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The Efficacy of Telemedicine Rehabilitation Programs In Regard Of Risk Factors Control In Patients With Paroxysmal Atrial Fibrillation Aftercatheter Ablation

Aim	To evaluate changes in traditional risk factors (RF) during cardiac rehabilitation (CR) programs with remote support in patients with paroxysmal atrial fibrillation (AF) after catheter ablation (CA).
Material and Methods	The lack of control of cardiovascular RFs is a predictor for AF recurrence after CA, development of complications, and decreased life expectancy. Telemedical CR programs may improve the control of RF and enhance the CR efficacy. This randomized controlled clinical study in three parallel groups included 135 patients aged 35 to 79 years. In groups 1 and 2, CR programs with remote support were performed, which included a single personal consulting for the disease, achieving control of all patient's RFs, and remote support during 3 months (group 1, by phone and group 2, by e-mail). Participants of group 3 received standard recommendations. Body weight, blood pressure (BP), blood lipids, smoking status, and physical activity (PA) were determined at baseline and at 12 months after CA with the IPAQ questionnaire.
Results	In both intervention groups at 12 months, there were positive changes in RF: body weight index decreased by 3.6% in group 1 (p=0.01) and by 2.3% in group 2 (p=0.002) vs. 0 in the control group; systolic BP decreased by 7.1% (p<0.001) and 1.5% (p=0.003) in groups 1 and 2 (vs. increases by 3.3% in group 2); total cholesterol decreased by 9.4% (p<0.001) and by 6.3% (p=0.003), respectively, (vs. 0 in group 3); values of metabolic equivalents (METs) used for walking increased by 55.0% (p=0.014), 75.0% (p=0.001), and 1.4% in groups 1, 2 and 3, respectively. No significant intergroup differences in the frequency of AF recurrence, repeated CA, and hospitalizations were found.
Conclusion	CR programs with remote support provide improved control of BP, body weight, blood cholesterol, and AF in patients with AF after CA, according to the results of the one-year follow-up.

Keywords	Atrial fibrillation; catheter ablation, risk factor control; rehabilitation programs with remote support
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Atrial fibrillation (AF) is the most common heart rhythm disorder in routine clinical practice [1] that significantly worsens the prognosis [2]. Despite significant improvements in stroke prevention and heart rhythm control in patients with AF, the incidences of AF is increasing, which is partly due to higher prevalence of risk factors (RFs) for cardiovascular diseases (CVDs), such as arterial hypertension (AH), inadequate physical activity (PA), and other behavioral RFs, obesity, diabetes mellitus (DM). Many of these RFs may be reversed. There is evidence that their elimination can help prevent AF [3]. However, this aspect is still underestimated and understudied.

Interventional treatments for AF, such as radiofrequency (RF) and cryoballoon (CRYO) catheter ablation of pulmonary veins, have become more common in recent years. They have proven to be highly effective in the treatment of AF [4, 5]. However, patients with AF continue to face significant risk of cardiovascular complications and death after treatment, partly due to the substantial burden of conventional AF and other CVDs. It is well-known that certain RFs of AF (AH, inadequate PA, consumption of alcohol, hyperlipidemia, obesity/overweight, smoking, hyperglycemia) can affect the outcome of catheter ablation (CA) and predispose to more frequent recurrences. Aggressive control of modifiable RFs can reduce

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the recurrence rate [6]. In this regard, it is crucial to involve AF patients in comprehensive secondary prevention and rehabilitation programs, which should include patient education, control of all relevant RFs, psychological support, and improvement of treatment adherence [7, 8]. Several studies have shown that these programs are clinically successful [9, 10]. The matter of insufficient involvement of patients with CVDs in cardiac rehabilitation (CR) programs is well known, and this dictates the need to search for novel formats including remote ones. This approach has been shown effective regarding patient adherence, particularly in younger age groups [11, 12]. However, there are only few studies of such programs in AF patients, and the way patients view remote technologies and the efficacy of the CR programs can vary depending on cultural differences between nations. All this necessitates performing such studies in the Russian population of AF patients.

According to the randomized trial, this article addresses the management of RFs in patients with AF who underwent CA and took part in two different CR programs with remote support. This is the second publication of this study. The patients' psychological health and quality of life (QoL) were the main issues of the initial publication [13].

The objective of the study was to assess the evolution of traditional RFs during the implementation of CR programs with remote support in patients with post-CA paroxysmal AF.

Material and Methods

The study design has been previously described in detail [13]. A prospective, randomized, three-parallel group study included 135 (70 male and 65 female) patients aged 35–79 years with a verified diagnosis of paroxysmal AF and hospitalized for CA.

Acute coronary syndromes or stroke within 6 months before the inclusion; valvular AF; heart failure of functional class (FC) III–IV and other severe somatic and mental diseases; inability to fill in the questionnaires in Russian were the exclusion criteria.

After signing the informed consent, a case report form (CRF) was filled in, which included demographic and social characteristics, information on behavioral RFs, anthropometrics, blood pressure (BP), total cholesterol (TC), and plasma glucose. PA was assessed using the International Questionnaire on Physical Activity (IPAQ) [14, 15]. Ordered drug therapy and adherence, clinical outcomes of 12 months after the date of randomization (hospital admissions, ambulance calls, recurrence of AF, repeat CA) were registered in the CRF.

Patients were randomized to three groups (1:1:1). In treatment Group 1 and Group 2, CR 1 and CR 2 strategies were implemented, which included a single personal counseling during hospital stay (60-minute long) and remote support. Remote support was provided by phone in Group 1 or by email in Group 2 once every 14 days for 3 months. In Group 3 (control), patients received standard recommendations at discharge. The follow-up lasted for 12 months, during which patients continued to be supervised in residential outpatient clinics.

The study protocol was approved by the local ethics committee of the Moscow Scientific Practical Center for Medical Rehabilitation, Regenerative and Sports Medicine.

Statistical data processing was conducted using SPSS 23.0 (SPSS Inc., USA). Distribution of quantitative variable was analyzed using the Kolmogorov-Smirnov test. If the distribution was parametric, the means and standard deviations (M±SD) were calculated. For non-normally distributed qualitative ordinal and quantitative variables, the medians and interquartile ranges ((Me [25%; 75%]) were calculated. Two groups were compared using the Mann-Whitney U-test for quantitative variables and Pearson's chi-squared test or two-tailed Fisher's exact test for qualitative variables. Intragroup changes were assessed using the Wilcoxon test for quantitative variables and McNemar chi-squared test for qualitative variables. Changes in the quantitative variables was also evaluated by Δ %, which was calculated using the following formula:

$$\Delta\% = [\,(N1 - N0)/N0] \times 100\%;$$

where N0 is the baseline value of an indicator, N1 is the value of the indicator over time. The differences were considered statistically significant with two-tailed p-value of less than 0.05.

Results

The main social demographic and clinical characteristics of patients are presented in Table 1.

With the exception of education, the three patient groups were comparable in terms of basic demographics (sex, age), social characteristics (marital status, employment status, income level), and the majority of clinical characteristics. More than 50% of patients in each group had AH (57.8%, 77.8%, and 66.7%, respectively); many patients also had chronic heart failure (CHF). More than 75% of the subjects had FC III according to the modified EHRA score: the main complaints included palpitations (99.3%), weakness (64.4%), dyspnea (51.9%). The subjects were mainly patients with abnormal body weight. According to the IPAQ questionnaire, one in ten patients had a low level of PA (13.3%, 11.1%, and 8.9%, respectively). The percentage of smokers was small, but more than 40% of patients occasionally or regularly drank alcohol.

The vast majority (94%) of patients received anticoagulant therapy, 57% of patients took antiarrhythmic drugs, approximately every second patient took an angiotensin-

converting enzyme inhibitor/angiotensin II receptor blocker and beta-blockers, 34.8% patients received statins.

After the 12-month follow-up, some positive changes in terms of RFs of CVDs were observed in the treatment groups. Compared to the baseline, patients of the treatment groups showed a significant decrease in systolic blood pressure (SBP): by 7.1% in Group 1 and by 1.5% in Group 2, and SBP increased by 3.3% in the control group (Table 2). There were no statistically significant changes in diastolic blood pressure levels.

Weight loss was established at the long-term stage in both CR groups: body mass index (BMI) decreased by a mean of 3.6% in Group 1 and 2.3% in Group 2, and it did not change in the control group (Table 3).

After 12 months, patients of both treatment groups were more engaged in PA than the control group, which was

Table 1. Baseline social demographic and clinical characteristics of patients

Parameter	Treatment group 1 (n = 45)	Treatment group 2 (n = 45)	Group 3 control group (n = 45)	p_{1-3}	p_{2-3}
Social and demographic characteristics					
Age, years, mean ± SD	57.0 ± 7.5	57.8 ± 9.7	57.0 ± 10.3	0.750	0.750
Male, n (%)	23 (51.1)	25 (55.6)	22 (48.9)	0.833	0.527
Higher education, n (%)	39 (86.7)	33 (73.3)	26 (57.8)	< 0.005	0.120
Employment status, n (%)					
Any forms of employment	22 (48.9)	29 (64.4)	25 (55.6)	0.155	0.229
Marital status, n (%)					
Formally married	36 (80)	36 (80)	34 (75.6)	0.172	0.172
CVD risk factors					
Body mass index, kg/m2 (M ± SD)	29.9 ± 4.9	29.5 ± 3.6	29.9 ± 4.2	0.878	0.695
Waist circumference, cm (M ± SD)	81.1 ± 9.7	89.3 ± 11.1	89.6 ± 9.5	< 0.001	0.984
Low PA, n (%)	6 (13.3)	5 (11.1)	4 (8.9)	0.902	0.684
Smoking status, n (%)					
• Used to smoke but do not smoke now	16 (35.6)	11 (24.4)	17 (37.8)	0.646	0.314
• Continue to smoke	2 (4.4)	3 (6.7)	4 (8.9)		
Status of alcohol consumption, n (%)					
• Occasionally drink alcohol	17 (37.8)	19 (42.2)	19 (42.2)	0.223	0.568
• Regularly drink alcohol	2 (4.4)	0	1 (2.2)		
Clinical characteristics					
Systolic BP, mm Hg (mean ± SD)	129.3 ± 16.1	127.7 ± 15.7	126.6 ± 15.7	0.380	0.461
Diastolic BP, mm Hg (mean ± SD)	77.9 ± 9.2	77.6 ± 8.2	77.7 ± 7.0	0.789	0.722
Arterial hypertension, n (%)	26 (57.8)	35 (77.8)	30 (66.7)	0.384	0.239
Coronary artery disease, n (%)	2 (4.4)	6 (13.3)	4 (8.9)	0.677	0.502
Diabetes mellitus type 2, n (%)	0	1 (2.2)	4 (8.9)	0.117	0.361
CHF, n (%)	16 (35.6)	26 (57.8)	20 (44.4)	0.389	0.206
Severity of AF symptoms (modified EHRA), classes, n (%)					
II	7 (15.6)	5 (11.3)	4 (8.9)		
III	35 (77.8)	38 (82.2)	34 (75.6)	0.296	0.097
IV	3 (6.6)	1 (2.3)	7 (15.6)		
Drug therapy, n (%)					
• Warfarin	10 (22.2)	9 (20)	10 (22.2)	1.0	0.796
• Direct oral anticoagulants	32 (71.1)	32 (71.1)	34 (75.6)	0.634	0.634
• Antiplatelet drugs	4 (8.9)	1 (2.2)	0	0.117	1.0
• ACE inhibitors/angiotensin II receptor blockers	19 (42.2)	26 (57.8)	25 (55.6)	0.206	0.832
• Statins	18 (40)	17 (37.8)	12 (26.7)	0.180	0.259
Antiarrhythmic drugs, n (%)					
Class IC	6 (13.3)	11 (24.4)	15 (33.3)	0.003	0.264
Class II	23 (51.1)	28 (62.2)	18 (40)	0.290	0.035
Class III	14 (31.1)	12 (26.7)	21 (46.7)	0.458	0.016
Class IV	4 (8.9)	8 (17.8)	5 (11.1)	0.203	0.368

SD, standard deviation; PA, physical activity.

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Table 2. Changes in blood pressure in the treatment and control groups

Parameter	Treatment group 1 (n = 45)	Treatment group 2 (n = 45)	Group 3 control group (n = 45)	p_{1-3}	p_{2-3}
Changes in SBP, mm Hg					
Baseline, mean ± SD	129.3 ± 16.1	127.7 ± 15.7	126.6 ± 15.7	0.380	0.461
In 12 months, mean ± SD	120.6 ± 13.4	126.9 ± 11.5	130.6 ± 11.9	**0.001**	0.235
Δ%, Me [25 %; 75 %]	–7.1 [–14.8; 2.8]	–1.5 [–7.0; 4.8]	3.3 [–2.2; 10.9]	**< 0.001**	**0.003**
$p_{baseline - 12\ months}$	**0.001**	0.345	**0.028**	–	–
Changes in DBP, mm Hg					
Baseline, mean ± SD	77.9 ± 9.2	77.6 ± 8.2	77.7 ± 7.0	0.789	0.722
In 12 months, mean ± SD	76.5 ± 9.6	77.1 ± 6.1	76.1 ± 7.3	0.320	0.158
Δ%, Me [25 %; 75 %]	0 [–11.1; 7.3]	0 [–6.6; 6.1]	–2.5 [–10.0; 3.1]	0.585	0.266
$p_{baseline - 12\ months}$	0.439	0.694	0.151	–	–

SD, standard deviation; Me, median, SBP, systolic blood pressure; DBP, diastolic blood pressure.

Table 3. Changes in WC and BMI in the treatment and control groups

Parameter	Treatment group 1 (n = 45)	Treatment group 2 (n = 45)	Group 3 control group (n = 45)	p_{1-3}	p_{2-3}
WC, mean ± SD, cm					
Baseline	81.1 ± 9.7	89.3 ± 11.1	89.6 ± 9.5	**< 0.001**	0.984
In 12 months	80.5 ± 9.5	88.5 ± 11.1	88.8 ± 9.4	**< 0.001**	0.952
Δ%, Me [25 %; 75 %]	0 [–2.2; 0]	0 [–1.2; 0]	0 [0; 0]	0.077	**0.016**
$p_{baseline - 12\ months}$	**0.028**	**0.006**	0.276	–	–
BMI, mean ± SD, kg/m²					
Baseline	29.9 ± 4.9	29.5 ± 3.6	29.9 ± 4.2	0.878	0.695
In 12 months	28.8 ± 4.4	28.9 ± 3.4	29.7 ± 4.1	0.327	0.465
Δ%, Me [25 %; 75 %]	–3.6 [–7.1; 1.1]	–2.3 [–3.5; -0.9]	0 [–2.2; 1.0]	**0.010**	**0.002**
$p_{baseline - 12\ months}$	**0.001**	**< 0.001**	**0.026**	–	–

SD, standard deviation; Me, median; WC, waist circumference; BMI, body mass index.

shown by higher total weekly metabolic equivalents (METs) and METs spent for walking. Moreover, the percentage of patients with high levels of PA was significantly higher in both treatment groups than in the control group (Table 4, Figure 1).

The analysis of the lipid and carbohydrate metabolism showed a statistically significant decrease in TC in the treatment groups compared to the control group: by a mean of 9.4% in Group 1 and 6.3% in Group 2, and it did not change in the control group. In 12 months, the levels of triglycerides (TG) were also significantly lower in Group 1 than in the control group ($p<0.005$). It can be assumed that these changes could be attributed to changes in dietary habits and greater adherence to administering statins. There were no statistically significant differences in other lipid parameters and blood glucose (Table 5).

There were no significant changes and intergroup differences in smoking and alcohol consumption.

Although the study lacked the statistical power to assess clinical outcomes, an exploratory analysis of the frequency of AF recurrences following CA, repeat CAs and hospitalizations was conducted. There were no statistically significant differences between the groups. In Group 1, 13 (28.9%) patients experienced recurrence of AF, 1 (2.2%) patient underwent repeat CA, and 5 (11.1%) patients were hospitalized for CVDs. In Group 2, 15 (33.3%) patients experienced recurrent AF, 2 (4.4%) patients underwent repeat CAs, and 11 (24.4%) patients were hospitalized for CVDs. In Group 3, 19 (42.2%) patients had recurrent AF, 3 (6.7%) patients underwent repeat CAs, and 9 (20%) patients were hospitalized for CVDs.

However, patients of both treatment groups were less likely to complain of palpitations in 12 months, which were observed in 11 (24.4%), 8 (17.8%), and 24 (53.3%) patients in Group 1, Group 2, and Group 3, respectively ($p=0.005$ for Group 1 versus Group 3 and $p < 0.001$ for Group 2 versus Group 3). Moreover, the prevalence of AF symptoms was generally lower in Group 2 compared to the control group ($p= 0.003$), and the modifiable EHRA score was also lower and did not reach statistical significance (Table 6).

Discussion

According to our study, patients with AF following CA in the groups of CR programs with remote support showed

Table 4. Metabolic requirements for physical activity of varying intensity in the treatment and control groups

Parameter	Treatment group 1 (n = 45)	Treatment group 2 (n = 45)	Group 3 control group (n = 45)	p_{1-3}	p_{2-3}
Total METs (MET-min/wk)					
Baseline, mean ± SD	2596.8 ± 2332.2	2701.9 ± 4667.1	2586.1 ± 2080.1	0.802	0.764
In 12 months, mean ± SD	2677.4 ± 1084.7	2295.1 ± 1175.9	1960.1 ± 713.2	**< 0.001**	0.207
Δ%, Me [25 %; 75 %]	27.1 [–31.4; 149.7]	69.3 [–29.2; 200.3]	–7.4 [–48.2; 79.4]	**0.049**	0.010
$p_{baseline - 12\ months}$	0.323	0.170	0.200	–	–
METs spent on high PA					
Baseline, mean ± SD	447.6 ± 1206.8	654.2 ± 2602.8	210.7 ± 633.7	0.256	0.964
In 12 months, mean ± SD	154.7 ± 403.8	192.9 ± 596.9	87.1 ± 193.4	0.744	0.439
Δ%, Me [25 %; 75 %]	–100.0 [–100.0; -59.4]	–88.9 [–100; -12.5]	–100 [–100; -46.9]	0.893	0.596
$p_{baseline - 12\ months}$	0.224	0.507	0.732	–	–
METs spent on moderate PA					
Baseline, mean ± SD	442.7 ± 944.7	630.2 ± 1565.4	493.0 ± 978.3	0.808	0.564
In 12 months, mean ± SD	480.4 ± 442.9	398.7 ± 330.6	341.8 ± 262.2	0.123	0.501
Δ%, Me [25 %; 75 %]	41.7 [–50.0; 191.7]	–61.4 [–83.3; 187.5]	–18.3 [–72.5; 45.8]	0.176	0.235
$p_{baseline - 12\ months}$	**0.008**	0.465	0.430	–	–
METs spent on walking					
Baseline, mean ± SD	1675.7 ± 1389.8	1500.9 ± 1268.0	1864.9 ± 1476.8	0.510	0.324
In 12 months, mean ± SD	2042.3 ± 824.6	1703.5 ± 707.5	1499.5 ± 659.1	**0.004**	**0.046**
Δ%, Me [25 %; 75 %]	55.0 [–20.0; 150.0]	75.0 [3.1; 220.0]	1.4 [–51.1; 86.1]	**0.014**	**0.001**
$p_{baseline - 12\ months}$	**0.051**	**0.013**	0.463	–	–
Sitting, h/day					
Baseline, mean ± SD	358.7 ± 86.3	366.4 ± 122.9	357.6 ± 116.8	0.540	0.533
In 12 months, mean ± SD	328.0 ± 64.7	338.7 ± 69.1	338.7 ± 71.4	0.432	0.695
Δ%, Me [25 %; 75 %]	0 [–16.7; 0]	0 [–22.5; 18.3]	0 [–22.5; 20.0]	0.173	0.552
$p_{baseline - 12\ months}$	**0.015**	0.161	0.402	–	–

SD, standard deviation; Me, median; METs, metabolic equivalents; PA, physical activity.

Figure 1. Physical activity categories in the treatment and control groups at baseline and in 12 months

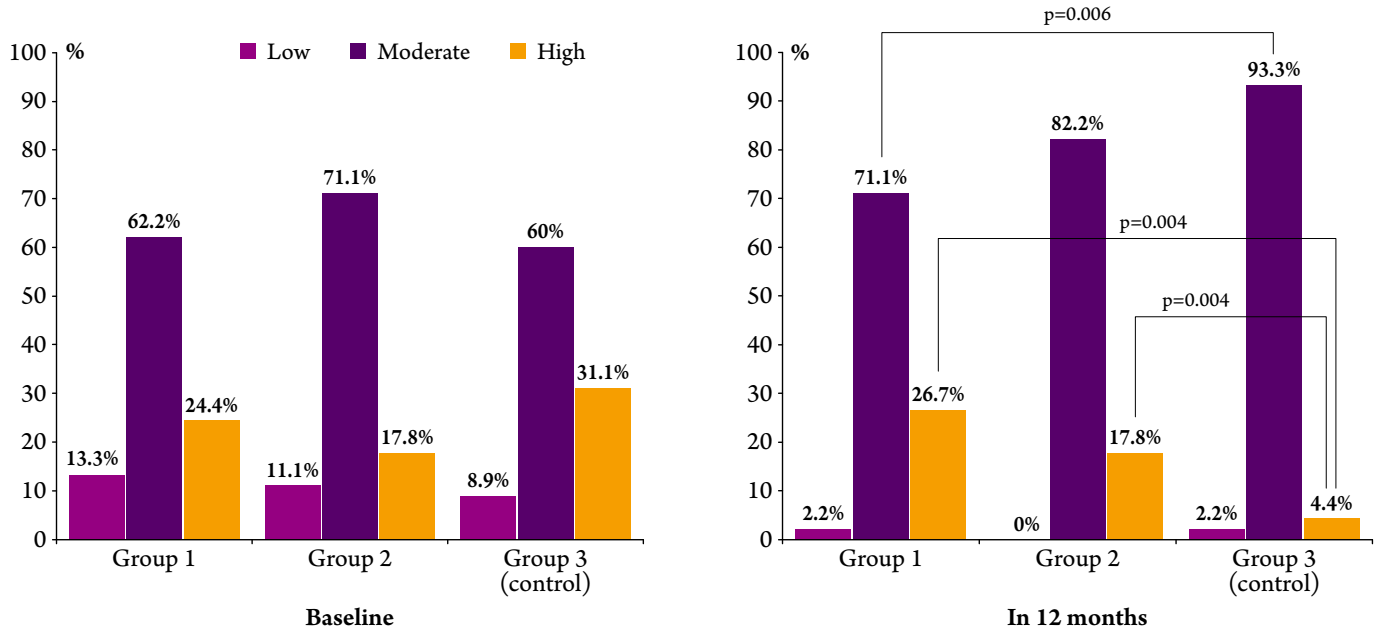

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Table 5. Changes in lipid and carbohydrate metabolism in the treatment and control groups

Parameter	Treatment group 1 (n = 45)	Treatment group 2 (n = 45)	Group 3 control group (= 45)	p_{1-3}	p_{2-3}
Changes in TC levels, mmol/L (mean ± SD)					
Baseline	5.3 ± 1.1	5.2 ± 1.0	5.4 ± 0.9	0.600	0.101
In 12 months	4.8 ± 0.8	4.9 ± 0.8	5.4 ± 0.9	**0.002**	**0.004**
Δ%, Me [25 %; 75 %]	–9.4 [–14.5; -2.0]	–6.3 [–9.1; 0]	0 [–4.6; 3.5]	**< 0.001**	**0.003**
$p_{baseline - 12 months}$	**< 0.001**	**0.001**	0.279	–	–
Changes in LDL cholesterol levels, mmol/L (mean ± SD)					
Baseline	3.0 ± 1.0	3.1 ± 1.0	3.3 ± 0.8	0.233	0.423
In 12 months	3.1 ± 0.7	3.1 ± 0.8	3.3 ± 0.8	0.099	0.212
Δ%, Me [25 %; 75 %]	0 [–3.7; 4.3]	0 [–2.9; 0.4]	0 [0; 0]	0.969	0.684
$p_{baseline - 12 months}$	0.649	0.373	0.644	–	–
Changes in TG levels, mmol/L (mean ± SD)					
Baseline	1.8 ± 1.0	1.9 ± 0.6	1.9 ± 0.6	0.195	0.874
In 12 months	1.5 ± 0.5	1.7 ± 0.7	1.8 ± 0.5	**0.004**	0.423
Δ%, Me [25 %; 75 %]	–7.1 [–24.8; 0]	–5.6 [–15.1; 0]	–5.3 [–9.5; 0]	0.102	0.292
$p_{baseline - 12 months}$	**< 0.001**	**0.001**	**< 0.001**	–	–
Changes in glucose levels, mmol/L (mean ± SD)					
Baseline	5.2 ± 0.9	5.2 ± 0.7	5.1 ± 0.9	0.608	0.283
In 12 months	5.0 ± 0.6	4.9 ± 0.5	5.0 ± 0.7	0.686	0.362
Δ%, Me [25 %; 75 %]	–3.9 [–12.0; 7.9]	–6.7 [–12.3; 2.1]	0 [–10.6; 7.7]	0.774	0.073
$p_{baseline - 12 months}$	0.185	**< 0.001**	0.324	–	–

SD, standard deviation; Me, median; LDL, low density lipoprotein; TG, triglycerides.

positive trends over the 12-months follow-up period in several key indicators of secondary prevention of AF, including higher PA and lower body weight as well as lower levels of SBP, TC, and TG. The incidence of recurrent AF did not differ between the study groups. Although this result might have been influenced by more frequent administration of antiarrhythmic drugs in the control group. However, there was a small reduction in the frequency of symptoms, such as palpitations, in the treatment groups. We have previously demonstrated the efficacy of the programs in enhancing patients' psychological status and improving their QoL [13].

Our data are consistent with findings of a number of studies of the support programs for AF patients undergoing interventional therapy, most of which showed a comparable efficacy in face-to-face or mixed formats with multiple patient visits to clinics.

In the ARREST-AF cohort study [16], which included 149 patients with AF following CA, BMI ≥ 27 kg/m^2 and ≥1 RFs, the subjects were offered a structured program for "aggressive" control of RFs, which required visiting the clinic at least once every 3 months and included intensive dietary counseling; recommendations for PA; a program for quitting smoking and excessive alcohol consumption; CPAP therapy in sleep apnea syndrome; additional drug correction of blood pressure, lipidemia and glycemia. Patients who consented (n = 61) were included in the treatment group, the remaining patients were included in the control group. Aggressive control of RFs led to a more pronounced reduction in SBP (by 34.1 ± 7.5 mm Hg versus 20.6±3.2 mm Hg; p=0.003) and body weight (–13.2±5.4 kg versus –1.5±5.1 kg; p=0.002), more frequent achievement of target lipid levels (46.2% and 17%, respectively; p=0.01) and glycated hemoglobin in the presence of DM. Moreover, a more pronounced reduction in the frequency, duration, and severity of AF symptoms was achieved in the group of aggressive control of RFs (p<0.001).

In the Danish study CopenHeartRFA [17–19] (210 patients with AF following CA), educational interventions (4 consultations every 5–7 weeks for up to 6 months after CA) and a physical training program were conducted. In 12 months, patients' physical performance increased in the CR group as shown by peak oxygen consumption VO_2 peak (25.82 mL/kg/min in the CR group versus 22.43 mL/kg/min in the standard treatment group; p=0.003), and in 24 months, there were fewer patients in the treatment group with high levels of anxiety symptoms than in the conventional treatment according to the HADS score (12% in the CR group versus 24% in the standard treatment group; p = 0.004).

In the Russian randomized clinical trial (RCT) [20], a personalized face-to-face CR program conducted contributed to higher physical performance in patients with AF following RFA and improved control of other RFs (a 2.1% decrease in SBP; p<0.05), BMI (a 2.8% decrease; p<0.05), TC levels (11.2% decrease; p < 0.001) and low-density lipoprotein cholesterol (18.8% decrease; p < 0.001),

Table 6. Changes in the incidence and severity of AF symptoms in the treatment and control groups

Parameter	Treatment group 1 (n = 45)	Treatment group 2 (n = 45)	Group 3 control group (n = 45)	p1–3	p2–3
Baseline					
EHRA, score, mean ± SD	2.9 ± 0.5	2.9 ± 0.3	3.1 ± 0.5	0.129	0.072
Severity of AF symptoms (modified EHRA), classes, n (%)					
II	7 (15.6)	5 (11.3)	4 (8.9)		
III	35 (77.8)	38 (86.4)	34 (75.6)	0.296	0.097
IV	3 (6.6)	1 (2.3)	7 (15.5)		
Presence of AF symptoms, n (%)	45 (100)	44 (97.8)	45 (100)	–	1.0
In 12 months					
Severity of AF symptoms (EHRA), classes Mean ± SD	1.5 ± 0.5	1.4 ± 0.5	1.6 ± 0.5	0.673	**0.059**
Severity of AF symptoms (EHRA), classes, n (%)					
I	21 (46.7)	28 (62.2)	19 (42.2)		
II	24 (53.3)	17 (37.8)	26 (57.8)	0.671	**0.058**
III	0	0	0		
IV	0	0	0		
Presence of AF symptoms, n (%)	26 (57.8)	17 (37.8)	31 (68.9)	0.274	**0.003**

SD, standard deviation.

higher levels of high-density lipoprotein cholesterol (20.6% increase; $p < 0.05$), unlike in the comparison group.

Considering evidence from several other RCTs, such as the newly published SORT-AF trial [21], in which the effect of a structured weight loss program on the efficacy of CA following AF was investigated for the first time, our findings on weight control and PA are of utmost significance. This study included patients with paroxysmal or persistent AF and obesity. The subgroup of patients with persistent AF and obesity experienced a favorable effect of weight loss and increased PA in the form of a reduced risk of recurrent AF, despite the fact that the overall results were neutral. ($p=0.032$). The weight loss program implemented in this study included visits to a physician twice a month, regular nutritional and PA counseling within 6 months, keeping a food diary, and resulted in a significant reduction in BMI from 34.9 ± 2.6 kg/m^2 to 33.4 ± 3.6 kg/m^2 versus no changes in BMI in the control group ($p<0.001$) in 12 months.

The correction of another key RF was investigated in the SMAC-AF RCT [22] including 184 patients with AF following CA who had BP >130/80 mm Hg. Aggressive control of AH reduced SBP, improved BP control in general, and reduced the risk of AF recurrence following CA by 42%, however, this advantage was only shown in older patients.

Despite the neutral findings on AF recurrences in our study, we were able to demonstrate a limited decrease in symptom severity, notably in the email support group. This contradiction seems understandable given the data on a rather complex relationship between objectively registered AF and clinical symptoms (not all episodes of AF are overt, and some patients have symptoms during sinus rhythm) [23, 24]. For example, more effective control of other RFs, such as weight loss and stricter control of BP, may account for the fact that fewer subjects complained of palpitations by the end of the study.

The presented results of the CR programs with different formats, content, and duration, but all aiming at changing the lifestyle of patients with AF following CA and achieve the target levels of the key RFs for CVD, opened up fresh prospects for improving the prognosis and QoL in patients of this category. It should be noted that changing behavior and lifestyle of patients and maintaining good medication adherence are a cornerstone of RF control as well as interventional and drug treatment of AF and comorbidities and are necessary for the long-term success of secondary prevention measures. The patient-centered approach also requires the adaptation of secondary prevention and rehabilitation programs to the current life situation, which often requires the use of remote technologies; this approach is particularly relevant in the current epidemiological setting.

Conclusion

This study showed that secondary prevention/rehabilitation strategies with remote support for patients with paroxysmal atrial fibrillation resulted in 12 months in better control of blood pressure, body weight, lower total

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cholesterol and triglyceride levels, higher physical activity, and slightly lower incidence and severity of symptoms of atrial fibrillation. Our findings allow recommending using the methods of secondary prevention/rehabilitation with remote support in patients with paroxysmal atrial fibrillation after interventional treatment.

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