardiologia (TC) migliora i risultati della Riabilitazione Cardiologica in pazienti arruolati in un programma di Riabilitazione Cardiologica (PRC) domiciliare dopo infarto acuto del miocardio (IMA). I pazienti sono stati suddivisi in tre gruppi: gruppo A (controllo): 15 pazienti che seguivano un PRC standard ospedaliero di tre sedute settimanali della durata di 8 settimane; gruppo B (intervento): 15 pazienti arruolati in un PRC domiciliare e monitorati tramite l'ausilio della TC utilizzando un dispositivo che registra l'elettrocardiogramma (Sorin Life Watch CG 6106); gruppo C (secondo gruppo di controllo): 15 pazienti che seguono un PRC domiciliare senza monitoraggio ekg tramite TC. Tutti i pazienti hanno eseguito un test ergometrico limitato da sintomi all'inizio del PRC. Sono stati inoltre valutati i dati psicometrici (STAI-Y1, STAI-Y2, BDI). Al termine del PRC i pazienti hanno ripetuto il test ergometrico e la valutazione psicometrica. 

Risultati: La TC applicata al PRC domiciliare è associata ad una buona compliance al programma. Rispetto al gruppo C nel gruppo B abbiamo osservato più alti valori della frequenza cardiaca massima, della durata di esercizio, del carico massimo di lavoro, ed un miglioramento dello stato d'ansia, un trend in riduzione dello stato depressivo con un miglioramento della qualità di vita. I risultati del gruppo B erano simili a quelli del gruppo A che svolgevano un programma tradizionale ospedaliero. 

Conclusioni: La TC applicata ad un PRC domiciliare risulta in un miglioramento dell'adesione, della capacità funzionale e del profilo psicologico dei pazienti, in particolare rispetto ai quelli arruolati in PRC domiciliare senza monitoraggio ekg tramite TC. Parole chiave: riabilitazione cardiologica, telecardiologia, infarto del miocardio.

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CAPTIONS
AMI: Acute Myocardial Infarction
CRP: Cardiac Rehabilitation Program
PTCA = percutaneous transluminal coronary angiography
LVEF = left ventricular ejection fraction
TC: Telecardiology
HR: Heart Rate
STAI-Y1: State Anxiety
STAI-Y2: Trait Scale of Anxiety Inventory
BDI: Beck Depression Inventory
SBP = systolic blood pressure
MOS/SF-36 = Medical Outcomes Study 36-Item Short-Form Health Survey

References