CLINICAL SCIENCE

TRANSDICIPLINARY APPROACH TO THE FOLLOW-UP OF PATIENTS AFTER MYOCARDIAL INFARCTION

Rosana Costa e Silva,[I] Lucia Pellanda,[I] Vera Portal,[I] Patricia Maciel,[I] Aline Furquim,[I] Beatriz Schaan[I,II]

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OBJECTIVES: To compare conventional and transdisciplinary care in a tertiary outpatient clinic for patients after their first acute myocardial infarction.
METHODS: One hundred fifty-three patients with acute myocardial infarction were randomized at hospital discharge and followed-up to compare conventional (n=75) and transdisciplinary care (n=78). They were submitted to a clinical evaluation, received a dietary plan, and were re-evaluated twice in 60-180 days by a nurse, dietitian and physician, when new clinical and laboratory data were collected. The primary outcome was clinical improvement, as evaluated by an index including reduction of body weight, lowering of blood pressure, smoking cessation, increase in physical activity and compliance with medication.
RESULTS*:* The groups were similar at baseline: 63.4% were men, 89.9% had an acute myocardial infarction with ST-segment-elevation, 32.7% were diabetic, and 72.2% were hypertensive. The clinical improvement index was similar between the studied groups: in 33.3 % (transdisciplinary care) vs. 30.4 % (conventional care) of patients, the improvement was very good (P=1.000). Rates of re-hospitalization and death (p=0.127) were similar between transdisciplinary and conventional care. Compliance with diet was higher for transdisciplinary care (50.0%) vs. conventional care (26.1%) (p=0.007), as was compliance with visits (73.3 vs. 40.3%, respectively, p<0.001).
CONCLUSIONS: Compliance with diet and visits was higher for transdisciplinary care vs. conventional care; however, the transdisciplinary approach did not provide more clinical benefits than the conventional approach after patients' first acute myocardial infarction in this setting.

KEYWORDS: Acute myocardial infarction. Cardiovascular diseases. Ambulatory care/methods. Prevention. Follow-up.

INTRODUCTION

Coronary artery disease (CAD) is the main cause of death in developed and developing countries. Of the 930,000 deaths recorded in Brazil in 1998, cardiovascular diseases were responsible for 31%. Since the 1960s, after the initial results of the Framingham study,[1] greater attention has been given to the so-called risk factors for cardiovascular diseases: smoking, systemic arterial hypertension, diabetes mellitus (DM), dyslipidemias, obesity and sedentarism. Secondary prevention is of paramount importance in avoiding further cardiovascular events in patients who have had a previous acute myocardial infarction (AMI). This includes lifestyle changes (quitting smoking, healthy eating, regular physical activity, weight loss, blood pressure control and lipid profile improvement) and pharmacological measures (statins, antiplatelet therapy, beta-blockers and angiotensin-converting enzyme inhibitors).[2] Multidisciplinary (simple knowledge juxtaposed from several health care providers), interdisciplinary (methods from one discipline are imported by another) and transdisciplinary (multidisciplinarity across specialties and settings) team approaches may be useful in this setting. We hypothesized that this last approach would be more beneficial since each health professional can act in various capacities, with the final result of better adherence to all known preventive measures.[3]

[I] Institute of Cardiology of Rio Grande do Sul/Fundação Universitária de Cardiologia – Rio Grande do Sul/RS, Brazil.
[II] Endocrine Division, Hospital de Clínicas de Porto Alegre – Porto Alegre/RS, Brazil.
Email: pesquisa@cardiologia.org.br
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In patients with diabetes, an interdisciplinary program was tested for 6 months at a randomly selected clinic; results were compared to those obtained with usual treatment at another clinic. Both metabolic control and compliance were better in individuals who underwent the program.[4] Similar results and improved quality of life were obtained in non-controlled studies, both in diabetics[5] and in difficult-to-control hypertensive patients.[6] However, a retrospective study conducted in a cardiology outpatient clinic that evaluated such practices for dyslipidemia management showed no difference in the lipid profile before and after implementation of an educational program with a physician and a nurse.[7] In the post-AMI scenario, the effectiveness of an in-hospital educational program was tested, where the program was conducted by a team (physician, nurse, pharmacist and manager) with the objective that each hospitalized patient leaves the hospital with a prescription in accordance to the National Cholesterol Education Program (NCEP) guidelines.[8] Prescription of lipid-lowering therapy at discharge increased from 40% to 72%. The percentage of patients who performed a lipid panel within 24 hours of admission increased from 13% to 38%. At discharge, 28%-77% of patients received lipid-lowering medication counseling.[9]

No prospective studies with randomized designs have evaluated conventional vs. transdisciplinary care of post-AMI patients in an outpatient clinic. The aim of the present study was to test the effectiveness of transdisciplinary care (TC, intervention) as compared to conventional care (CC, control) provided to patients after their first AMI. The primary outcome considered was clinical improvement, which was evaluated by means of a constructed index comprising reduction of body weight, lowering of blood pressure levels, cessation of smoking, increased physical activity and compliance with medication. The secondary outcomes considered were death, re-hospitalization and a combination of re-hospitalization and death.

METHODS

This randomized clinical trial contained two groups, control and intervention, which were distributed randomly in blocks of 20 by randomization software (Random, PEPI 4.0).

Patients

The 153 studied patients were hospitalized because of their first acute myocardial infarction. While they were still in the hospital, they were divided into two groups with a similar number (control, CC, n=75 and intervention, TC, n=78). These patients were submitted to a questionnaire that included data on the history of the current disease, previous clinical history (diabetes, dyslipidemia, systemic arterial hypertension), current medicines in use, smoking, physical activity, history of early cardiovascular disease in the family, and physical examination. For patients who were initially very ill, the data were collected during their hospital stay, after discharge from the Intensive Coronary Unit. After randomization and baseline evaluation, 4 patients from the CC group and 3 from TC died while still in the hospital, leaving the remaining 71 patients in CC and 75 in TC to be followed up during the 180 post-AMI days.

Systemic arterial hypertension was considered to be present in patients who had a previous diagnosis of hypertension and/or used antihypertensive drugs or who presented systolic blood pressure ≥ 135 mmHg and/or diastolic blood pressure ≥ 85 mmHg.[10] Patients were considered to have diabetes if they had a previous diagnosis of the disease and/or were on anti-hyperglycemic drugs. Dyslipidemia was considered to be present before AMI if the patient reported a personal history of the problem and/or used lipid-lowering drugs. All patients who smoked until the day of the AMI were considered to be current smokers, irrespective of the number of cigarettes per day. Patients were classified as physically active if they engaged in physical activity lasting more than 30 minutes per day for more than three times a week. The types of AMI were defined as ST-segment elevation myocardial infarction (ST segment ≥ 2 mm) and non-ST-segment elevation myocardial infarction (ST segment < 2 mm) .

During their hospital stay, all patients received treatment according to the American Heart Association (AHA) guidelines (thrombolytics, anticoagulants, antiplatelet drugs, statins, hemodynamic and surgical procedures: percutaneous coronary intervention and coronary artery bypass graft). Before discharge, they were visited by a dietitian who prescribed a post-discharge diet plan after nutritional evaluation. The CC patients were discharged from the hospital and referred to the conventional outpatient clinic for heart care at the Institute of Cardiology/University Foundation of Cardiology, where the patients were seen only by the appointed cardiologist. The TC group patients were referred for continued care to the outpatient clinic for secondary prevention of CAD, which employed a transdisciplinary approach. The patients and health professionals involved in outpatient treatment were not blinded as to their allocation. However, since the hospitalization of these patients was usually their first in our institution, they were typically not aware of how the outpatient clinic functions. The cardiologists following the CC group were aware of the study, having been informed of

its objectives and methods before the beginning of the study. These cardiologists kept a routine schedule with patients being seen for no more than 15 minutes; thus, the patients' care was different from that provided to the TC group.

All the patients included in this study freely signed an informed consent form, and the trial was previously approved by the Institutional Research Ethics Committee.

Follow-up at the outpatient clinic using the transdisciplinary approach

Transdisciplinary care at the outpatient clinic for secondary prevention of CAD was provided by a cardiologist, endocrinologist, nurse and dietitian. At every visit, new appointments were made for a total follow up period of six months. The two visits (the first 60-90 days after AMI and the second 120-180 days after AMI) followed protocols based on the NCEP guidelines[8] previously discussed by the team, and information was collected and stored in a database. Initially, the patient was seen by a nurse, and the drugs in use and current smoking status were reviewed. Those patients who were still smoking were advised to stop smoking by the nurse and also by the cardiologist. No oral medication was prescribed in this regard since these drugs are not routinely provided by the Public Health System in Brazil.

In diabetic patients, capillary glycemia was measured (Advantage reagent strips, Roche, Indianapolis, IN, USA), lower limbs were examined, and adherence to prescribed oral antidiabetic agents and insulin was reviewed.

After the above-described procedures, the dietitian evaluated body weight and performed a nutritional review. This review was followed by reinforcement of healthy nutritional habits, which included information on the characteristics and amount of healthy meals according to each case and also lifestyle modification reinforcement. The management plan was formulated as an individualized therapeutic alliance among the patient and family, the physician, and other members of the health care team.

Finally, patients were evaluated by the cardiologist, who completed the visit with the specific medical history, physical examination and specific complementary tests. Drug prescription by the cardiologist followed the AHA guidelines for both groups (statins, antiplatelet therapy, beta-blockers and angiotensin-converting enzyme inhibitors).[2] Diabetic patients were evaluated by an endocrinologist. Drug prescription by the endocrinologist followed the American Diabetes Association (ADA) guidelines for both groups.[11] All health professionals involved in patient care worked as a team in the same ward, and they discussed the patients' needs and management before they were released.

All patients receiving TC were stimulated by the health professionals to engage in regular physical activity as follows: Eight weeks after AMI, patients who did not have any medical or physical restrictions performed an erghometric test. Those who did not have any signs of ischemia during the test were encouraged to perform aerobic exercises, especially walking. They were instructed on how to measure their heart rate and told the highest heart rate they should achieve (70% of the maximum heart rate obtained during the maximal erghometric test). In the subsequent visits, patients were asked about their adaptation to the exercises and about any symptoms that they had after beginning physical activities. If patients reported new symptoms that could be related to their cardiac condition, they were re-evaluated with myocardial scintigraphy.

Blood pressure was measured with the patient seated for five minutes and using an aneroid or mercury sphygmomanometer, periodically calibrated according to the recommendations of the VII JNC.[8] Body weight and height were measured on a manual balance (Filizzola, SP, Brazil), with a maximum capacity for a 150 kg load and 1.90 m height.

The CC patients were asked to be present at the outpatient clinic 180 days after AMI, when a brief clinical exam was performed and a fasting blood sample was obtained. Those who did not appear were interviewed by phone and laboratory data were obtained from the central laboratory database.

The groups were compared for anthropometric measures, blood pressure and biochemistry (fasting plasma glucose and lipids) 60-180 days after discharge from hospital. The primary outcome was clinical improvement, which was evaluated by means of a constructed index comprising lowering of body weight (>5% from baseline), lowering of blood pressure levels (<135/85 mmHg), cessation of smoking (yes or no), increased physical activity and compliance with medication. We counted only total smoking cessation. There was no credit given for reduction in the amount of smoking. Compliance with medication was evaluated by asking questions directly to the patient/family members. For each item with a positive change, one point value was assigned. A final sum of ≥4 points was considered very good. The secondary outcomes were death, re-hospitalization and a combination of re-hospitalization and death. Each emergency room visit was counted separately. If a patient was subsequently admitted to the hospital, that emergency room visit was not counted as an endpoint, only the hospitalization.

Laboratory evaluation

Fasting blood samples were collected at the outpatient

clinic and analyzed at the hospital central laboratory. Total plasma cholesterol and triglycerides were analyzed in triplicate, using commercial kits (*Roche* Indianapolis, IN, USA). HDL-C was isolated using the heparin-2M $MnCl_2$ method and measured using the same enzymatic kit used for total plasma cholesterol. LDL-C was estimated using the Friedwald formula in mg/dl. Fasting plasma glucose was measured using the automated enzymatic method (*Roche* Indianapolis, IN, USA).

Statistical analysis

Based on the results of previous studies, we estimated that a sample size of 80 individuals in each group would have a power of 80% to detect a 10% difference in the clinical improvement index for $\alpha = 0.05$. The data are presented as means and standard deviations. The analysis followed the intention to treat principle. For patients who did not return for the 120-180 day evaluation, data were derived from the 60-90 day evaluation using a conservative approach. The differences in initial characteristics and outcomes among the comparison groups were analyzed using the Chi-square test for nominal variables and the Student's t-test for continuous variables. ANOVA for repeated measures was used for follow-up comparisons. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) 10.0 software. Values of $p<0.05$ were considered statistically significant.

RESULTS

The studied individuals were 58.0 ± 11.2 years old; 26.0% were more than 65 years old, 63.4% were males, 64.6% were sedentary, and 86.3% had AMI with ST-segment elevation. Almost a third (32.7%) of patients reported a personal history of diabetes mellitus before AMI, and a personal history of arterial hypertension was reported in 72.2%. Coronary artery bypass graft surgery was performed in four patients from the CC group and three of the TC group. Coronary percutaneous intervention without a stent was performed in seven and five patients from each group, respectively, and coronary percutaneous intervention with stent was performed in 37 and 22 patients of each group, respectively. There was no statistical difference between these data. Randomization was performed before any revascularization procedure was undertaken. Table 1 shows the baseline characteristics of the 153 patients studied. The groups were similar to each other at baseline (hospitalization).

Table 2 shows the clinical outcomes of the patients studied. The clinical improvement index was very good in 33.3% patients with TC and 30.4% patients with CC (P=1.000) at their last evaluation. Compliance with diet was higher with TC (50.0%) *vs.* CC (26.1%) (p=0.007), as was compliance with visits (73.3 *vs.* 40.3% for TC and CC, respectively, p<0.001). Other outcomes (number of patients

Table 1 - Baseline characteristics of individuals studied after diagnosis of their first acute myocardial infarction (AMI)

	CC (n=71)	TC (n=75)	p
Age (years)	58.9 ± 13.2	57.8 ± 10.7	0.112
Male (%)	48 (64.0)	49 (62.8)	0.880
Men age>55 years/Women age>60 (%)	43 (57.3)	44 (56.4)	0.908
Smokers (%)	24 (32.4)	35 (46.1)	0.088
Sedentarism (%)	47 (66.2)	53 (71.6)	0.480
Body weight (kg)	77.1 ± 15.3	75.5 ± 12.9	0.475
BMI (kg/m^2)	28.1 ± 4.6	27.6 ± 5.3	0.561
Plasma glucose (mg/dl)	155.9 ± 69.4	158.0 ± 73.3	0.878
SBP (mmHg)	136.8 ± 27.1	129.7 ± 29.6	0.134
DBP (mmHg)	78.9 ± 17.1	79.2 ± 17.2	0.932
AMI with ST-elevation (n,%)	67 (89.3)	65 (83.3)	0.281
AMI without ST-elevation (n,%)	8 (10.7)	13 (16.7)	0.281
Family history for CAD (n,%)	53 (75.7)	56 (75.7)	0.996
Personal history of dyslipidemia (n,%)	27 (47.4)	22 (48.9)	0.879
Personal history of hypertension (n,%)	48 (71.6)	48 (72.7)	0.889
Personal history of diabetes (n,%)	19 (30.6)	17 (35.4)	0.597

Data are mean ± SD or number (%). CC: conventional care; TC: transdisciplinary care; BMI: body mass index; AMI: acute myocardial infarction; SBP: systolic blood pressure; DBP: diastolic blood pressure; CAD: coronary artery disease.

who quit smoking, became physically active, adhered to medication, number of re-hospitalizations, visits to the emergency room and deaths) were similar between the groups studied.

Table 3 shows data from the comparative analysis of compliance achieved according to group, considering the targets defined by international guidelines. The percentages of patients who achieved body weight reduction of more than 5% from baseline (p=0.313) as well as ideal blood pressure (p=1.000) and lipid levels (p=0.401, p=0.633, p=1.000 and p=1.000 for total cholesterol, HDL-c, LDL-c and triglycerides, respectively) were not different between CC and TC.

Among the patients from the TC group who achieved higher clinical improvement indices (≥4 points), loss of weight of more than 5% from baseline (53.3% *vs* 6.3%, p=0.001) was more commonly observed as compared to patients with lower clinical improvement indices. However, other variables were not different between patients with higher and lower clinical improvement indices; compliance with the visits (73.3 *vs.* 75%, p=1.000), visits to the emergency room (46.7 *vs.* 43.8%, p=1.000), re-hospitalization after discharge (33.3 *vs.* 15.6%, p=0.252), re-hospitalization or death (33.3% *vs.* 15.6%, p=0.252), lower systolic and diastolic blood pressure levels (60.0% *vs.* 37.5%, p=0.211 and 80% *vs.* 65.6%, p=0.496, respectively), lower total and LDL-cholesterol levels (80.0% *vs.* 75.9%, p=1.000 and 80.0% *vs*. 52.4%, p=0.240, respectively), higher HDL-cholesterol levels (40.0% *vs*. 62.5%, p=0.203), and lower triglyceride levels (66.7% *vs.* 62.5%, p=1.000) were all not significant.

Table 2 - Clinical outcomes and compliance: Comparative analysis at 60-180 days after AMI of the evolution of patients receiving CC and TC

Evaluation	CC	TC	P
Clinical improvement index ≥4 (n,%)*	7 (30.4) (n=23)	8 (33.3) (n=24)	1.000
Quit smoking (n,%)	11 (45.8) (n=69)	16 (45.7) (n=64)	1.000
Physical Activity (n,%)	24 (33.8) (n=71)	21 (28.4) (n=74)	0.590
Compliance with the diet (n,%)	18 (26.1) (n=69)	37 (50.0) (n=74)	0.007
Compliance with medication (n,%)	51 (75.0) (n=68)	55 (74.3) (n=74)	1.000
Compliance with visits (n,%)	29 (40.3) (n=71)	55 (73.3) (n=74)	<0.001
Re-hospitalizations (n,%)	28 (37.8) (n=71)	46 (62.2) (n=75)	0.168
Visits to the emergency room (n,%)	32 (43.2) (n=71)	31 (39.7) (n=75)	0.742
Deaths (n,%)	3 (4.0) (n=71)	1 (1.3) (n=75)	0.250

Data number (%). CC: conventional care; TC: transdisciplinary care. Clinical improvement index (n=47): lowering body weight (>5% from baseline), lowering blood pressure levels (<135/85 mmHg), quit smoking, more physical activity and compliance with medication. Each item was worth 1 point. A final sum ≥4 was considered very good.

Table 3 - Clinical and laboratory characteristics of CC and TC patients at 60-180 days after AMI

Evaluation	CC	TC	P
Body weight reduction of at least 5% (n,%)	12 (34.3) (n=35)	10 (22.2) (n=45)	0.313
SBP ≤ 135mmHg (n,%)	26 (53.1) (n=49)	30 (52.6) (n=57)	1.000
DBP ≤ 85mmHg (n,%)	32 (65.3) (n=49)	43 (75.4) (n=57)	0.289
Total cholesterol ≤ 200 mg/dl (n,%)	24 (72.7) (n=33)	32 (82.1) (n=39)	0.401
HDL-c ≥40mg/dl in men and ≥45mg/dl in women (n, %)	15 (48.4) (n=31)	21 (55.3) (n=38)	0.633
LDL-c ≤100 mg/dl (n,%)	16 (55.2) (n=29)	17 (56.7) (n=30)	1.000
Triglycerides ≤ 150mg/dl (n,%)	20 (64.5) (n=31)	25 (64.1) (n=39)	1.000

Data are reported as number (%). CC: conventional care; TC: transdisciplinary care; AMI: acute myocardial infarction; SBP: systolic blood pressure; DBP: diastolic blood pressure.

DISCUSSION

The transdiciplinary approach involves multidisciplinarity across specialties and settings, stretching beyond the boundaries of the several specific disciplines. It can meet the needs of patients in many settings, especially with chronic-degenerative diseases and those with multiple systems involvement. To our knowledge, this is the first study to test this approach in patients with a complex chronic degenerative disease such as coronary artery disease.

In the present outpatient clinic model, the patients visited a health team composed of a nurse, a dietician, a cardiologist and an endocrinologist (for diabetic patients). The theoretical advantages of this approach are the exchange of knowledge between the professionals involved, the emphasis to the patients that specific measures must be adopted to avoid further coronary events, and the maintenance of the specific competencies of each healthcare field. This kind of approach can be particularly useful as a complement to regular care in patients with chronic diseases, who frequently present prolonged self-management difficulties.[12]

The transdisciplinary care provided in the outpatient clinic for secondary prevention of CAD at our hospital did not show the expected results in regards to the primary and secondary endpoints. We believe that the clinical index constructed was complete and highly informative. Although not statistically significant, more patients in the group that received the intervention had a very good clinical index as compared to usual care. Also, we observed better compliance of patients with outpatient visits and diet following the transdisciplinary approach. We therefore speculate that a longer follow-up period might disclose differences in the studied endpoints since they are directly related to compliance with diet and visits.

Our population was similar to others described in the literature. The percentage of women with AMI, which has increased in the last few decades, was 36.6% in the present study, *vs.* 27.2%[13] and 35%[14] observed in other series. The mean age of occurrence of the first AMI has also been rising over the last few years, and it was similar in this case to other Brazilian studies: 58.4 ± 11.7 in our sample *vs.* 60.5[13] and 61 years[14] in others. The number of smokers and patients with a personal history of dyslipidemia was also similar to previous reports[14], as was the occurrence of diabetes mellitus (over 30%)[15]. The percentage of hypertensive patients at the time of admission to the study was 72%, higher than the 53.8 and 39.2% observed by Manfroi et al.[16] and Borghi et al. respectively[17]. This is probably because our institution is a reference center for severe cardiac diseases throughout the south of the country. It is important to note that these baseline characteristics were similar between the 2 groups, showing that they were adequately randomized.

Several studies reinforce the idea that the treatment of risk factors for CAD is more successful using a multidisciplinary approach. This approach was tested and shown to be beneficial for achieving better blood pressure control in difficult-to-manage hypertension[6] and diabetic patients.[4,5] In dyslipidemic patients, multidisciplinary cardiovascular disease prevention counseling positively influenced participant readiness for a lifestyle behavior change, which translated into significant reductions in several risk factors.[12] Our results in post-AMI patients are not in accordance with these studies. We believe that the causes for our negative results were not the approach itself nor the care provided but, rather, the high number of patients lost and the contamination of the control group with patients from the intervention group. Because the transdiciplinary approach is a new concept, we had pragmatic difficulties in implementing it in our institution, and many patients were urged back to the conventional approach by their attending physicians. There was no attempt at pill counting to validate compliance because our aim with the interventions performed was that they could be reproduced afterwards under real-world conditions. One other limitation that merits discussion is the short duration of the follow-up. The impact of the transdisciplinary measures may be more profound in the long term, suggesting the need for further studies with longer follow-up periods.

Our institution previously sought to implement a program of educational nursing strategies in addition to conventional medical ambulatory care for patients with ischemic heart disease. This proved to be beneficial because more patients stopped smoking and fewer risk factors were present after implementation of the program.[18] Because we considered that better results could be obtained with a more comprehensive approach, we tested the inclusion of other professionals in the present study.

The present proposal to treat patients in a transdisciplinary outpatient clinic for the secondary prevention of CAD did not prove to be beneficial considering the given endpoints. However, this does not necessarily mean that the approach itself has no value. It is possible that improved techniques to increase adherence, a larger sample size and longer follow-up could bring better results in ongoing studies. The achievement of higher clinical improvement indices, better compliance with medication and greater weight loss as compared to baseline among patients from the intervention group (TC) indicates that some benefits can be obtained using transdisciplinary care since better compliance with conventional care did not result in such improvements (data not shown). This emphasizes the need for a continuous search for better preventive strategies.

Further studies are necessary to evaluate the cost-effectiveness of transdisciplinary care, but we hypothesize that this approach may represent a reduction of cost since lifestyle modification and better compliance may ultimately lead to a reduced need for medication and better clinical outcomes.

We conclude that compliance with diet and visits was higher with transdisciplinary care than with conventional care. However, the transdisciplinary approach did not provide more clinical benefits than the conventional approach for patients after their first acute myocardial infarction.

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