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EXERCISE-BASED REHABILITATION FOR METABOLIC SYNDROME - CASE REPORT

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EXERCISE-BASED REHABILITATION FOR METABOLIC SYNDROME - CASE REPORT (Abstract): Physical activity is a key part of cardiac rehabilitation, especially in patients with metabolic syndrome. Recent reports suggest that high-intensity interval training is more effective than continuous moderate intensity training, classically employed in cardiac rehabilitation programs. However, the implementation of a standard training protocol aimed at achieving a target heart rate during exercise can be limited by exaggerated pressor response, especially in deconditioned subjects. We report the case of a 47-year-old male with metabolic syndrome who was enrolled in a one-year exercise based-cardiac rehabilitation program. We implemented a two-phase protocol, starting with 5 continuous training sessions at 25 W, during which we gradually increased exercise duration up to 30 minutes. The second phase of the program consisted of biweekly interval training sessions of 25-50, 50-75 and finally 75-100 W. The switch to higher workloads was made only after the patient presented appropriate pressor response adaptation to current training intensity. Our program positively influenced our subject`s cardiovascular risk factors and allowed discontinuation of antihypertensive drug therapy. **Keywords**: CARDIAC REHABILITATION, METABOLIC SYNDROME, INTERVAL TRAINING.

At least 3-5 weekly sessions of physical activity (150 minutes of moderate intensity or 75 minutes of vigorous physical exercise) decrease all-cause mortality and positively influence cardiovascular risk factors, including the incidence of metabolic syndrome (MS) (1, 2, 3). MS is not only more prevalent in patients with cardiovascular disease, but also an independent risk factor for higher morbi-mortality rates among these patients (4). It is estimated that half of the patients referred to cardiac rehabilitation suffer from metabolic syndrome, and several studies have shown an improvement of all MS diagnostic criteria after cardiovascular rehabilitation. The fact that short-term effects of cardiac rehabilitation appear to be more spectacular than the long-term results can be due to poor long-term adherence to lifestyle changes (5).

The level of physical activity is inversely correlated to metabolic syndrome incidence, making it one of the most important components of cardiac rehabilitation programs (6). Performing cardiopulmonary exercise (CPX) testing when enrolling a patient in a rehabilitation program allows an objective assessment of the subject`s physiologic response to exercise and plays a key part in risk stratification and determining optimal exercise training intensity. CPX test results include peak $VO_2$ – a marker of the patient`s functional capacity, the anaerobic threshold – which guides exercise prescription, respiratory exchange ratio and oxygen pulse. CPX testing is particularly useful in patients on beta-blocker treatment, in which the Karvonen method (using heart rate reserve in prescribing target heart rate during exercise) should not be employed (7).

Patients with cardiovascular disease are usually recommended moderate intensity exercise at 60-80% of the maximum heart rate or anaerobic threshold. Recent reports suggest that high-intensity interval training is more efficient than classical moderate-intensity continuous training (8). According to another report, even 51 minutes per week of high intensity interval training was as effective as 150 minutes per week of moderate intensity continuous training in patients with metabolic syndrome (9). Further studies are needed to determine the most effective length of the high intensity interval bout as well as the optimal weekly volume of training.

CASE REPORT

CD, a 47-year-old male, was referred to the local Cardiovascular Rehabilitation Clinic for exercise testing and exercise-based rehabilitation for grade II arterial hypertension. His past medical history also included obesity, mixed dyslipidemia and a positive family history of hypertension and diabetes. The patient met the criteria for metabolic syndrome: class 1 abdominal obesity (Body Mass Index 34.1, waist circumference 118 cm) elevated fasting glucose (112 mg%), hypertriglyceridemia (209 mg%), hypertension (165/100 mmHg on admission), so we decided to start treatment with a low dose angiotensin converting enzyme inhibitor.

During the cardiopulmonary stress test our patient achieved a maximum workload of 120 W (59% of predicted value), with a peak oxygen uptake (VO_2) of 1719 mL/min (62% of predicted value) and anaerobic threshold of 1710 mL/min (17.6 mL/kg/min), suggesting a slight reduction of functional capacity (Weber class A). The test was halted after 11 minutes due to uncontrolled blood pressure (BP) values (230/120 mmHg), although our previous Ambulatory Blood Pressure Monitoring (ABPM) illustrated appropriate blood pressure control (mean 24h-Systolic BP 115 mmHg, mean 24h-Diastolic BP 71 mmHg, max-BP 150/125 mmHg, 24h systolic abnormal ratio 2.8%, dipping index 18%).

Our patient was enrolled in an exercise-based rehabilitation program, consisting of biweekly 30-minute sessions of aerobic resistance training on a bicycle ergometer under the supervision of a certified kinesiotherapist. The first phase of rehabilitation consisted of 5 sessions during which we progressively increased cycling duration from 10 to 30 minutes. This was performed at a continuous workload of 25 W. We started the second phase training sessions with 2.5-minute warm-up followed by five sets of 4-minute cycling at 25 W and 1-minute training at 50 W, ending with a 2.5-minute cool-down. The work-out intensity was gradually increased according to protocol (tab. I). The switch to higher workloads (50-75W and 75-100W after 1 and 5 months, respectively), was determined by patient’s pressor response during exercise.

TABLE I
Interval training protocol

	2.5-minute warm-up	5 x 5 minutes training sequences of:	2.5-minute cool down	Exercise duration
25-50W	10 W	4` - 25W + 1` - 50 W 3` - 25W + 2` - 50 W 2` - 25W + 3` - 50 W 1` - 25W + 4` - 50 W	10 W	30 minutes
50-75W		4` - 50W + 1` - 75 W 3` - 50W + 2` - 75 W 2` - 50W + 3` - 75 W 1` - 50W + 4` - 75 W		30 minutes
75-100W		4` - 75W + 1` - 100 W 3` - 75W + 2` - 100 W 2` - 75W + 3` - 100 W 1` - 75W + 4` - 100 W		30 minutes

A second cardiopulmonary stress test was performed after 1 year of exercise-based physical rehabilitation, with significantly improved results (maximum workload 178 W, 86% of predicted value, VO_2 max 2174 mL78% of predicted value, oxygen pulse 17 mL/min). Our patient`s cardiovascular risk markers also showed gradual improvement during the 1-year follow-up (tab. II), allowing the withdrawal of previous angiotensin converting enzyme inhibitor treatment.

TABLE II
Evolution of clinical and biological parameters during the one-year follow-up

	Baseline value	Months 3	6	12
Weight	108	106	103	98
Waist circumference	118	117	114	110
Triglycerides	209	180	103	92
Total cholesterol	209	180	151	160
Low density lipoprotein cholesterol (LDL)	113.2	83	55	57.6
Glycemia	112	108	103	98
Systolic BP	165	132	130	117
Diastolic BP	100	92	79	68
Resting Heart Rate	92	86	72	65

DISCUSSION

High intensity training has proven more effective than continuous moderate intensity training standardly used in cardiac rehabilitation. Although several training protocols have been studied and published (8), the implementation of a standard, universal protocol, aimed at achieving a target heart rate during exercise is often limited by patient`s exaggerated pressor response, as illustrated in our case report.

During the first CPX testing, our patient rated the perceived exertion as "somewhat hard" (Borg scale 13) but the test was halted after 11 minutes due to high blood pressure (230/120 mmHg). Although according to our subject`s test results (maximum workload 120 W, Weber class A) we could have begun the phase I trainings at a 50 W workload, our patient presented an exaggerated pressor response after just 4 minutes of training (BP 200/110 mmHg) forcing us to decrease initial continuous exercise workload to 25 W. Cycling duration at 25 W was also limited by high blood pressure values (127/72 mmHg at baseline, 160/100 mmHg after 4 minutes and 170/100 after 10 minutes), requiring 5 sessions in which we gradually increased exercise duration from 20 to 30 minutes thus allowing pressor response adaptation.

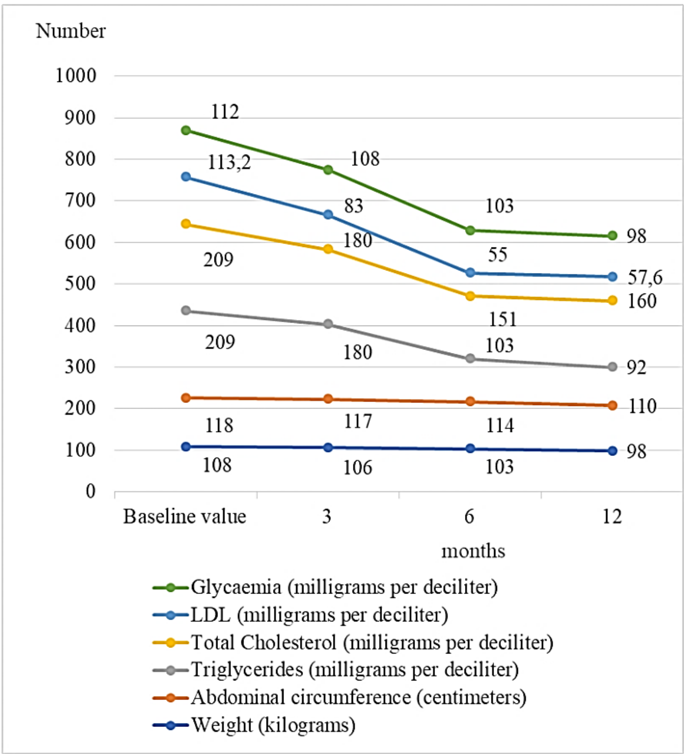

Fig. 1. Beneficial effects during 1 year of exercise rehabilitation: weight, triglycerides, LDL, waist circumference, total cholesterol and fasting glucose have all improved by 9.2%, 55.9%, 49.11%, 6.7%, 23.4% and 12.5%, respectively.

Our two-phased training protocol ensured that the patient maintained adequate blood pressure values during work-out and permitted the switch to higher workload exercise sessions only after achieving appropriate pressor response adaptation to current exercise intensity (blood pressure during peak workload interval below 140/90 mmHg). Our approach has proven as effective as other rehabilitation protocols (5) in reducing the patient`s resting heart rate (by 29%, 27 beats per minute), systolic and diastolic blood pressure values (by 29 and 32%, respectively), thus allowing withdrawal of the antihypertension medication. After one year of exercise-based cardiac rehabilitation our subject no longer meets the metabolic syndrome criteria, exhibiting a 12.5% decrease in fasting glucose, a 55.9% decrease in serum triglycerides as well as a 6.7% decrease in waist circumference, now below the 102 cm threshold (fig.1).

Patient adherence is still an unresolved issue in cardiac rehabilitation (8). However, our individualized exercise protocol was enthusiastically received by our patient, who was present for 82% of his scheduled sessions, an excellent adherence rate compared to those reported in other studies (8). We believe that our 3- and 6-month check-ups contributed to this high adherence rate as it allowed the patient to acknowledge his progress.

CONCLUSIONS

The intensity of interval training in our patient was limited by exaggerated pressor and chronotropic response to relatively low exercise workload, although according to the cardiopulmonary exercise test our subject presented mildly altered functional capacity (Weber class A). Our patient with metabolic syndrome benefited from long-term exercise-based cardiac rehabilitation but required an individualized exercise protocol.

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