

# IMPACT OF BALANCE, GAIT AND COORDINATION TRAINING IN THE COMPLEX CARDIOREHABILITATION PROGRAM FOR GERIATRIC PATIENTS AFTER CARDIAC SURGERY (VALVE REPLACEMENT)

Koleva I<sup>1, 2, 3</sup>, Alexiev A<sup>3</sup>, Leikuse D<sup>2</sup>, Yoshinov BR<sup>4</sup>, Yoshinov RR<sup>5</sup>

<sup>1</sup> Physiotherapy Department at the Medical University of Sofia, Bulgaria, yvette@cc.bas.bg

<sup>2</sup> Department of Anatomy and Physiology at Daugavpils University, Latvia, irena.kaminska@du.lv

<sup>3</sup> National Heart Hospital, Cardio-Rehabilitation Department, Sofia, Bulgaria

<sup>4</sup> Medical Faculty of Sofia University, Bulgaria, dr.yvette.5@gmail.com

<sup>5</sup> University of Telecommunications, Sofia, Bulgaria

## Abstract

**Key Words:** *balance training, cardiac surgery, cardiorehabilitation, valve heart replacement*

After valvular cardiosurgery (with extracorporeal circulation), most geriatric patients develop vertebro-basilar insufficiency with balance problems or ataxia signs.

**Our GOAL** was to evaluate the possible impact of balance, gait and coordination training in the complex cardiorehabilitation (CR) algorithm of old patients after cardiac surgery.

## MATERIAL AND METHODS

**We observed 369 patients** after cardiac surgery. Patients were randomized into three therapeutic groups. The control was done before, during and at the end of the CR course (of 10 treatment days), and one month after its end.

In all patients, we applied a complex cardio-rehabilitation (CR) programme of *physiotherapy and ergotherapy*; including cardio-training, respiratory exercises (predominantly for external and internal intercostal muscles); and goal-oriented activities (standing up, walking and climbing stairs). Group (gr) 1 received only this CR programme. In gr 2 we added *balance and gait training exercises*. In the next group (gr 3) we applied additionally *coordination exercises* for the upper and lower extremities.

**The statistical ANALYSIS OF RESULTS** demonstrates in all patients significant improvement of circulatory parameters; upgrade in cardiac functional parameters, enlargement in autonomy. We observed bigger amelioration in quality of life in the third group.

**CONCLUSION:** Balance and coordination training must be included in the CR-algorithm in geriatric patients after cardiosurgery.

## Introduction

### Cardiac rehabilitation – basic principles

*Cardiac rehabilitation (CR)* is a professionally supervised program to help people recover from heart attacks, heart surgery and percutaneous coronary intervention (PCI) procedures such as stenting and angioplasty (Cuccurullo, 2004; Gonzalez et al, 2004). Cardiac rehabilitation, also called *cardio-rehab*, is a medically supervised program *for people who have had a heart attack, heart failure, heart valve surgery, coronary artery bypass grafting, or percutaneous coronary intervention* (Wenger et al., 1995). *Cardiac rehab involves* adopting heart-healthy lifestyle changes *to address* risk factors for cardiovascular disease. To help the patient to adopt *lifestyle changes*, the program includes exercise training, education on heart-healthy living, and counseling to reduce stress and help the patient to return to an active life.

According the *American Heart Association*: Cardiac rehab programs usually provide *education and counseling* services to help heart patients increase physical fitness, reduce cardiac symptoms, improve health and reduce the risk of future heart problems, including heart attack (Zolman and Tobis, 1968; Fletcher et al, 2001; DHHS, 2008).

**General indication for CR** is the cardio-vascular dysfunction or insufficiency (Exercise, 1994).

**Concrete indications for CR** include: *Heart attack*; *Heart condition* [such as coronary artery disease (CAD), angina or heart failure]; *Heart procedure or surgery* [including coronary artery bypass graft (CABG) surgery, percutaneous coronary intervention (PCI), including coronary angioplasty (balloon angioplasty) and stenting, valve replacement, or a pacemaker or implantable cardioverter defibrillator (ICD)].

Cardiac Rehabilitation *is an interdisciplinary, between Cardiology, Cardiac Surgery, Physical & Rehabilitation Medicine* (Fletcher et al, 2001). For the staff, working in CR, different competences are needed: theoretical knowledge and practical skills – from different thematic fields.

A close collaboration between medical doctors – specialists is necessary. The Cardiac Rehabilitation involves a long-term commitment from the patient and a team of health care providers. The **cardiac rehab team** may include *doctors* (such as a family doctor, cardiologist, cardio-surgeon; physical & rehabilitation medicine specialist) *nurses, physical and occupational therapists, dietitians or nutritionists, and psychologists or other mental health specialists*. Sometimes a *case manager* will help. Some countries use the collaboration of a specialist in *Adapted Physical activity (APhA)*. Working with the team is an important part of cardiac rehab.

Cardiac rehab is provided in an *outpatient clinic* or in a *hospital rehab center*.

The specificity of cardiac rehabilitation (CR) imposes the necessity of *individual approach*. The period of application is different: weeks, months or years, according the patient's needs.

Obligatory elements of CR are: ***medication; regular physical activity; patient's education*** – therapeutic councils, motor reeducation, smoking cessation; rational alimentary regimen, diet and weight reduction, control of the arterial hypertension; control of dyslipidemia; stress management (Pollack et al, 2000; Pescatello et al, 2004; Nelson et al, 2007).

According the initiatives of the World Health Organization (WHO) and the Societies of Cardiology and Cardio-respiratory rehabilitation, the month of February is considered as international Heart month, and the second week of February is considered as the week of Cardiac Rehabilitation, this year – 14-20 February 2021. The current year's slogan was: "Beating Strong, Living Long" (fig.1).



Figure 1. Cardiac Rehabilitation week 2021

## Cardiorehabilitation procedures

Rehabilitation is a functional treatment, based on a detailed functional assessment.

**For functional assessment** we apply measurement of the arterial tension RR [mm Hg], Walking Tests [Physical capacity tests (*Exercise capacity*) and *Veloergometry*]. Usually, for *functional evaluation* in clinical practice, we use different approaches in the acute and in the chronic stages. *During the acute stage* the assessment is done by the cardiologist or the cardiac surgeon. *During the sub-acute stage*, we apply *Sitting Rising test*; *Timed standing up & go (TUG / SUG)* test (for 3 meters) and the 5 meters walk test. *During the chronic stage*, we use *walk tests* assessment 12 minutes' walk test (12-MWT) or 6 minutes walk test (6-MWT); or *veloergometry (VET)*; *Clinostatic Hypertension reaction* and *Orthostatic Hypotension reaction*.

**For treatment**, we apply a complex cardio-rehab programme, adapted to the individual patient, including *physiotherapy*, *ergotherapy*; *hydro / balneo / therapy* or *hydro-physiotherapy*; *climatotherapy*; *magnetotherapy*.

From the group of ***physiotherapeutic and ergotherapeutic methods*** we use [Shephard, 1997; Thomson et al, 2003; Holviala et al, 2006]:

- ✓ *respiratory exercises*;
- ✓ *passive mobilizations*;
- ✓ *active exercises (aerobic)*;
- ✓ *individual sessions or group sessions*;
- ✓ *exercises with devices (against the gravity and against dosed resistance)*;

- ✓ *games, dances, tai-chi; tourism;*
- ✓ *mechanotherapy; treadmill, gladiator - for contra resistance exercises (especially for extremities, accentuating on lower extremities – cardio training);*
- ✓ **system HUBER MOTION.**

After valvular cardiostomy (with extracorporeal circulation), many geriatric patients develop (latent) cerebro-vascular insufficiency in the vertebro-basilar system with balance problems or ataxia signs. For these problems, we must include other types of exercises.

### Aim of the article

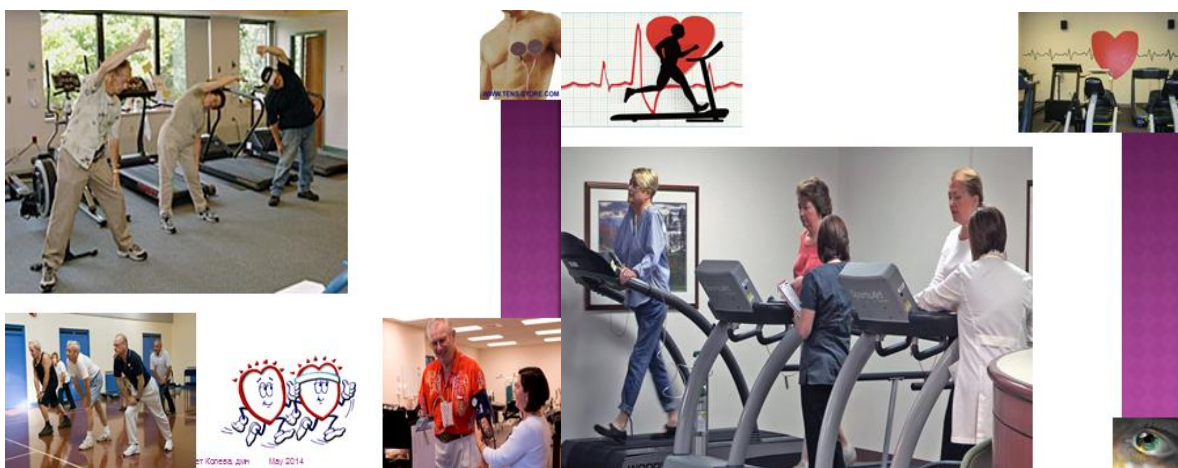
**The general aim** of our own systematic investigations in the field of cardiorehabilitation was to evaluate the prevalence of cerebro-vascular insufficiency in geriatric patients after *cardiac surgery with extracorporeal circulation* and to investigate the possible impact of **balance, gait & coordination training** in the complex cardiorehabilitation (CR) algorithm of these patients.

**The goal of current article** is to evaluate the possible impact of balance, gait and coordination training in the complex cardiorehabilitation (CR) algorithm of old patients after cardiac surgery.

### Material and methods

**We observed 369 patients** after cardiac surgery (7-10 days after valve replacement - aortic, mitral or tricuspid). Patients were randomized into three therapeutic groups (123 per group). The control was done before, during and at the end of the CR course (of 10 treatment days), and one month after its end - using a battery of clinical methods and functional scales.

In all patients, we applied a complex cardio-rehabilitation (CR) programme of *physiotherapy and ergotherapy* (figures 2 and 3); including cardio-training, respiratory exercises (predominantly for external and internal intercostal muscles); and goal-oriented activities (standing up, walking and climbing stairs). The found comprised diet and patient's education (figure 4).



Figures 2 and 3. **Physiotherapeutic methods for CR – group exercises, treadmill**

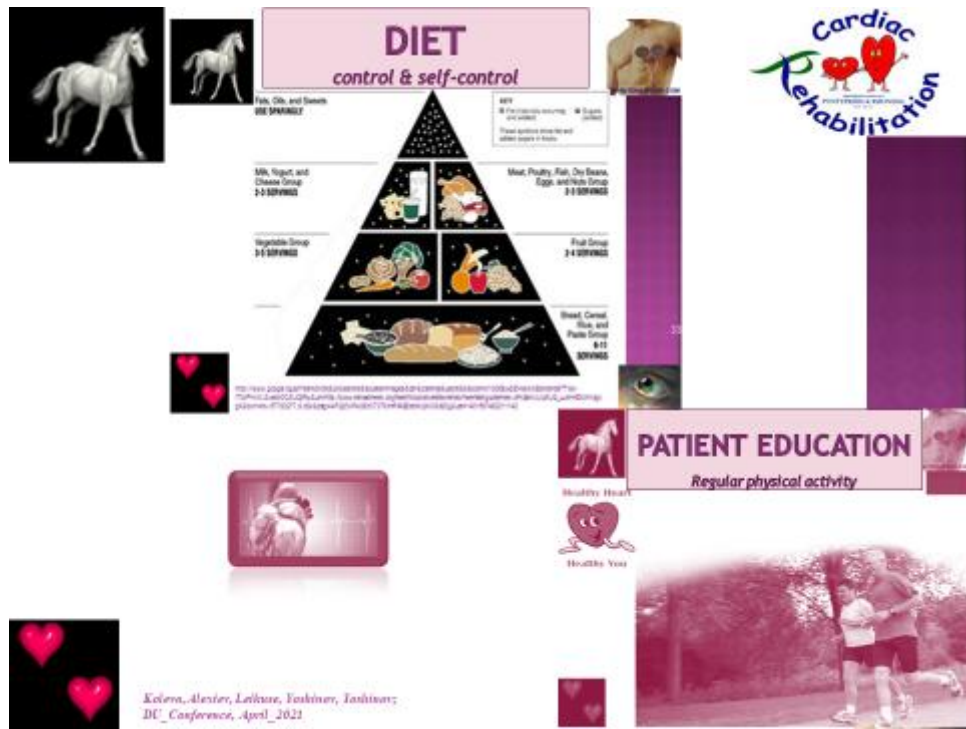


Figure 4. Diet and Patient's education

The control group (Gr 0) received only this CR programme.

In the experimental groups (E) we added *balance & gait training exercises* (figures 5 and 6):

- In gr-E1 – only *balance & gait training*;
- In the next group Gr-E2 we applied additionally *coordination exercises* for the upper and lower extremities.



Figure 5. Balance training



Figure 6. Specific Balance exercises for seniors

## Results

**The statistical analysis of the results of functional assessments** demonstrates in all patients significant improvement of circulatory parameters (response of arterial tension and pulse to physical activity); upgrade in cardiac functional parameters (Holter-cardiography; Trans-Thoracic Echocardiography /ejection fraction/), enlargement in autonomy (Timed Up and Go test; Functional Independence Measure – subscales of Self-care, Transfers and Locomotion). We observed bigger amelioration in quality of life in the third group.

Next figures illustrate our results. The improvement of circulatory parameters are presented in figures 7 and 8. We can observe the response of arterial tension and arterial radial pulse (heart rate) to physical activity.

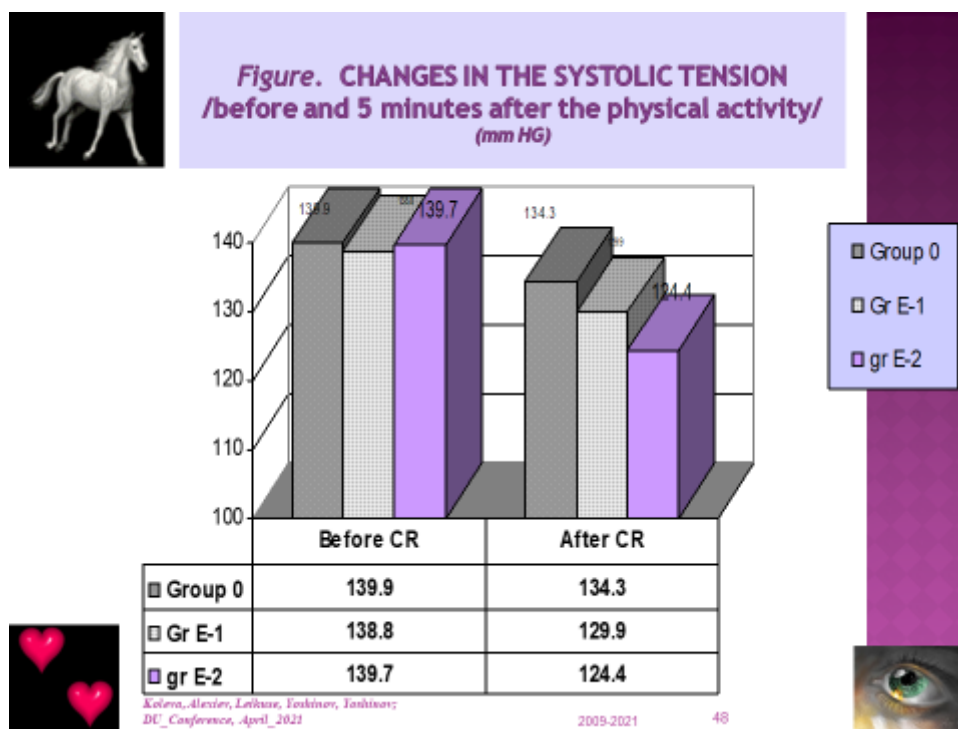


Figure 7. Changes in the arterial systolic tension

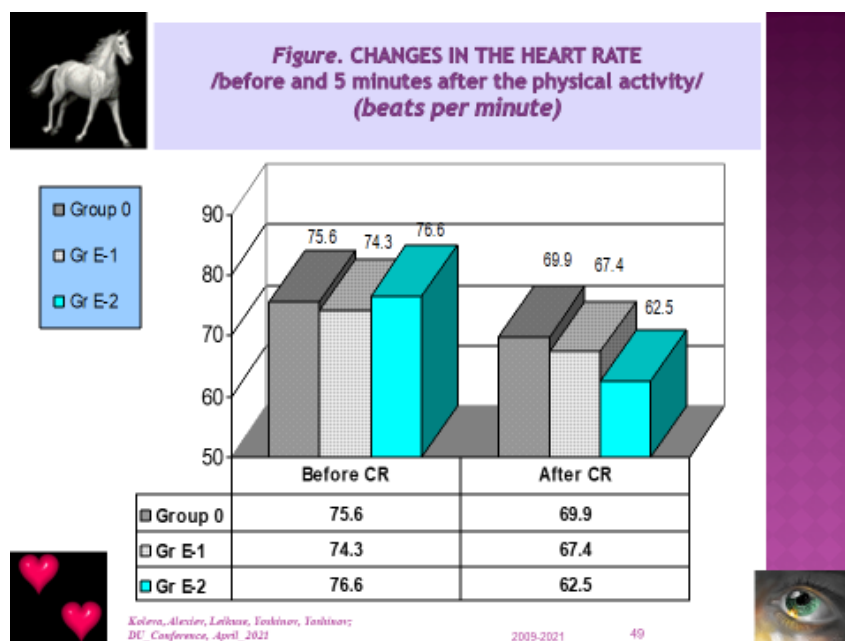


Figure 8. Changes in the heart rate (arterial pulse measured)

The upgrade in cardiac functional parameters, measured by Holter-cardiography and Trans-Thoracic Echocardiography /ejection fraction/ will be published in cardiological journals.

The enlargement in autonomy can be measured by the results of the Timed Up and Go (TUG) test (figure 9).

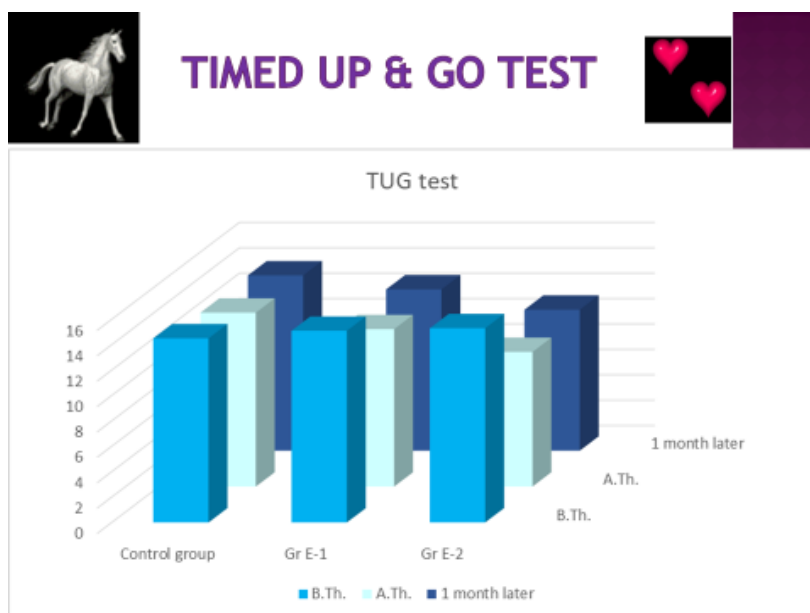


Figure 9. Results of the TUG-test

The amelioration of the quality of life after cardiorehabilitation programme is illustrated by the results of the WHO-5 Well-being index of Ohio university (Bech, 2004), presented in next figure 10. The results are stable one month after the end of the CR-program.

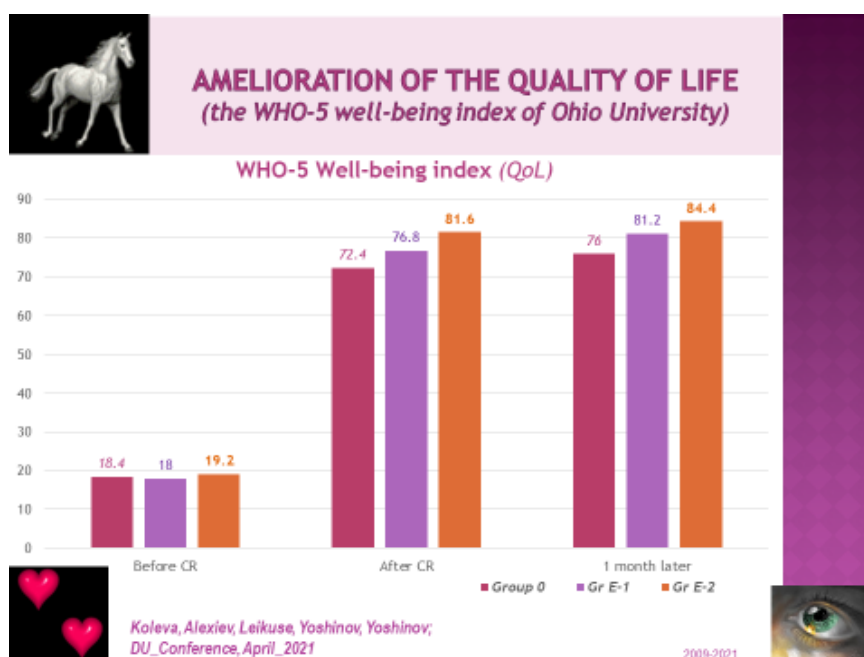


Figure 10. Amelioration in the quality of life (WHO-5 well-being index)

## Discussion

Clinical practice demonstrates the importance of the early mobilization after cardiac operation for the functional recovery.



The upgraded cardio-rehab algorithm must include: *physiotherapy and ergotherapy* with functional activities, aerobic training; respiratory exercises; balance & coordination exercises; gait training.

Of course, this CR algorithm includes the obligatory elements of every rehabilitation algorithm, as follows: *diet; medication; control of risk factors; patient education; regular physical training; activities.*

The organization of the program of care of every cardiac or cardio-surgical patient must be monitored – *from the cardiosurgery or the intensive ward to the cardiorehabilitation unit* (fig.11).

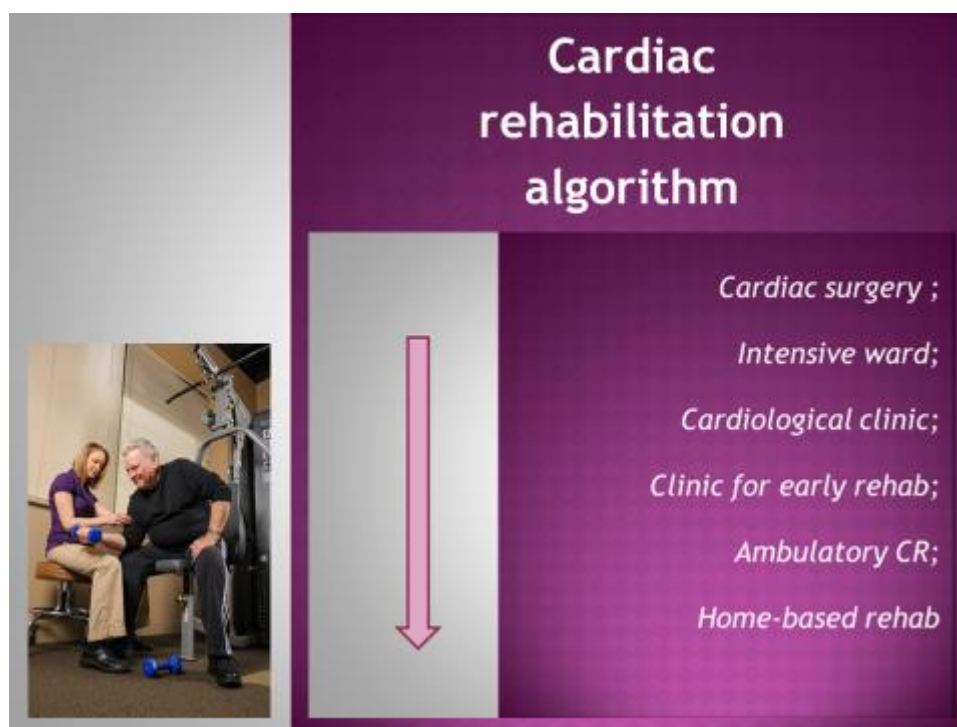


Figure 11.

*The benefits of the application of cardiorehab programmes* include: clinical amelioration; regulation of dyslipidemia; smoking cessation; reduction of mortality of myocardial infarction; amelioration of the quality of life. Our results coincide with the data of many authors (Pollock et al, 2000; Rejeski and Mihalko, 2001; Nelson et al, 2007).

### Conclusions

Cardiac rehabilitation improves the quality of life, reduce the need for medicines to treat heart or chest pain, decrease the chance to go back to a hospital or emergency room for a heart problem, prevent future heart problems, and even help the patient to live longer. Balance, gait & coordination training must be obligatory element of cardiac rehabilitation algorithm in geriatric patients after cardiac surgery requiring extra-corporeal circulation.

## References

- Bech P. Measuring the dimensions of psychological general well-being by the WHO-5. QoL Newsletter 2004; 32: 15-16.
- Cuccurullo S. Editor. Physical Medicine and Rehabilitation Board Review. – New York: Demos Medical Publishing, 2004.
- DHHS. 2008 *Physical Activity Guidelines for Americans*. Rockville (MD): U.S. Department of Health and Human Services; 2008.
- Exercise for Patients with Coronary Artery Disease. *Medicine & Science in Sports & Exercises*, 26, 1994, 3, 400.
- Fletcher G, Balady G, Amsterdam E, et al. Exercise standards for testing and training: a statement for healthcare professionals from the American Heart Association. *Circulation*. 2001; 104(14): 1694-740.
- Gonzalez P., S. Cuccurullo, I. Jafri, L. Luciano. Cardiac Rehabilitation. – In: Cuccurullo S. Editor. Physical Medicine and Rehabilitation Board Review. – New York: Demos Medical Publishing, 2004.
- Holviala JH, Sallinen JM, Kraemer WJ, Alen MJ, Häkkinen KK. Effects of strength training on muscle strength characteristics, functional capabilities, and balance in middle-aged and older women. *J Strength Cond Res*. 2006; 20(2): 336-44.
- Nelson ME, Rejeski WJ, Blair SN, et al. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation*. 2007; 116 (9): 1094-105.
- Pescatello L, Franklin B, Fagard R, Farquhar W, Kelley G, Ray C. American College of Sports Medicine. Position Stand. Exercise and hypertension. *Med Sci Sports Exerc*. 2004; 36(3): 533-53.
- Pollock M, Franklin B, Balady G, et al. American Heart Association Science Advisory. Resistance exercise in individuals with and without cardiovascular disease: benefits, rationale, safety, and prescription: an advisory from the Committee on Exercise, Rehabilitation, and Prevention, Council on Clinical Cardiology, American Heart Association; Position paper endorsed by the American College of Sports Medicine. *Circulation*. 2000; 101 (7): 828-33.
- Rejeski WJ, Mihalko SL. Physical activity and quality of life in older adults. *J Gerontol A Biol Sci Med Sci*. 2001; 56 Spec No 2: 23-35.
- Shephard R. Aging, Physical Activity, and Health. Champaign (IL): Human Kinetics; 1997.
- Thompson P, Buchner D, Pina I. Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease: a statement from the Council on Clinical Cardiology (Subcommittee on Exercise, Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity). *Circulation*. 2003; 107 (24): 3109-16.
- Wenger NK, Froelicher ES, Smith LK et al. Cardiac rehabilitation as secondary prevention. Agency for Health Care Policy and Research and National Heart, Lung, and Blood Institute. *Clin Pract Guidel Quick Ref Guide Clin*. 1995; Oct: 1–23
- Zohman L, Tobis JS. A rehabilitation program for inpatients with recent myocardial infarction. *Arch Phys Med Rehabil* 1968; 49: 443.