Canadian Journal of Cardiology 35 (2019) 382–388

Clinical Research

The Effect of Cardiac Rehabilitation and a Specialized Clinic on Outcomes of Patients With Atrial Fibrillation

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ABSTRACT

Background: Cardiac rehabilitation (CR) intervention programs are currently not part of management in patients with atrial fibrillation (AF). We sought to determine the effect of CR compared with a specialized AF clinic (AFC) and usual care on outcomes in patients with AF.

Methods: This was a single-centre retrospective cohort study that was carried out using 3 databases: the Hearts in Motion database (2010-2014), prospectively collected data in an AFC (2011-2014), and a retrospective chart review for patients in usual care (2009-2012). Three care pathways were compared: (1) CR; (2) AFC; and (3) usual specialist-based care. The main outcome was AF-related emergency department visits and cardiovascular hospitalizations.

Results: Of 566 patients with newly diagnosed AF, 133 (23.5%) patients underwent CR, 197 patients (34.8%) attended the AFC, whereas the remaining 236 (41.7%) were followed in a usual specialist-based care clinic. At 1 year, AF-related emergency department visits and cardiovascular hospitalization rates occurred in 7.5% in the CR group, 16.8% in the AFC group, and 29.2% in usual care. After a

RÉSUMÉ

Introduction : Les programmes interventionnels de réadaptation cardiaque ne font actuellement pas partie de la prise en charge des patients atteints de fibrillation auriculaire (FA). Nous avons tâché d'établir l'effet de la réadaptation cardiaque sur le pronostic des patients atteints de FA, comparativement aux soins dispensés dans une clinique spécialisée dans le traitement de la FA et aux soins usuels.

Méthodologie : Il s'agit d'une étude de cohorte rétrospective menée dans un seul centre à l'aide de trois bases de données : la base de données *Hearts in motion* (2010 – 2014), un corpus de données recueillies de manière prospective dans une clinique spécialisée dans le traitement de la FA (2011 – 2014) et les données d'un examen rétrospectif de dossiers de patients ayant reçu les soins usuels (2009 – 2012). Trois protocoles de soins ont été comparés : 1) réadaptation cardiaque; 2) soins dispensés dans une clinique spécialisée dans le traitement de la FA; 3) soins usuels dispensés par un spécialiste. Le paramètre d'évaluation principal de l'étude combinait les visites à l'urgence liées à la FA et les hospitalisations pour un motif cardiovasculaire.

Atrial fibrillation (AF) is the most common cardiac arrhythmia affecting 1%-2% of the general population worldwide.[1] Incidence of AF increases with advanced age, excessive alcohol intake, smoking, hypertension, diabetes, congenital heart defects, valvular heart disease, cardiomyopathies, obstructive sleep apnea, chronic obstructive airway disease, and hyperthyroidism.[2] The lifetime risk of developing AF in adults 40 years or older is approximately 25%.[3]

In Canada, it is estimated that 250,000-350,000 patients are suffering from AF. The prevalence of AF is expected to significantly increase because of our aging population. AF increases stroke risk fivefold independently and is associated with 1.5- to 1.9-fold increase of all-cause mortality. Moreover, it adversely affects quality of life, by reducing exercise capacity and impairing left ventricular function.[4] Patients with AF often report symptoms of palpitations, dyspnea, dizziness, and decreased exercise tolerance, which decreased quality of life in approximately 58% of cases.[5] The primary treatment goals of AF are directed to relieve symptoms, improve quality of life, and to prevent related complications.[6] Rate and rhythm control strategies in addition to long-term anticoagulation are considered the standard care of management of AF. However, these management strategies might not be adequately delivered in many instances. Data from the **Real-li**fe Global **S**urvey **E**valuating Patients With **A**trial **F**ibrillation (REALISE-AF)

Received for publication September 11, 2018. Accepted December 6, 2018.

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See page 388 for disclosure information.

https://doi.org/10.1016/j.cjca.2018.12.013

propensity matched analysis, usual care was associated with the highest rate of the main outcome (odds ratio, 4.91; 95% confidence interval, 2.09-11.53) compared with CR, as did the AFC compared with CR (odds ratio, 2.75; 95% confidence interval, 1.14-6.6).
Conclusions: Among patients with AF, CR was associated with a lower risk of AF-related outcomes. These findings support further study of the use of CR in the management of these patients to determine the optimal model of care for AF patients.

Résultats : Sur 566 patients ayant reçu le diagnostic de FA pour la première fois, 133 (23,5 %) se sont prêtés à une réadaptation cardiaque, 197 (34,8 %) se sont rendus dans une clinique spécialisée dans le traitement de la FA et les 236 restants (41,7 %) ont été suivis par un spécialiste dans une clinique de soins usuels. Après 1 an, le taux de visites à l'urgence associées à la FA et d'hospitalisations pour un motif cardiovasculaire a été de 7,5 % dans le groupe des patients qui se sont prêtés à une réadaptation cardiaque, de 16,8 % dans le groupe de patients qui se sont rendus dans une clinique spécialisée dans le traitement de la FA et de 29,2 % dans le groupe de patients ayant reçu les soins usuels. D'après une analyse avec appariement des coefficients de propension, les soins usuels ont été associés au taux le plus élevé de patients répondant au paramètre d'évaluation principal (risque relatif approché : 4,91; intervalle de confiance [IC] à 95 % : 2,09 − 11,53), comparativement à la réadaptation cardiaque. Un taux également plus élevé a été associé aux soins dispensés dans une clinique spécialisée dans le traitement de la FA, comparativement à la réadaptation cardiaque (risque relatif approché : 2,75; IC à 95 % : 1,14 − 6,6).
Conclusions : Chez les patients atteints de FA, la réadaptation cardiaque a été associée à un risque plus faible de présenter les événements liés à la FA. Ces résultats justifient une étude plus approfondie de l'utilisation de la réadaptation cardiaque dans le cadre de la prise en charge des patients atteints de FA pour établir le modèle de soins optimal pour ces patients.

study showed that 41% of patients with AF do not have sufficient control of heart rate or rhythm.[7] The best method of delivery of care for patients with AF remains controversial. AF clinics (AFCs) have been proven to reduce AF-related hospitalizations, and in one study, reduced cardiovascular mortality.[8-10]

Cardiac rehabilitation (CR) is a medically supervised comprehensive long-term program that involves prescribed exercise, cardiac risk factors modification, education, and counselling. We sought to determine whether each of these models of care are superior to usual care in prevention of AF-related clinical outcomes via applying a 12-week program for eligible AF patients.

Methods

This was a retrospective cohort study including patients diagnosed with new onset AF evaluated at the Queen Elizabeth II Health Sciences Centre between January, 2009 and December, 2013. The study was approved by the institutional research ethics board.

Data sources and study population

The Hearts in Motion program is the CR program at the Queen Elizabeth II Health Sciences Centre that has been established since 2006; it includes twice-weekly supervised exercise, once-weekly education with goal-setting, and behaviour change using "SMART" (specific, measurable, attainable, relevant, and timely) goal-setting for all known cardiac risk factors successively. The program has had an ongoing prospective registry that has been collecting data on participating patients since 2007. In 2010, patients with a diagnosis of AF were permitted for participation in the program. Data from the Hearts in Motion database were used to obtain baseline characteristics on the patients who underwent CR along with the usual AF management care from January 1, 2010 until June 30, 2014. The patients in the AFC group were recruited prospectively from November 1, 2011 until September 1, 2013 and followed in a specialized nurse-run, physician-supervised AFC. The usual care group was obtained through retrospective chart review between January 1, 2009 and October 31, 2011. CR involved a 12-week supervised exercise program, as well as educational classes on diet, smoking cessation, diabetes, blood pressure and lipid management, exercise prescription, weight reduction, sleep apnea screening, AF burden assessment and education, and anticoagulation management as per current guidelines.[11] The AFC comprised a nurse-run, physician-supervised clinic initiated by referral from the emergency department (ED). Patients received a telephone call from the AFC nurse within 48-72 hours of the referral, invited to a group learning session on AF, and were provided with the nurse contact information. The in-clinic visit used a standard format for data collection, review with the supervising physician, and treatment plan in place. Further details of the specialized AFC have been published previously.[8] The usual care group were patients referred to the cardiology clinic at the Queen Elizabeth II Health Sciences Centre, with a new diagnosis of AF. In all 3 groups, data on baseline characteristics, demographic data, and associated comorbidities of all groups were collected through review of the electronic medical records. Medications including β-blockers, calcium channel blockers, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, diuretics, digoxin, aspirin, and oral anticoagulants were identified at baseline. Medication prescription was left to the discretion of the treating physician. The main outcome was a composite of AF-related ED visits and cardiovascular

hospitalizations at 6 and 12 months starting 12 weeks from completing CR intervention program for the AFC group and after the initial clinic visit for the other 2 groups. Cardiovascular hospitalizations were defined as an admission or discharge diagnosis of AF, heart failure, acute coronary syndrome, or cerebrovascular ischemic event. An acute coronary syndrome was defined as chest pain with a troponin elevation or significant electrocardiographic changes of ischemic injury. A cerebrovascular ischemic event was a neurology-confirmed diagnosis of a transient ischemic attack or stroke. An AF-related ED visit was defined as an ED admission or discharge diagnosis of AF, or the ED admission complaint included palpitations, syncope, presyncope, chest pain, dyspnea, malaise, or symptoms suggestive of a thromboembolic event. Secondary outcome was appropriate use of oral anticoagulation on the basis of the Canadian Cardiovascular Society guidelines. Because the guidelines for oral anticoagulation changed during the course of the study, data are presented on the basis of the most up to date guidelines.[12]

Statistical analysis

Baseline variables are summarized as mean or frequencies with percentage where appropriate. Comparisons for continuous variables were done using analysis of variance, whereas the Kruskal–Wallis test was used for categorical variables. Baseline characteristics and demographic data were compared between the 3 groups. Similarly, prescribed medications were summarized and compared between groups. Logistic regression modelling was used to perform multivariable analysis on the main outcome measure. AF-related ED visits and cardiovascular hospitalizations at 12 months were summarized using odds ratios (ORs) and 95% confidence intervals (CIs). Variables identified for inclusion into the multivariable model were age, diabetes mellitus, hypertension, and congestive heart failure, hypertension, age, diabetes, stroke/transient ischemic attack age $\geq$ 65 years ($CHADS_2$-65) score $\geq$ 1. All P values were 2-sided and values < 0.05 were considered statistically significant. A propensity analysis was performed to control for confounding by indication. This technique accounts for the nonrandom assignment to each group, mitigates potential confounding factors and selection biases, and increases statistical efficiency.

The variables that were entered into the propensity score were age, $CHADS_2$-65 score, and sex. These variables were chosen because they are known to influence AF-related outcomes. Statistical analyses were conducted using SAS software, version 9.4 (SAS Institute Inx, Cary, NC). Propensity scores were used to match patients who attended the AFC with those who attended CR using a SAS macro. A greedy matching procedure was used to select matched pairs initially identical to 5 decimal places of probability.[13] If no match existed at 5 decimal places, then matching would occur at 4 decimal places, and so on. If no match existed at 1 decimal place, then that patient was excluded from the matched analysis.

Results

A total of 566 patients with newly diagnosed AF were found to be eligible for the study. There were 133 (23.5%) patients in the CR group, 197 patients (34.8%) attended the AFC, and 236 (41.7%) patients were followed in usual care. Baseline characteristics and demographic data of the 3 groups are shown in Table 1. There were 266 (41.0%) women in the study. AF patients who underwent the CR program had a higher rate of diabetes and hypertension. There was a greater proportion of patients with $CHADS_2$-65 $\geq$ 1 in the CR group (94.0%) and usual care (72.9%) than in the AFC group (69.5%; $P < 0.001$). More patients in the CR group received acetylsalicylic acid compared with the other 2 groups; medications remained unchanged throughout the study period (Table 2).

Outcomes

The rate of cardiovascular hospitalizations and AF-related ED visit rates were similarly lower in the CR group (5.3%) and the AFC group (11.2%) after 6 months of follow-up than in the usual care group (19.9%; $P < 0.05$; Table 3). This same trend was seen at 12 months with rates of 7.5%, 16.8%, and 29.2% in the CR, AFC, and usual care groups, respectively ($P < 0.0001$) (Fig. 1). The breakdown of the causes for ED visits and hospitalizations are as follows in the CR group: rapid AF (n = 6), 2 hospitalizations (heart failure [n = 1], weakness [n = 1]). In the AFC group, there were 11 AF-related ED visits (rapid AF) and 11 hospitalizations (transient ischemic attack [n = 1], stroke [n = 1], heart failure

Table 1. Baseline characteristics

Characteristic	Cardiac rehabilitation (n = 133)	AF clinic (n = 197)	Usual care (n = 236)
Age 65-74 years*	50 (37.6)	89 (45.2)	122 (46.7)
Age $\geq$ 75 years	29 (21.8)	47 (23.9)	65 (27.5)
Female sex	47 (35.3)	79 (45.1)	106 (44.9)
Heart failure	17 (12.8)	21 (10.7)	23 (9.8)
Diabetes*	51 (38.4)	25 (12.7)	23 (9.7)
Hypertension*	110 (82.1)	86 (43.6)	71 (30.1)
Vascular disease	12 (8.0)	22 (11.2)	21 (8.9)
Stroke	12 (9.0)	12 (6.1)	17 (7.2)
Ejection fraction, %	55.6 ± 11.2	57.5 ± 8.2	55.6 ± 9.8
$CHADS_2$ score*			
0	11 (8.3)	80 (40.6)	86 (36.4)
1-2	95 (71.4)	91 (46.2)	115 (48.7)
> 2	27 (20.3)	26 (13.2)	35 (14.8)

Data are presented as n (%) or mean ± SD.

AF, atrial fibrillation; $CHADS_2$, **C**ongestive Heart Failure, **H**ypertension, **A**ge, **D**iabetes, **S**troke/Transient Ischemic Attack.

* $P < 0.05$ between 3 groups.

Table 2. Medications at baseline

Medication	Cardiac rehabilitation (n = 133)	AF clinic (n = 197)	Usual care (n = 236)
β-Blockers	93 (69.9)	123 (62.4)	141 (59.7)
CCBs	28 (21.1)	36 (18.3)	51 (21.6)
ACEIs/ARBs	44 (33.1)	49 (24.9)	55 (23.3)
Diuretics	45 (33.8)	68 (34.5)	56 (23.8)
Digoxin	0	1 (0.5)	11 (4.7)
ASA*	82 (61.6)	58 (29.7)	99 (41.9)
Oral anticoagulants*	46 (34.6)	121 (61.4)	104 (44.1)
Antiarrhythmics	2 (1.5)	16 (8.1)	13 (5.5)

Data are presented as n (%).
ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ASA, acetylsalicylic acid; CCB, calcium channel blocker.
* $P < 0.05$.

[n = 4], AF [n = 4], and syncope [n = 1]). In the usual care group there were 26 AF-related ED visits and 21 hospitalizations (AF [n = 6], stroke [n = 5], heart failure [n = 8], non-ST-elevation myocardial infarction [n = 1], and cardiac arrest [n = 1]). Prescription of oral anticoagulation for those with $CHADS_2$-65 score $\geq$ 1 after the baseline visit was recorded in each group and was highest in the AFC group (78.8%), compared with the CR (36.8%) or usual care (56.4%) groups ($P < 0.001$) (Fig. 2).

Matched and multivariate analysis

To account for between group differences, a propensity matched analysis was performed. The characteristics of the matched groups are shown in Table 4. Differences between groups remained with respect to diabetes, hypertension, use of aspirin, diuretics, and oral anticoagulation. In a multivariate analysis, after adjusting for CHADS2-65 score > 1, age, hypertension and diabetes, patients in the CR group had significantly lower AF-related ED visits and cardiovascular hospitalization rates after 1-year follow-up compared with usual care (OR, 6.51; 95% CI, 2.99-14.1; $P < 0.0001$) as well as AFC (OR, 3.08; 95% CI, 1.40-6.79; P 0.005; Table 5). After performing a propensity matched analysis, the effect of CR remained significant in being associated with a lower number of AF-related ED visits and cardiovascular hospitalizations after 1-year follow-up, compared with each of the AFC and usual care groups (Table 4).

Discussion

This study showed that patients who underwent CR had a lower rate of AF-related ED visits and hospitalizations at 6 months and 1 year than in patients who were managed in an AFC or in usual specialist-based care. The AFC performed better than usual care in prevention of AF-related ED visits and hospitalizations. The rate of oral anticoagulation was highest in the AFC group.

The optimal management of patients with AF remains controversial. Previous studies have suggested that a combined specialist and nurse-based AFC is associated with significant reductions in ED visits, hospitalizations, and improved survival.[8-10] Gillis et al. designed an observational cohort study in Calgary, Alberta of a nurse-led AFC, which showed an 82% reduction in ED visits in the 6 months post-AFC assessment, compared with 6 months pre-AFC assessment.[9] The results were so positive that funds to permanently establish this clinic were allocated. Hendriks et al. showed a significant reduction in cardiovascular mortality in a randomized controlled trial of a nurse-led, physician-supervised AFC in The Netherlands, compared with usual care (1.1% in the nurse-led care vs 3.9% in the usual care group; hazard ratio, 0.28 [95% CI, 0.09-0.85]; $P = 0.025$).[10] In British Columbia, a number of AFCs were funded to improve provincial AF care.

The importance of CR in the management of patients with AF has recently been highlighted. Because many AF risk factors are modifiable with lifestyle intervention strategies, intense cardiac risk factors modification in patients with AF should improve the quality of life, reduce cardiovascular complications, and lower the burden and relative risk of AF.[14] Abed et al. examined the effect of weight reduction and cardiometabolic risk factor treatment in patients with AF and reported an improvement in AF-related quality of life in the experimental arm.[15] The **L**ong-Term **E**ffect of **G**oal-Directed Weight Management on **A**trial Fibrillation **C**ohort: A Long-Term Follow-Up Stud**y** (LEGACY) study was a prospective cohort study that showed that weight reduction of $\geq$ 10% was associated with a sixfold greater probability of arrhythmia-free survival compared with those who lost less weight or did not lose weight at all.[16] Furthermore, previous studies have evaluated the effect of chronic exercise training on AF. Reed et al. reported a beneficial effect of chronic exercise training in permanent AF that resulted in improving rate control, functional capacity, and quality of life.[17] Giacomantonio et al. stated that moderate intensity physical activity improves exercise capacity, the ability to carry out the daily activities, and improves quality of life in patients with AF.[18] The Henry Ford Exercise Testing (FIT) project examined 64,561 adults without AF from 1991 to 2009 and reported that 1 higher metabolic equivalent during treadmill testing was associated with a 7% lower risk of incident AF, with a stronger relationship among obese patients.[19] The Impact of **Cardio**-respiratory **Fit**ness on Arrhythmia Recurrence in Obese Individuals With Atrial Fibrillation (CARDIO-FIT) study reported an association between a gain of $\geq$ 2 metabolic

Table 3. AF-related ED visits and CV hospitalizations

Group	AF-related ED visits, n (%)	CV hospitalizations, n (%)
CR	6 (4.5)	2 (1.5)
AF clinic	11 (5.6)	11 (5.6)
Usual care	26 (11.0)	21 (8.9)

AF, atrial fibrillation; CR, cardiac rehabilitation; CV, cardiovascular; ED, emergency department.

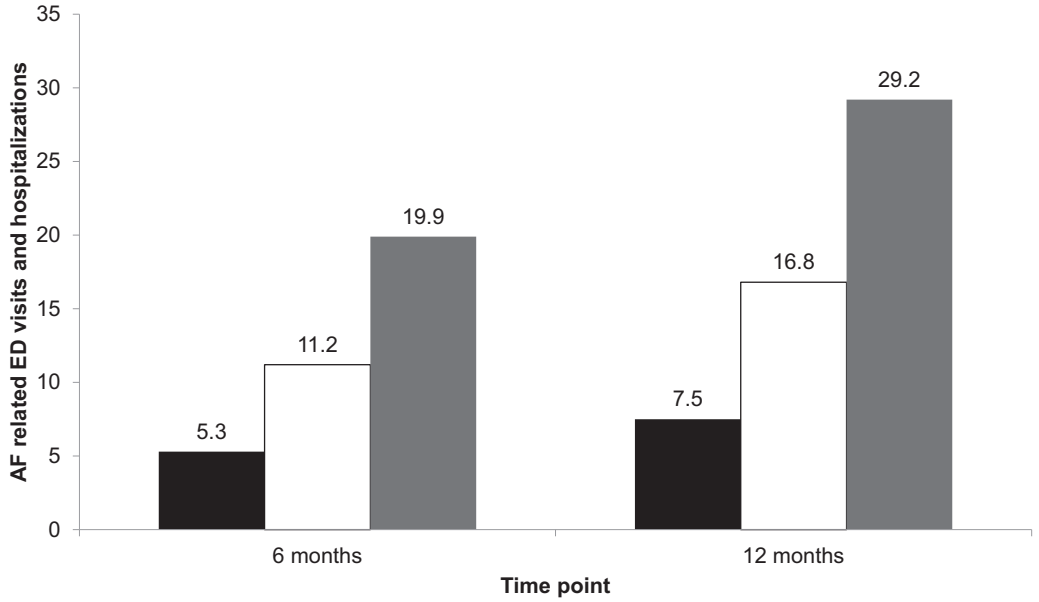

Figure 1. Cardiovascular hospitalization and AF-related emergency visits at 6 and 12 months. The **white bars** represent the AF clinic, the **black bars** CR, and the **grey bars** usual care. AF, atrial fibrillation; CR, cardiac rehabilitation; ED, emergency department.

equivalents before and after a tailored exercise program to be associated with improvements in AF burden and symptom severity in a single-centre cohort study.[20] Malmo et al. reported that high-intensity exercise reduces AF burden in absence of significant changes in blood pressure and left atrial size with modest improvement of body mass index and blood lipid levels in short-term follow-up. They recommended that promoting exercise as well as modifying other comorbidities could significantly dampen AF burden and reduce the need for pharmacologic and interventional arrhythmia management strategies.[21]

CR has changed significantly to encompass a multidisciplinary approach focused on the well-being of cardiac patients, rather than simple monitoring to resume physical activity safely. Some of the purported benefits of CR in AF patients include addressing physiologic and psychological effects of

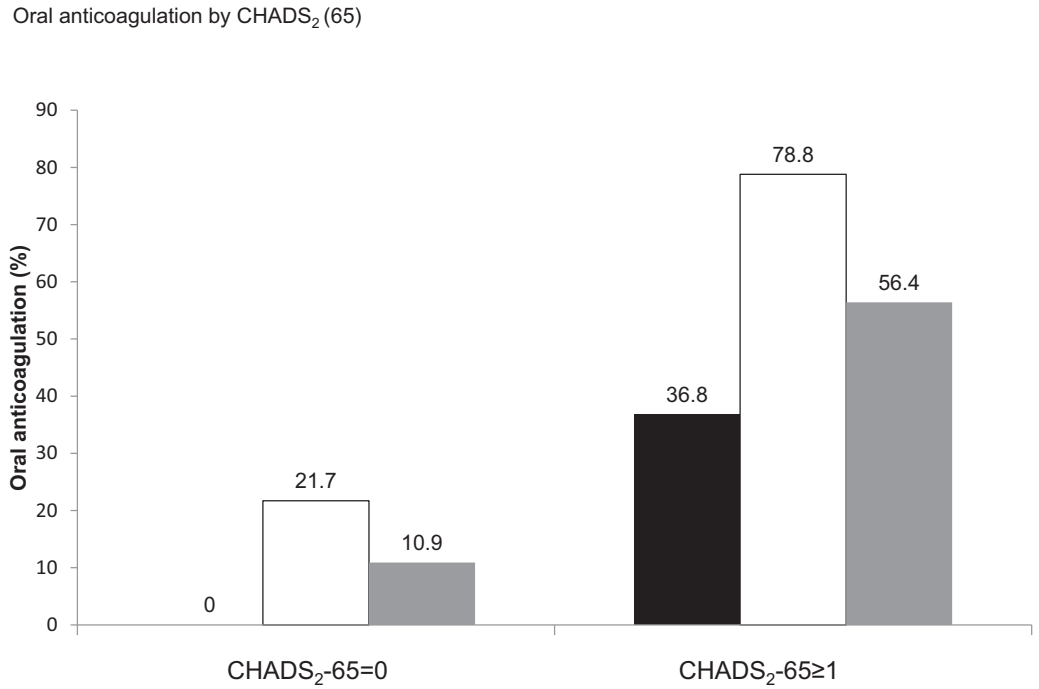

Figure 2. Oral anticoagulation in each group according to $CHADS_2$-65 at last follow-up. The **white bars** represent the AF clinic, the **black bars** CR, and the **grey bars** usual care. AF, atrial fibrillation; $CHADS_2$-65, congestive heart failure, hypertension, age, diabetes, stroke/transient ischemic attack age $\geq$ 65 years; CR, cardiac rehabilitation.

Table 4. Baseline characteristics of matched groups: cardiac rehabilitation compared with AF clinic; cardiac rehabilitation compared with usual care

Characteristic	Cardiac rehabilitation (n = 102)	AF clinic (n = 102)	Cardiac rehabilitation (n = 116)	Usual care (n = 116)
Age, years				
< 65	53 (52)	51 (50)	52 (44.8)	54 (46.6)
65-74	25 (24.5)	25 (24.5)	35 (30.2)	32 (27.6)
≥ 75	24 (23.5)	26 (25.5)	29 (25)	30 (25.9)
Female sex	47 (46.1)	45 (44.1)	45 (38.8)	46 (39.7)
Heart failure	12 (11.8)	14 (13.7)	17 (14.7)	13 (11.2)
Diabetes	38 (37.3)*	18 (17.6)	46 (39.7)*	16 (13.8)
Hypertension	80 (78.4)*	62 (60.8)	95 (81.9)*	45 (38.8)
Stroke	8 (7.8)	8 (7.8)	10 (8.6)	8 (6.9)
Ejection fraction, %	56.1 ± 11.5	57.4 ± 8.5	55.5 ± 11.3	54.5 ± 11.5
$CHADS_2$ score				
0	11 (10.8)	11 (10.8)	11 (9.5)	11 (9.5)
1-2	74 (72.5)	76 (74.5)	80 (69)	85 (73.3)
≥ 2	17 (16.7)	15 (14.7)	25 (21.6)	20 (17.2)
β-Blockers	68 (66.7)	69 (67.6)	78 (67.2)	69 (59.5)
Calcium channel blockers	20 (19.6)	22 (21.6)	25 (21.6)	32 (27.6)
Angiotensin-converting enzyme inhibitors/angiotensin receptor blockers	31 (30.4)	41 (40.2)	36 (31)	35 (30.2)
Diuretics	34 (33.3)*	50 (49)	40 (34.5)	36 (31.3)
Digoxin	0 (0)	1 (1)	0 (0)	3 (2.6)
Aspirin	61 (59.8)*	23 (22.8)	71 (61.2)*	44 (37.9)
Oral anticoagulants	35 (34.3)*	80 (78.4)	41 (35.3)*	62 (53.4)

Data are presented as n (%) or mean ± SD.

AF, atrial fibrillation; $CHADS_2$, **C**ongestive Heart Failure, **H**ypertension, **A**ge, **D**iabetes, **S**troke/Transient Ischemic Attack.

* $P < 0.05$.

cardiac illness, symptom control, stabilization of the atherosclerotic process, and enhancing the psychosocial status of the patients. CR is a well proven intervention that reduces mortality and morbidity in patients with heart disease.[22,23] The beneficial effects achieved with CR result from the multidisciplinary approach to cardiovascular disease. At least 50% of the mortality reduction achieved with exercise-based CR (28%) is attributable to modification of major risk factors, particularly smoking cessation.[22] Other factors attributed to the beneficial CR achievements include reduction of inflammatory markers such as serum C-reactive protein, ischemic preconditioning, and improving the endothelial function.[24] Finally, CR might provide important benefits to improve achievement in metabolic equivalents and optimization of maximal oxygen consumption. These known benefits are associated with quality of life improvement and reduction in recurrent cardiovascular events.

In this study, the comprehensive CR intervention program was effective in reducing AF-related ED visits and cardiovascular hospitalization rates over 6 months and 1-year follow-up periods in AF patients who underwent this strategy compared with other AF patients who did not. This could be explained by successfully implementing a comprehensive program with close supervision concerning lifestyle modification and risk factor control, which in turn will help in relieving related symptoms and improving life quality. The main limitations of our study include its retrospective nature and lack of data about quality of life. It is also important to mention the presence of exposure bias because patients enrolled in CR likely have more clinical encounters and counselling compared

Table 5. AF-related ED visits and cardiovascular hospitalizations at 12 months comparing cardiac rehabilitation, AF clinic, and standard of care

Variable	Entire cohort	Propensity matched cohorts	
		Cardiac rehabilitation to AF clinic	Cardiac rehabilitation to usual care
Group			
Cardiac rehabilitation	Reference	Reference	Reference
AF clinic	3.14 (1.43-6.89)*	2.75 (1.14-6.6)*	n/a
Standard	6.64 (3.08-14.32)*	n/a	4.91 (2.09-11.53)*
$CHADS_2$-65 ≥ 1	1.03 (0.5-2.09)	0.19 (0.02-1.51)	1.52 (0.28-8.25)
Hypertension	1.09 (0.64-1.86)	2.89 (0.78-10.8)	1.15 (0.52-2.53)
Diabetes	1.85 (0.99-3.47)*	2.39 (0.92-6.24)	1.01 (0.41-2.5)
Age, years			
< 65	Reference	Reference	Reference
65-74	1.28 (0.68-2.39)	2.1 (0.67-6.54)	0.99 (0.42-2.33)
≥ 75	1.53 (0.84-2.8)	4.03 (1.36-11.97)*	1.41 (0.6-3.3)

Data are presented as odds ratio (95% confidence interval).

AF, atrial fibrillation; $CHADS_2$-65, congestive heart failure, hypertension, age, diabetes, stroke/transient ischemic attack age ≥ 65 years; ED, emergency department; n/a, not applicable.

* $P < 0.05$.

with the other groups. This might have been a driving factor particularly because the results support a reduction in cardiovascular hospitalizations, and patients might be detected and treated for a potential cardiac issue more quickly, than if they were not in an intensive program. There might also be selection bias in the CR group because those who attend CR might be more likely to be motivated, or might be more stable with respect to AF. The effect of family physician encounters were not captured in this study, and this might influence the outcomes.

In this study we showed that the additional use of CR with standard management of AF could provide benefit in improving AF-related outcomes especially in AF patients with cardiovascular risk factors. The use of intensive risk factor modification and exercise training in patients with AF requires further study to better understand its effect on important cardiovascular outcomes.

Funding Sources

Supported by Bayer Inc, Boehringer Ingelheim, Pfizer Canada, Capital Health Research Foundation.

Disclosures

Dr Parkash has research grants from Boehringer Ingelheim, Pfizer and Bayer. Dr Giacomontonio has research grants from Pfizer. The other authors have no conflicts of interest to disclose.

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