Original Research

Can exercise-based cardiac rehabilitation increase physical activity in patients who have undergone total thoracoscopic ablation?

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Evidence of the effect of exercise therapy in patients who have undergone total thoracoscopic ablation is lacking. This study aimed to evaluate the effects of eight weeks exercise-based cardiac rehabilitation on cardiopulmonary fitness and adherence to exercise in patients who underwent total thoracoscopic ablation and followed a regimen of exercise therapy. Twenty-four patients were involved in the study and were divided into two groups. The exercise group underwent exercise therapy, which included aerobic and resistance exercises, twice a week as part of an eight weeks hospital-based outpatient cardiac rehabilitation program. Cardiopulmonary exercise test was used to evaluate exercise capacity and the International Physical Activity Questionnaire was utilized to identify the amount of physical activity and confirm adherence to exercise at six months postoperatively. There were significant differences between the groups in moderate activity level (p = 0.004) and extent of total physical activity (p = 0.0001). Complications such as recurrent atrial fibrillation did not occur during the exercise training. Exercise-based cardiac rehabilitation was beneficial in maintaining the activity level at six months postoperatively. Early exercise intervention at four weeks post-surgical ablation is a safe and effective therapy that can increase physical activity. Further studies are needed to verify the effect of exercise intervention in a larger sample size of patients who have undergone total thoracoscopic ablation.

Keywords

Exercise therapy; Atrial fibrillation; Adherence to exercise

1. Introduction

Atrial fibrillation (AF) is a condition of abnormal atrial rhythms, with irregular and often rapid heart rates [1]. Prevalence of AF is estimated to be about 0.4% in the general population: women show a two-fold increased risk, whereas men show a 1.5-fold increased risk [2]. Patients with AF have a three- to five-fold higher risk of strokes, so early interventions are critical for reducing risk of strokes and other related complications [3].

Initial treatment of AF is focused on antiarrhythmic medication although pharmacological treatment has been reported to be unsatisfactory [4]. Total thoracoscopic ablation, a minimally invasive surgical technique, has been performed to ablate the epicardial site and is superior to catheter ablation in terms of restoration of sinus rhythm following arrhythmias [5, 6].

The exercise capacity of patients with AF is 20% lower than that of the age-matched normal population [7]. Cardiopulmonary fitness is an important factor in reduction of mortality and improvement of survival rates in these patients [8, 9]. Exercise therapy can improve exercise capacity, daily activity level, and quality of life in patients with AF [10, 11]. Improvement of exercise capacity after cardioversion has been shown to be delayed [12]. Several studies [13, 14] have reported that surgical intervention can improve clinical outcomes, including cardiopulmonary fitness and quality of life, but reports on the effect of exercise intervention after thoracoscopic ablation are limited.

Adherence to a home-based exercise regimen after exercise therapy is crucial for maintaining the effect of exercise intervention. Several factors including self-motivation, self-efficacy, social support, and previous adherence to exercise-related behavior are related to compliance to home-based physical activity [15]. Interventions that aid in adherence to the exercise regimen including an activity monitor and feedback system, written exercise instructions, and behavioral exercise programs have been employed before [16]. Among these interventions, the monitoring and feedback approach has showed more positive outcomes on adherence to exercise [17]. This study was performed to confirm the effect of exercise therapy on the exercise capacity and compliance to exercise at home after center-based cardiac rehabilitation (CR) in patients recovering from total thoracoscopic ablation (TTA).

2. Methods

2.1 Study designs

Twenty-four patients who underwent TTA (Fig. 1) were included and were allocated to two groups: exercise group (n = 12) aged 58.4 ± 6.5 years, and control group (n = 12) aged 59.5 ± 6.1 years based on their willingness to participate in the program. The exclusion criteria were the following: patients with recurrent AF after surgery, those with musculoskeletal problems, and those who disagreed to participate in this study. A cardiopulmonary exercise test was performed on the patients, and cardiopulmonary function-related parameters were recorded using 12-lead electrocardiography. A questionnaire for assessment of extent of physical activity was also used. Prior to conduct of the study informed consent was obtained from all subjects and all methods were carried out in accordance to relevant guidelines and regulations. The study protocol was approved by the Samsung Medical Center Institutional Review Board (IRB No: 2018-04-060-001) and complied with the 1964 Helsinki declaration and its subsequent amendments. This study was registered in ClinicalTrials.gov and has the clinical trial registration number NCT04500184.

2.2 Cardiopulmonary exercise test

The patients underwent a symptom-limited, incremental treadmill ergometer test with continuous respiratory gas exchange analysis (Parvo Medics, East Sandy, UT, USA), wherein clinical variables such as electrocardiography results and VO_2peak were measured preoperatively and three months postoperatively. Exercise responses, including heart rate, blood pressure, and respiratory exchange ratio, were also measured. General procedures for the present test were performed according to the American College of Sports Medicine guidelines [18].

2.3 Physical activity level

The self-administered International Physical Activity Questionnaire short form, consisting of four generic items, was also used in this study [19]. Patients chose the questionnaire items according to their activity level; walking (3.3 Metabolic equivalents: METs) and moderate (4.4 METs) and vigorous (8.0 METs) activities. The questionnaire score was calculated, where a higher score indicated increased activity. Subjects were instructed to check the questionnaire before and six months after the surgery.

2.4 Exercise program

The exercise regimen was started one month postoperatively. The exercise program was prescribed according to frequency, intensity, time, and type of exercise and was conducted twice a week for eight weeks (16 sessions). Each training session was conducted for 1 hour, and warm-up and cool-down were performed for 5 min each. The exercise regimen consisted of aerobic exercise and resistance training. The initial exercise intensity for aerobic exercise was 40%–50% of the heart rate reserve [(maximal heart rate-resting heart rate) × 40%–50% + resting heart rate] and was progressively increased to reach 75% during a 2-month period. The initial duration of aerobic exercise was 10 min in 3 sessions, and it was progressively increased to 30 min per session during the study period. Patients were instructed to undergo resistance training after 2 weeks of aerobic exercise. Patients' electrocardiograms were monitored during the exercise using Quinton Q-Tel RMS 3.1 (Quinton, Bothell, WA, USA). Patients were encouraged to be physically active during the training period by performing supplementary treadmill and stationary bike exercises at the Samsung Sports Medicine Center (Seoul, Republic of Korea). A similar exercise program has been reported previously [10].

2.5 Statistical analysis

Descriptive statistics were used to determine the mean and standard deviation. To compare the differences in repeated measures of continuous data between groups, we used repeated measures analysis of variance (ANOVA). Paired *t*-tests were used to identify the effects of exercise in each group when the interactions between time and group were confirmed in repeated measures ANOVA. All statistical analyses were performed using SPSS version 21 (IBM Corp., Armonk, NY, USA). A p-value < 0.05 was considered statistically significant.

3. Results

3.1 Study description

Sixty patients treated at Samsung Medical Hospital (Seoul, Republic of Korea) with TTA were enrolled for this study. We excluded subjects with recurrent AF (n = 3) and musculoskeletal problems (n = 2); we also excluded patients for other reasons (n = 5). Other reasons for exclusion included self-reported reasons for non-participation in clinical trial due to lack of interest (n = 10), long distances to the center from home (n = 11), and inability to exercise due to disease (n = 5). Twenty-four patients consented to this study and all patients completed this eight weeks intervention (Fig. 2). Persistent AF was the superior type between the groups (67%), followed by the paroxysmal type (33%). The rate of previous cardioversion treatment was 50% in the intervention group and 42% in the control group and that of advanced intervention as cardioversion was 17% and 8%, respectively (Table 1).

3.2 Cardiopulmonary function

Between the groups, differences in improvement in cardiopulmonary fitness ($F = 4.119$, $p = 0.055$) was marginally significant. VO_2peak after the exercise intervention improved by 9% from 26.1 ± 3.6 mL/kg/min to 28.9 ± 7.6 mL/kg/min in the exercise group. However, other parameters obtained from the cardiopulmonary exercise test were not significantly different between the groups (Table 2).

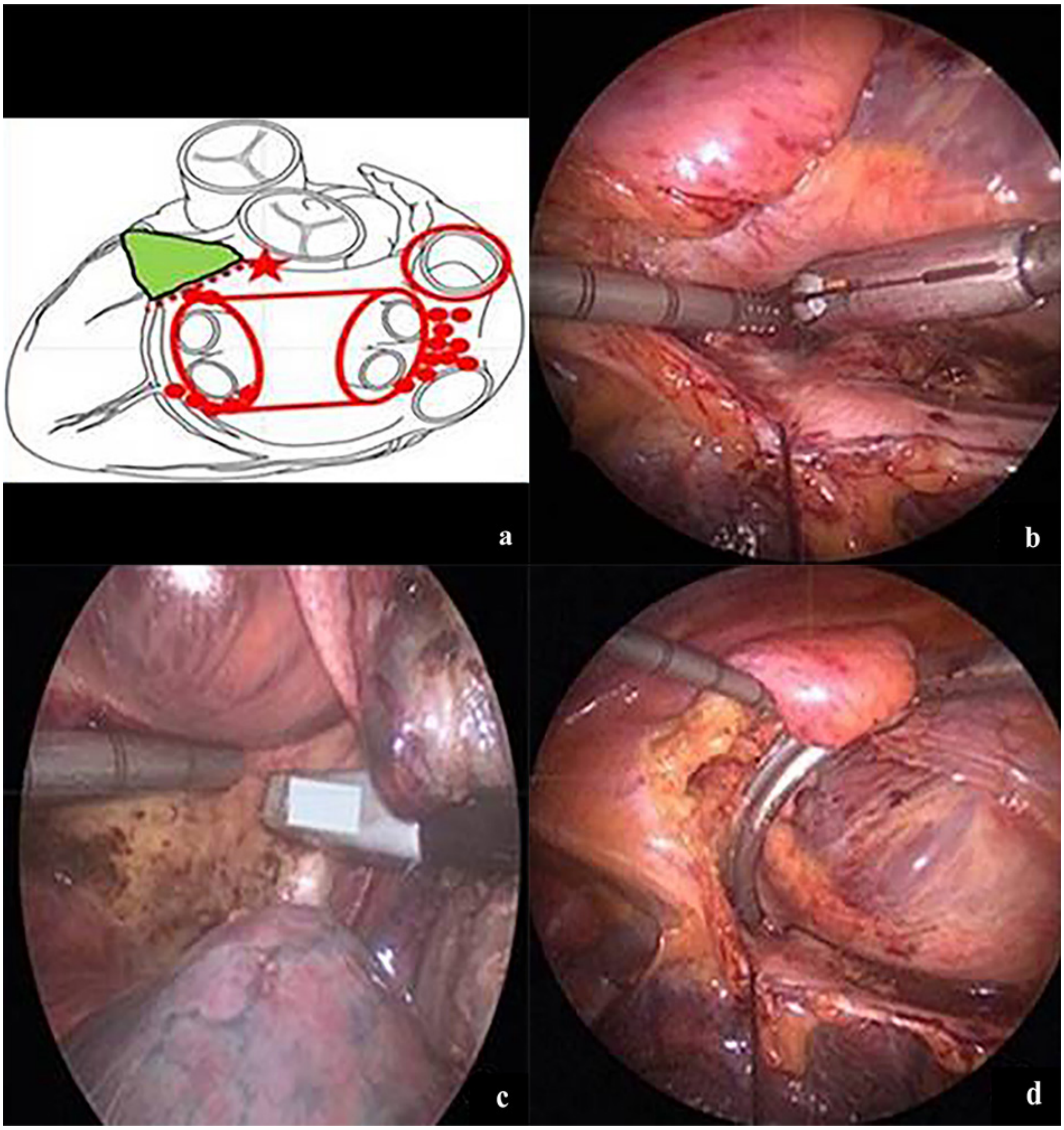

Fig. 1. Surgical intervention using total thoracoscopic ablation. (a) Intervention site for ablation. (b) Roof line ablation. (c) Ganglionated plexi ablation. (d) Superior vena cava circular ablation.

3.3 Physical activity level

At the low physical activity level, there were no significant differences between groups, although the level of activity increased from 668.3 ± 665.0 MET-min/week to 915.8 ± 776.2 MET-min/week in the exercise group. At the moderate physical activity level, the interaction between group and time was revealed to have a significant difference (F = 10.614, p = 0.004). Change to moderate activity exerted a positive effect in the intervention group from 340.4 ± 725.0 MET-min/week to 510.0 ± 712.9 MET-min/week, whereas the control group showed a negative effect from 1032.5 ± 1013.5 MET-min/week to 510.0 ± 1056.3 MET-min/week. On the basis of the results, total physical activity showed a significant difference in interaction between group and time (F = 17.871, p = 0.0001). In the exercise group, the eight weeks exercise intervention improved the total physical activity (PA) at six months postoperatively (Table 3). Recurrent arrhythmias or other exercise-related complications did not occur during the intervention period.

4. Discussion

This study demonstrated that exercise therapy is beneficial in increasing PA and improving marginal exercise capacity in patients undergoing TTA. It also revealed that early enrollment in exercise-based CR was safe and effective. This study was valuable in identifying the effect of exercise therapy in patients treated with thoracoscopic ablation.

Cardiopulmonary fitness in patients with AF has been reported to be 20% lower than the age-matched general population [7]. Subjects of this study had lower exercise capacity

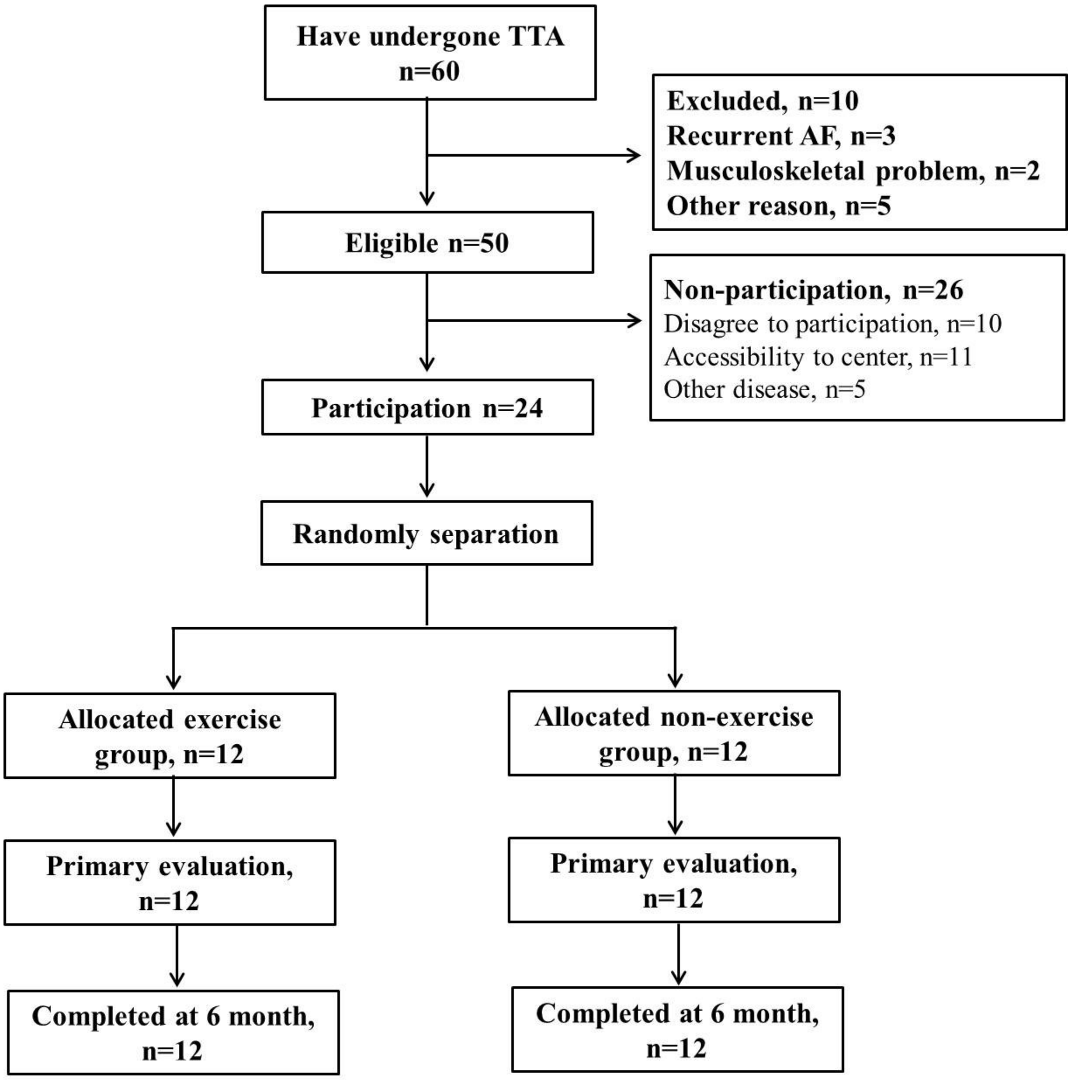

Fig. 2. Flowchart for study process related to the subject's selection and follow-up period.

than their age-matched normal population pre-intervention. Exercise therapy can improve VO_2peak and can reduce mortality by 20% in patients treated for AF [8]. In this study, although VO_2peak increased after the intervention, the statistical significance was marginal. Exercise intervention for patients with surgical thoracoscopic ablation has not been reported. Hence, findings of this study on improvement of exercise capacity could not be compared with other studies. Several factors including the small sample size and short-term intervention used in this study also need to be considered. According to a systematic review, the effects of exercise training in individuals with permanent AF remain controversial [20]. Different testing equipment could affect the measurement of these factors, as cycle ergometer testing estimated a VO_2peak 5% lower than that for treadmill ergometer testing [21]. Therefore, further studies of patients who have undergone TTA with longer exercise duration and frequency, are needed to identify improvement of parameters about tolerance as well as VO_2peak.

Improvement in PA level is associated with improvement in exercise capacity and is influenced by a higher socioeconomic status, less comorbidity, better physical abilities, and fewer depressive symptoms, resulting in a reduction in the incidence of cardiovascular diseases [22, 23]. In the present study, preoperative and six months postoperative PA levels were checked using a questionnaire. The activity level was different for the two groups in this study; the exercise group had more participants with a low activity level, whereas the control group had more participants with moderate activity level. At six months postoperative, scores for all categories of activity level improved in the exercise intervention group. The self-efficacy of patients was strongly related to the increase in habitual PA, and encouragement has been shown to motivate increased habitual PA [24]. On the basis of the results, improvement in PA level was found to be associated with encouragement for enrollment in CR and regular attendance at a facility.

Table 1. Characteristics of subjects at baseline.

Parameters	Exercise group (n = 12)	Non-exercise group (n = 12)
Age (years)	58.4 ± 6.5	59.5 ± 6.1
Number of male subjects	10	10
Number of female subjects	2	2
Weight (kg)	73.8 ± 9.6	72.5 ± 9.5
BMI (kg/m^2)	26.1 ± 3.6	25.5 ± 3.1
Atrial fibrillation (type)		
Paroxysmal, n	4	4
Persistent, n	8	8
Duration (months)	34.5	84
Treatment		
Previous ablation, n	2	1
Previous cardioversion, n	6	5
CHA_2DS_2VASc score		
0, n	5	4
1, n	2	4
≥2, n	5	4

BMI, body mass index; CHA_2DS_2VASc, Congestive heart failure Hypertension Age$_2$ Diabetes mellitus Stroke$_2$ Vascular disease Age Sex category of female.

Table 2. The results of cardiopulmonary exercise test preoperatively and 3 months postoperatively.

Variables	Exercise group		Non-exercise group		F	p
	Baseline	Post 3 M	Baseline	Post 3 M		
VO_2peak (mL/kg/min)	26.07 ± 3.64	28.89 ± 7.62	28.30 ± 7.44	26.85 ± 6.23	4.119	0.055
AT (%)	60.16 ± 6.37	61.42 ± 7.11	56.4.2 ± 1.54	56.33 ± 11.27	0.065	0.127
RPP (mmHg·bpm)	23896.25 ± 6023.47	19906.92 ± 4158.98	23103.16 ± 4311.78	18893.92 ± 3712.45	0.011	0.918
Exercise time (min)	11.58 ± 2.54	11.78 ± 2.69	12.45 ± 2.23	12.15 ± 2.40	0.539	0.470
RER	1.10 ± 0.13	1.11 ± 0.08	1.07 ± 0.12	1.12 ± 0.11	0.307	0.585

Data are means ± standard deviation. VO_2peak, peak oxygen uptake; AT, anaerobic threshold; RPP, rate pressure product; RER, respiratory exchange ratio; M, month.

F-value and *p*-value of means of interaction between group and time from two-way repeated ANOVA.

Table 3. The results of physical activity level preoperatively and 6 months postoperatively.

Physical activity level	Exercise group		Non-exercise group		F	p
	Baseline	Post 6 M	Baseline	Post 6 M		
Low	668.25 ± 664.95	915.75 ± 776.23	692.83 ± 783.08	478.50 ± 294.99	2.304	0.143
Moderate	340.42 ± 724.99	510.0 ± 712.92†	1032.50 ± 1013.52	510.00 ± 1056.25	10.614	0.004*
Vigorous	52.25 ± 144.50	1100.00 ± 1750.09	220.00 ± 573.98	660.75 ± 1770.51	0.903	0.352
Total PA	1060.50 ± 979.77	2426.75 ± 164.98†	1863.00 ± 1653.18	1648.50 ± 1716.21	17.871	0.000***

Data are means ± standard deviation. PA, physical activity; M, month.

F-value and *p*-value of means of interaction between group and time from two-way repeated ANOVA.

† It means that a significant difference within group confirmed by paired *t*-test.

$p < 0.05$*, $p < 0.001$***.

Exercise maintenance in this study was evaluated using a questionnaire at six months postoperatively. From previous studies, adherence was defined as attendance to the exercise program with a prescribed number of sessions, intensity, frequency, and duration of aerobic exercise [25]. At the three months follow-up period, exercise group maintained total PA at postoperative six months. Improvement in patient's self-efficacy and motivation to exercise were helpful in increasing and maintaining PA or exercise level [26]. Social support can help improve perceived behavioral control, resulting in improvement in exercise adherence [27]. Among other studies, the results of this study were associated with face-to-face education in center-based program, although effects of cognitive training for behavioral change were not evaluated.

Assessment of arrhythmia recurrence after surgery is required to understand the success of intervention. Postoperative recurrence rate of atrial arrhythmia was 16% six months after surgery [28]. The risk factors of recurrent AF are old age, hypertension, left atrial volumes [28]. Physical exertion in hospitalization is associated with developing paroxysmal AF [29]. Therefore, recommendation for initial time of exercise can be explained as an important consideration for prevention of recurrent AF. In this study, patients were instructed to participate in moderate-intensity exercise therapy at one month post-operation, if they did not exhibit recurrent AF or any other complications. The observed results support the fact that early participation in exercise is a safe and effective intervention for patients with TTA. However, exercise intensity needs to be considered when starting the intervention early in the postoperative period.

This clinical study has few limitations. First, 24 patients participated in this study, which is a small number. The sample size was too small to verify the effects of exercise therapy. Therefore, further studies with larger sample sizes are necessary to confirm the effect of exercise therapy. Second, the present study used a PA questionnaire, which is a patient-reported outcome, for checking the subject's activity level and adherence to exercise after intervention. This questionnaire had three categories: low, moderate, and vigorous activity levels, and was capable of reflecting the PA level of the last 7 days only. It was insufficient to obtain the total PA data for three months and could not identify the start time of exercise. To overcome this, further studies that use other measurement tools are needed.

5. Conclusions

Exercise-based CR of eight weeks was associated with an increase in PA and exercise maintenance in patients that have undergone TTA surgery. Early exercise training is a safe and effective intervention without side effects and is recommended for these patients. Future studies with long-term follow-up are needed to determine the effect of exercise-based CR in patients who have undergone TTA.

Author contributions

YGS and DSJ designed the study and YGS performed the study and recorded the data. YGS and JS analyzed the data and prepared the table and figures. YGS, DSJ, and MKK interpreted the results. YGS wrote manuscript. All authors critically revised the manuscript and approved the final manuscript.

Ethics approval and consent to participate

The study protocol was approved by the Samsung Medical Center Institutional Review Board (IRB No, 2018-04-060-001) and complies with the 1964 Helsinki declaration and its later amendments.

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Conflict of interest

The authors declare no conflict of interest.

References

[1] Charitos EI, Purerfellner H, Glotzer TV, Ziegler P. Clinical classifications of atrial fibrillation poorly reflect its temporal persistence: insights from 1,195 patients continuously monitored with implantable devices. Journal of the American College of Cardiology. 2014; 63: 2840–2848.

[2] Chugh SS, Havmoeller R, Naraysanan K, Singh D, Rienstra M, Benjamin EJ, *et al.* Worldwide epidemiology of atrial fibrillation: a Global Burden of Disease 2010 Study. Circulation. 2014; 129: 837–847.

[3] Wolf PA, Dawber TR, Thomas HE, Kannel WB. Epidemiologic assessment of chronic atrial fibrillation and risk of stroke: the Framingham study. Neurology. 1978; 28: 973–977.

[4] Camm AJ, Lip GY, Caterina RD, Savelieva I, Atar D, Hohnloser SH, *et al.* Focused update of the ESC guidelines for the management of atrial fibrillation an update of the 2010 ESC guidelines for the management of atrial fibrillation-developed with the special contribution of the European Heart Rhythm Association. Europace. 2012; 14: 1385–1413.

[5] Bulava A, Mokracek A, Hanis J, Kurfirst V, Eisenberger M, Pesl L. Sequential hybrid procedure for persistent atrial fibrillation. Journal of the American Heart Association. 2015; 4: e001754.

[6] Boersma LV, Castella M, Boven WJ, Beruezo A, Yilmtaz A, Nadal M, *et al.* Atrial fibrillation catheter ablation versus surgical ablation treatment (FAST): a 2-center randomized clinical trial. Circulation. 2012; 125: 23–30.

[7] Ueshima K, Myers J, Ribisl PM, Morris CK, Kawaguchi T, Liu J, *et al.* Exercise capacity and prognosis in patients with chronic atrial fibrillation. Cardioloy.1995; 86: 108–113.

[8] Pardaens K, Van Cleemput J, Vanhaecke Jl, Fagard RH. Atrial fibrillation is associated with a lower exercise capacity in male chronic heart failure patients. Heart. 1997; 78: 564–568.

[9] Hegbom F, Sire S, Heldal M, Orning OM, Stavern K, Gjesdal K. Short-term exercise training in patients with chronic atrial fibrillation: effects on exercise capacity, AV conduction, and quality of life. Journal of Cardiopulmonary Rehabilitation and Prevention. 2006; 26: 24–29.

[10] Hegbom F, Stavern K, Sire S, Heldal M, Orning OM, Gjesdal K. Effects of short-term exercise training on symptoms and quality of life in patients with chronic atrial fibrillation. International of Cardiology. 2017; 16: 86–92.

[11] Vanhees L, Schepers D, Defoor J, Brusselle S, Tchursh N, Fagard R. Exercise performance and training in cardiac patients with atrial fibrillation. Journal of Cardiopulmonary Rehabilitation and Prevention. 2000; 20: 346–352.

[12] Lipkin DP, Frenneaux M, Stewart R, Joshi J, Lowe T, McKena WJ. Delayed improvement in exercise capacity after cardioversion of atrial fibrillation to sinus rhythm. British Heart Journal. 1998; 59: 572–577.

[13] Risom SS, Zwisler AD, Rasmussen TB, Sibilitz KL, Madsen TL, Swendsen JH, *et al.* Cardiac rehabilitation versus usual care for patients treated with catheter ablation for atrial fibrillation: results of the randomized CopenHeartRFA trial. American Heart Journal. 2016; 181: 120–129.

[14] Fengsrud E, Wickbom A, Almroth H, Englund A, Ahlsson A. Total endoscopic ablation of patients with long-standing persistent atrial fibrillation: a randomized controlled study. Interactive Cardiovascular and Thoracic Surgery. 2016; 23: 292–299.

[15] Essery R, Geraghty AW, Kirby S, Yardley L. Predictors of adherence to home-based physical therapies: a systematic review. Disability and Rehabilitation. 2017; 39: 519–534.

[16] Peek K, Sanson-Fisher R, Mackenze L, Carey M. Interventions to aid patient adherence to physiotherapist prescribed self-management strategies: a systematic review. Physiotherapy. 2016; 102: 127–135.
[17] Room J, Hannink E, Dawes H, Barker K. What interventions are used to improve exercise adherence in older people and what behavioural techniques are they based on? A systematic review. BMJ Open. 2017; 7: e019221.
[18] American College of Sports Medicine (ed.) American College of Sports Medicine of referencing in ACSM's Guidelines for Exercise Testing and Prescription. Lippincott Williams & Wilkins: Philadelphia. 2010.
[19] Chun MY. Validity and reliability of Korean version of international physical activity questionnaire short form in the elderly. Korean Journal of Family Medicine. 2012; 33: 144–151.
[20] Risom SS, Zwisler AD, Johansen PP, Sibilitz KL, Lindschou J, Gluud C, *et al.* Exercise-based cardiac rehabilitation for adults with atrial fibrillation (Review). Cochrane Database Systematic Reviews. 2017; 9: CD011197.
[21] Hambrecht RP, Schuler GC, Muth T, Grunze MF, Marburger CT, Niebauer J, *et al.* Greater diagnostic sensitivity of treadmill versus cycle exercise testing of asymptomatic men with coronary artery disease. The American Journal of Cardiology. 1992; 70: 141–146.
[22] Dohnke B, Nowossadeck E, Muller-Fahrnow W. Motivation and participation in a phase III cardiac rehabilitation programme: an application of the health action process approach. Research in Sports Medicine. 2010; 18: 219–235.
[23] Picorelli AM, Pereira LS, Pereira DS, Felicio D, Sherrington C. Adherence to exercise programs for older people is influenced by program characteristics and personal factors: a systematic review. Journal of Physiotherapy. 2014; 60: 151–156.
[24] Sweet SN, Tulloch H, Fortier MS, Pipe AL, Reid RD. Patterns of motivation and ongoing exercise activity in cardiac rehabilitation settings: A 24-month exploration from the TEACH study. Annals of Behavioral Medicine. 2011; 42: 55–63.
[25] Karmali KN, Davies P, Taylor F, Beswick A, Martin N, Ebrahim S. Promoting patient uptake and adherence in cardiac rehabilitation. Cochrane Database Systematic Review. 2014; 25: CD007131.
[26] Kolt GS, McEvoy JF. Adherence to rehabilitation in patients with low back pain. Manual Therapy. 2003; 8: 110–116.
[27] Courneya KS, McAuley E. Cognitive mediators of the social influence-exercise adherence relationship: A test of the theory of planned behavior. Journal of Behavioral Medicine. 1995; 18: 499–515.
[28] On YK, Park KM, Jeong DS, Park PW, Lee YT, Park SJ, *et al.* Electrophysiologic results after thoracoscopic ablation for chronic atrial fibrillation. The Annals of Thoracic Surgery. 2015; 100: 1595–1603.
[29] Hansson A, Madsen-Härdig B, Olsson SB. Arrhythmia-provoking factors and symptoms at the onset of paroxysmal atrial fibrillation: a study based on interviews with 100 patients seeking hospital assistance. BMC Cardiovascular. Disorders. 2004; 4: 13.