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Original Study-Brief Report

Impact of Atrial Fibrillation on Falls in Older Patients: Which is a Problem, Existence or Persistence?

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A B S T R A C T

Objectives: Several studies have suggested a possible relationship between atrial fibrillation (AF) and falls. However, whether the relationship depends on AF types is unclear. We investigated the relationship between sustaining AF and falls.
Design: Single hospital-based cohort study with a follow-up of falls within 3 years after baseline.
Setting and Participants: A total of 14,056 patients from our cohort between February 2010 and March 2016.
Measures: Incidence of falls within 3 years by baseline cardiac rhythm was measured, and we investigated the effects of AF types on incidence of falls.
Results: The study population was divided into younger (<75 years old; n = 11,808) and older (≥75 years old; n = 2248) groups, and then divided into 3 groups according to the baseline cardiac rhythm: sinus rhythm (SR), paroxysmal AF (PAF), and persistent AF (PeAF). There were more male patients in the PeAF group; these patients had more comorbidities both in the younger and older groups. The cumulative incidence rates of falls at 1 year in patients with SR, PAF, and PeAF were similar in the younger group (0.4%, 0.4%, and 0.6%, respectively; *P* = .496), whereas those were significantly different in the older group (2.3%, 2.7%, and 5.0%, respectively; *P* = .024). In multivariate analysis, both PAF [hazard ratio (HR) 1.179; 95% confidence interval (CI) 0.553–2.511, reference SR] and PeAF (HR 1.502; 95% CI 0.635–3.556) were not associated with falls in the younger group. In the older group, PeAF was independently associated with incidence of falls (HR 2.257; 95% CI 1.262–4.037), but PAF was not (HR 1.317; 95% CI 0.673–2.574).
Conclusions/Implications: PeAF, not PAF, was associated independently with falls in older patients, suggesting the possible effect of irregular beats on physical frailty in the older population.

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Atrial fibrillation (AF) is the most common cardiac arrhythmia in clinical practice. With the aging of society, the number of patients with nonvalvular AF are increasing gradually and steadily.[1,2]

Meanwhile, falls represent a functional decline in older adults,[3] and are associated with increase of mortality.[4] From the aspect of physical function, exercise performance is decreased in patients with AF compared with those with normal sinus rhythm (SR).[5,6] Therefore, it is natural that falls are observed more frequently in patients with AF.[7] Moreover, as the decline of exercise performance by AF is caused via the hemodynamic deterioration by atrial asystole and irregular

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ventricular beats,[8] the decline should be promoted especially while AF is sustaining.

As there have not been reports evaluating whether the effects on falls are different between sustaining and transient AF, we investigated it using a single-center database in a cardiovascular hospital.

Methods

Study Patients and Data Collection

We established a single hospital-based cohort with a cardiovascular hospital in Tokyo, Japan, in June 2004, which contains data on all new patients attending our hospital, excluding foreign travelers and patients with active cancer. The principle aim of establishing this hospital-based database is to monitor the prevalence and prognosis of cardiovascular diseases in urban areas of Japan.[9,10] Data on patients' health status and incidence of cardiovascular events and mortality are linked with hospital medical records and data collected through a postal survey repeated approximately once or twice anually.[9,10]

The data used in this study were derived from the records of 14,056 patients registered between February 2010, when the electronic medical charts were introduced in our institute, and March 2016. The study population was divided into 2 groups by age (younger <75 years of age and older ≥75 years of age groups). Each group was further divided into 3 groups according to the baseline cardiac rhythm: SR (n = 10,254/1872), paroxysmal AF (PAF; n = 1044/193), and persistent AF (PeAF; n = 510/183).

Data Collection

After taking electrocardiogram (ECG) and chest radiogram, cardiovascular status was evaluated for each patient by echocardiography, exercise test, 24-hour Holter recordings, and blood laboratory data according to the discretion of attending physicians. In addition, the following information was collected: patient data, including sex, age, height, and weight; cardiovascular risk factors, including hypertension (use of antihypertensive agents, systolic blood pressure ≥140 mm Hg, or diastolic blood pressure ≥90 mmHg on admission) and diabetes mellitus (use of oral hypoglycemic agents or insulin, or glycosylated hemoglobin ≥6.5%); cardiovascular disease, including structural heart disease, congestive heart failure, or a history of a disabling cerebral infarction or transient ischemic attack (TIA); and use of medications. Body mass index was calculated as weight in kilograms divided by the square of height in meters. An estimated glomerular filtration rate (eGFR) was calculated using the equation for the Japanese population: $eGFR = 194 \times (\text{serum creatinine})^{-1.094} \times (\text{age})^{-0.287} \times (0.739$, if the patient is female).[11] Chronic kidney disease was defined as eGFR of <60 mg/min/1.73 m^2, anemia was defined as hemoglobin level <11 g/dL, and symptomatic heart failure was defined as New York Heart Association class ≥2.

Structural heart diseases include (1) valvular heart disease (moderate or severe stenosis or regurgitation using echocardiography), (2) coronary heart disease (diagnosed by angiography or scintigraphy), (3) hypertrophic and dilated cardiomyopathy (diagnosed by echocardiography or magnetic resonance imaging), and (4) congenital heart disease (diagnosed by echocardiography).

Definition of AF

In the present study, AF was diagnosed based on electrocardiography at the initial visit, which included 12-lead surface ECG or 24-hour Holter monitor recordings. AF was also diagnosed based on any medical history of AF by the referring physicians.

PAF at the initial visit was defined as (1) SR on ECG and previous diagnosis of PAF by the referring physicians; (2) symptomatic AF on ECG at the initial visit and duration of AF estimated as <7 days according to symptoms or ECG recordings; and (3) asymptomatic AF on ECG at the initial visit and no AF within the recent 1 week. Patients whose AF was estimated to continue for >7 days were categorized as PeAF.

Clinical Outcomes

Patients were monitored for accidental falls by 2 ways. First, fall history outside of the hospital (not during the period of hospitalization) was self-reported by patients or accompanying family members at daily clinical visits. Second, admission with bone fracture or injury by falls was informed by being linked to the medical records, and by study documents of prognosis sent once per year to those who stopped hospital visits or who were referred to other hospitals.

Statistical Analysis

Among the baseline characteristics, continuous and categorical variables are expressed as means ± standard deviation and number (percentage), respectively. One-way ANOVA and χ^2 were used to test the differences of continuous and categorical variables between the 3 groups by cardiac rhythm, respectively. To determine the relationships between the 3 groups and falls, univariate and multivariate Cox regression analyses were performed, where the variables with *P* value of <.10 in the univariate models were entered into the multivariate model using the stepwise method. Statistical analyses were performed using SPSS v 19.0 (IBM Corp, Armonk, NY) for Windows (Microsoft Corp, Redmond, WA). In all analyses, $P < .05$ was taken to indicate statistical significance.

Ethical Issues

The ethics committee at our institute granted ethical permission for this study, and all of the patients provided written informed consent.

Results

Characteristics of the Study Population

The 14056 patients in the study population included 8496 men (60.4%) and had a mean age of 58.4 years. The number of patients in the younger and older groups were 11,808 (84.0%) and 2248 (16.0%), respectively.

Baseline characteristics according to baseline cardiac rhythm in the younger and older groups are shown in Table 1. The patients with PeAF were more male and had more symptomatic heart failure and chronic kidney disease, and had higher $CHADS_2$ scores compared to those with SR and PAF in both of the younger and older groups. Diuretics and anticoagulants were prescribed more frequently in patients with PeAF than in those with SR and PAF.

Incidence of falls within 3 years by baseline cardiac rhythm are shown in Figure 1A and B.

During the follow-up period of 555 (interquartile: 14–1096) days, a total of 152 (1.1%) patients experienced falls: 66 (0.6%) in the younger group and 86 (3.8%) in the older group. The Kaplan–Meier curves of incidence of falls according to baseline cardiac rhythm are shown in Figure 1A and B. The cumulative incidence rates of fall events at 1 year in patients with SR, PAF, and PeAF were 0.4%, 0.4%, and 0.6%, respectively, in the younger group (log-rank test, $P = .496$) and 2.3%, 2.7%, and 5.0%, respectively, in the older group (log-rank test, $P = .024$).

Effects of AF Types on Incidence of Falls

In univariate analyses, the hazard ratios (HR) of PAF and PeAF compared with SR were 1.080 (95% confidence interval [CI],

Table 1
Characteristics of the Study Population

Younger Group	PeAF (n = 510)	PAF (n = 1044)	SR (n = 10254)
Age (y)	62 ± 9	58 ± 11	53 ± 14
Men	422 (83%)	816 (78%)	6193 (60%)
Body mass index (kg/m^2)	24.8 ± 4.1	23.8 ± 3.4	23.3 ± 4.4
Hypertension	240 (47%)	428 (41%)	2851 (28%)
Diabetes mellitus	105 (21%)	118 (11%)	1216 (12%)
Dyslipidemia	149 (29%)	303 (29%)	2924 (29%)
Previous cerebral infarction/TIA	33 (6%)	29 (3%)	116 (1%)
Symptomatic heart failure	72 (14%)	54 (5%)	598 (6%)
Structural heart diseases	146 (29%)	147 (14%)	2314 (23%)
Chronic kidney disease	325 (64%)	559 (54%)	3198 (31%)
Anemia	6 (1%)	15 (1%)	197 (2%)
$CHADS_2$ score (points)	0.95 ± 1.03	0.63 ± 0.82	0.48 ± 0.77
Medications			
Antihypertensives	59 (12%)	103 (10%)	783 (8%)
Diuretics	51 (10%)	44 (4%)	284 (3%)
Antiplatelets	52 (10%)	120 (11%)	1360 (13%)
Anticoagulants	386 (76%)	578 (55%)	400 (4%)
Antiarrhythmics	177 (35%)	565 (54%)	722 (7%)
Hypnotics	236 (46%)	463 (44%)	3657 (36%)
Older Group	**PeAF (n = 183)**	**PAF (n = 193)**	**SR (n = 1872)**
Age (y)	81 ± 4	80 ± 4	80 ± 4
Men	109 (60%)	96 (50%)	860 (46%)
Body mass index (kg/m^2)	23.2 ± 3.9	22.4 ± 3.5	23.0 ± 3.7
Hypertension	108 (59%)	124 (64%)	995 (53%)
Diabetes mellitus	48 (26%)	38 (20%)	411 (22%)
Dyslipidemia	56 (31%)	72 (37%)	718 (38%)
Previous cerebral infarction/TIA	14 (8%)	15 (8%)	89 (5%)
Symptomatic heart failure	53 (29%)	33 (17%)	272 (15%)
Structural heart diseases	85 (46%)	74 (38%)	787 (42%)
Chronic kidney disease	131 (72%)	131 (68%)	994 (53%)
Anemia	26 (14%)	18 (9%)	200 (11%)
$CHADS_2$ score (points)	2.30 ± 1.05	2.17 ± 0.99	1.99 ± 0.98
Medications			
Antihypertensives	36 (20%)	39 (20%)	261 (14%)
Diuretics	39 (21%)	25 (13%)	432 (9%)
Antiplatelets	35 (19%)	41 (21%)	190 (23%)
Anticoagulants	129 (70%)	124 (64%)	190 (10%)
Antiarrhythmics	37 (20%)	78 (40%)	217 (12%)
Hypnotics	116 (63%)	120 (62%)	1149 (61%)

Categorical and consecutive data are presented as numbers (%) and means ± standard deviation, respectively. $CHADS_2$, Congestive heart failure/Hypertension/Age/Diabetes mellitus/Stroke.

0.509–2.290) and 1.664 (95% CI 0.710–3.900), respectively, in the younger group. On the other hand, the HRs of PAF and PeAF compared to SR were 1.231 (95% CI 0.631–2.404) and 2.198 (95% CI 1.230–3.930), respectively, in the older group (Table 2).

In multivariate analysis, both PAF (HR 1.179; 95% CI 0.553–2.511) and PeAF (HR 1.502; 95% CI 0.635–3.556) were not significantly associated with falls in the younger group, although age (HR 1.036 [per year]; 95% CI 1.008–1.064), male (HR 0.498; 95% CI 0.296–0.840), diabetes mellitus (HR 1.974; 95% CI 1.099–3.544) and symptomatic heart failure (HR 2.159; 95% CI 1.146–4.071) were independently associated with them. In the older group, PeAF was independently associated with incidence of falls (HR 2.257; 95% CI 1.262–4.037), whereas PAF was not (HR 1.317; 95% CI 0.673–2.574). Otherwise, age (HR 1.103 [per year]; 95% CI 1.057–1.151) and structural heart diseases (HR 1.741; 95% CI 1.121–2.705) were associated independently with falls.

Discussion

We investigated the impact of AF types on the incidence of falls in patients in a cardiovascular hospital. In our patients, both PAF and PeAF were not associated with falls in the younger group, whereas PeAF, but not PAF, was independently associated with falls in the older group.

The number of older patients is increasing along with the aging of society. In older patients, the prevention of falls is important because activity of daily living will decline as a result of falls. Moreover, falls are independently associated with increased mortality risk.[4,12,13] Similarly, AF is known to be closely associated with older age[14] and increases the risks of death.[15] O'Neal et al[7] reported that falls were more likely to be reported in patients with AF (10%) than in those without AF (6.5%) ($P < .001$). Our data were consistent with the previous study, although the incident rates were slightly less.

Notably, our data demonstrated that PeAF but not PAF was associated significantly with falls in older patients, suggesting that sustaining form plays a specific role. Although the mechanisms underlying the relationship between sustaining AF and falls are unknown, several mechanisms can be proposed. First, AF, especially PeAF instead of PAF, may represent worse patient profiles including age, diabetes, depression, and cognitive decline,[5,16] which are associated with the physical impairment and, thus, increase the risk of falls.[17–19]

Second, impaired mobility because of sustaining AF could be a specific mechanism. Atwood et al reported that patients with PeAF have decreased exercise tolerance, and after successful cardioversion their exercise capacity was improved.[8] This may be due to adverse hemodynamic statuses during AF. An irregular sequence of RR intervals produces poorer hemodynamic consequences that are independent of heart rate.[20] AF decreases cardiac output because of irregular ventricular rate, and also due to a lack of atrial

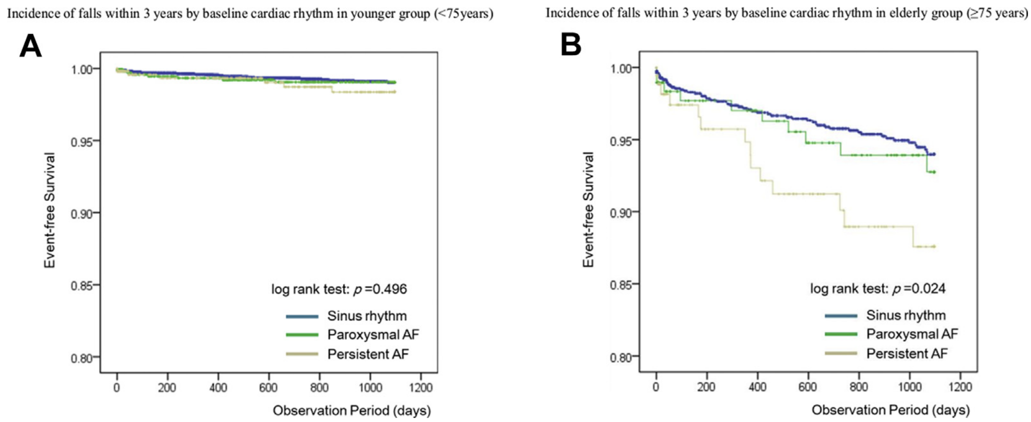

Fig. 1. (A) Kaplan–Meier event-free survival curves for fall events within 3 years by baseline cardiac rhythm in younger group; (B) Kaplan–Meier event-free survival curves for fall events within 3 years by baseline cardiac rhythm in elderly group.

Table 2
Univariate and Multivariate Cox Regression Analyses for Falls Within 3 Years

	HR (95% CI)	*P* Value
Younger Group Variables		
Univariate model		
SR	reference	
PAF	1.080 (0.509–2.290)	.842
PeAF	1.664 (0.710–3.900)	.241
Age (per y)	1.048 (1.020–1.077)	.001
Men	0.553 (0.333–0.919)	.022
Body mass index (per kg/m^2)	1.000 (0.936–1.068)	.995
Hypertension	2.255 (1.342–3.790)	.002
Diabetes mellitus	2.442 (1.416–4.212)	.001
Previous cerebral infarction/TIA	0.911 (0.126–6.575)	.926
Symptomatic heart failure	2.810 (1.542–5.122)	.001
Structural heart diseases	1.908 (1.146–3.177)	.013
Chronic kidney disease	0.797 (0.473–1.343)	.395
Anemia	2.399 (0.751–7.660)	.140
Medications		
Antihypertensives	2.141 (1.189–3.855)	.011
Diuretics	3.117 (1.532–6.346)	.002
Antiarrhythmics	1.187 (0.630–2.237)	.596
Hypnotics	1.885 (1.112–3.194)	.019
Multivariate model		
SR	Reference	
PAF	1.179 (0.553–2.511)	.670
PeAF	1.502 (0.635–3.556)	.354
Age (per y)	1.036 (1.008–1.064)	.011
Men	0.498 (0.296–0.840)	.009
Diabetes mellitus	1.974 (1.099–3.544)	.023
Symptomatic heart failure	2.159 (1.146–4.071)	.017
Older Group Variables		
Univariate model		
SR	Reference	
PAF	1.231 (0.631–2.404)	.542
PeAF	2.198 (1.230–3.930)	.008
Age (per y)	1.105 (1.060–1.153)	<.001
Age (≥75 y)	–	<.0
Men	1.071 (0.700–1.640)	.751
Body mass index (per kg/m^2)	0.964 (0.902–1.031)	.285
Hypertension	1.834 (1.128–2.982)	.014
Diabetes mellitus	1.076 (0.662–1.748)	.768
Previous cerebral infarction/TIA	1.354 (0.590–3.105)	.474
Symptomatic heart failure	1.688 (1.046–2.725)	.032
Structural heart diseases	1.765 (1.137–2.738)	.011
Chronic kidney disease	1.622 (1.017–2.587)	.042
Anemia	2.062 (1.196–3.552)	.009
Medications		
Antihypertensives	1.801 (1.133–2.862)	.013
Diuretics	1.722 (1.022–2.902)	.041
Antiarrhythmics	1.340 (0.788–2.281)	.280
Hypnotics	1.182 (0.745–1.876)	.478
Multivariate model		
SR	Reference	
PAF	1.317 (0.673–2.574)	.421
PeAF	2.257 (1.262–4.037)	.006
Age (per y)	1.103 (1.057–1.151)	<.001
Structural heart diseases	1.741 (1.121–2.705)	.014

contraction.[21,22] Low cardiac output can decrease multiorgan perfusion, which may include legs.

Third, such a decrease of multiorgan perfusion may also result in decreased cerebral perfusion, which may decrease cognitive function. In particular, attention disorders and decline of executive function would be the risk of falls.[23] Thus, AF could be a risk of falls via neurocardiovascular instability.[24]

Fourth, AF-related medications may also explain the risk of falls. Patients with AF are usually prescribed medications for rate or rhythm control, which suppress the response of heart rate and somewhat lower blood pressure. As a consequence, especially in older patients, these medications may cause dizziness and staggering, both of which increase the risk of falls. By similar reasons, antihypertensive medications can be a strong risk for falls.[25] Moreover, polypharmacy is a risk factor for falls, independent of the type of drugs and other comorbidities.[26]

Finally, TIA can be a cause of falls. Although coincidence of falls and TIA were not recorded in our database, coexistence of undetermined TIA can possibly be speculated.

Our data confirmed that AF is a risk factor for falls, consistent with a previous report.[7] Moreover, our data indicated that persistence of AF increases the fall risk, whereas the PAF was not a clinically significant risk. Notably, effect of PeAF on falls was significant only in age ≥75 years, but not in age <75 years. Future studies should examine methods of preventing falls in patients with PeAF in the older population. Eliminating unnecessary medications and exercise to increase muscle strength or functional mobility may be effective interventions.[27,28] It will also be necessary to investigate whether suppression of progression to PeAF is effective for preventing falls. Pulmonary vein isolation should be an ideal intervention because successful catheter ablation can reduce both PeAF- and AF-related medications.[29]

Our study had several limitations. First, our database consisted of a cohort at a single cardiovascular hospital. Therefore, our results cannot necessarily be generalized to community-based populations. Second, as not all falls are reported to the attending physicians,[30] our data, based on patient-reported events, may have underestimated the incidence of falls. Third, although we adjusted for potential confounders, residual confounding factors may remain.

Conclusions/Implications

In conclusion, in this single-center cohort study, we found that PeAF was independently associated with falls in older patients, suggesting the possible effect of irregular beats on physical frailty in the older population.

References

1. Ohsawa M, Okayama A, Sakata K, et al. Rapid increase in estimated number of persons with atrial fibrillation in Japan: An analysis from national surveys on cardiovascular diseases in 1980, 1990 and 2000. J Epidemiol 2005;15:194–196.
2. Inoue H, Fujiki A, Origasa H, et al. Prevalence of atrial fibrillation in the general population of Japan: An analysis based on periodic health examination. Int J Cardiol 2009;137:102–107.
3. Tinetti ME, Kumar C. The patient who falls: "It's always a trade-off". JAMA 2010;303:258–266.
4. Dunn JE, Rudberg MA, Furner SE, et al. Mortality, disability, and falls in older persons: The role of underlying disease and disability. Am J Public Health 1992; 82:395–400.
5. Kilander L, Andren B, Nyman H, et al. Atrial fibrillation is an independent determinant of low cognitive function: A cross-sectional study in elderly men. Stroke 1998;29:1816–1820.
6. Singh SN, Tang XC, Singh BN, et al. Quality of life and exercise performance in patients in sinus rhythm versus persistent atrial fibrillation: A Veterans Affairs Cooperative Studies Program Substudy. J Am Coll Cardiol 2006;48:721–730.
7. O'Neal WT, Qureshi WT, Judd SE, et al. Effect of falls on frequency of atrial fibrillation and mortality risk (from the REasons for Geographic and Racial Differences in Stroke Study). Am J Cardiol 2015;116:1213–1218.
8. Atwood JE, Myers JN, Tang XC, et al. Exercise capacity in atrial fibrillation: A substudy of the Sotalol-Amiodarone Atrial Fibrillation Efficacy Trial (SAFE-T). Am Heart J 2007;153:566–572.
9. Suzuki S, Yamashita T, Otsuka T, et al. Recent mortality of Japanese patients with atrial fibrillation in an urban city of Tokyo. J Cardiol 2011;58:116–123.
10. Suzuki S, Yamashita T, Ohtsuka T, et al. Prevalence and prognosis of patients with atrial fibrillation in Japan: A prospective cohort of Shinken Database 2004. Circ J 2008;72:914–920.
11. Matsuo S, Imai E, Horio M, et al. Revised equations for estimated GFR from serum creatinine in Japan. Am J Kidney Dis 2009;53:982–992.
12. Bowling CB, Booth JN III, Safford MM, et al. Nondisease-specific problems and all-cause mortality in the REasons for Geographic and Racial Differences in Stroke study. J Am Geriatr Soc 2013;61:739–746.
13. Sylliaas H, Idland G, Sandvik L, et al. Does mortality of the aged increase with the number of falls? Results from a nine-year follow-up study. Eur J Epidemiol 2009;24:351–355.
14. Lloyd-Jones DM, Wang TJ, Leip EP, et al. Lifetime risk for development of atrial fibrillation: The Framingham Heart Study. Circulation 2004;110:1042–1046.

15. Kannel WB, Wolf PA, Benjamin EJ, et al. Prevalence, incidence, prognosis, and predisposing conditions for atrial fibrillation: Population-based estimates. Am J Cardiol 1998;82:2N–9N.
16. Benjamin EJ, Levy D, Vaziri SM, et al. Independent risk factors for atrial fibrillation in a population-based cohort. The Framingham Heart Study. JAMA 1994; 271:840–844.
17. Chaves PH, Kuller LH, O'Leary DH, et al. Subclinical cardiovascular disease in older adults: Insights from the Cardiovascular Health Study. Am J Geriatr Cardiol 2004;13:137–151.
18. Barzilay JI, Blaum C, Moore T, et al. Insulin resistance and inflammation as precursors of frailty: The Cardiovascular Health Study. Arch Intern Med 2007; 167:635–641.
19. Magnani JW, Wang N, Benjamin EJ, et al. Atrial fibrillation and declining physical performance in older adults: The Health, Aging, and Body Composition Study. Circ Arrhythm Electrophysiol 2016;9:e003525.
20. Clark DM, Plumb VJ, Epstein AE, et al. Hemodynamic effects of an irregular sequence of ventricular cycle lengths during atrial fibrillation. J Am Coll Cardiol 1997;30:1039–1045.
21. Daoud EG, Weiss R, Bahu M, et al. Effect of an irregular ventricular rhythm on cardiac output. Am J Cardiol 1996;78:1433–1436.
22. Rodman T, Pastor BH, Figueroa W. Effect on cardiac output of conversion from atrial fibrillation to normal sinus mechanism. Am J Med 1966;41:249–258.
23. Srikanth V, Beare R, Blizzard L, et al. Cerebral white matter lesions, gait, and the risk of incident falls: A prospective population-based study. Stroke 2009;40: 175–180.
24. Jansen S, Frewen J, Finucane C, et al. AF is associated with self-reported syncope and falls in a general population cohort. Age Ageing 2015;44:598–603.
25. Woolcott JC, Richardson KJ, Wiens MO, et al. Meta-analysis of the impact of 9 medication classes on falls in elderly persons. Arch Intern Med 2009;169: 1952–1960.
26. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. N Engl J Med 1988;319:1701–1707.
27. Panel on Prevention of Falls in Older Persons, AGS, British Geriatrics, S. Summary of the Updated American Geriatrics Society/British Geriatrics Society clinical practice guideline for prevention of falls in older persons. J Am Geriatr Soc 2011;59:148–157.
28. Campbell AJ, Robertson MC. Rethinking individual and community fall prevention strategies: A meta-regression comparing single and multifactorial interventions. Age Ageing 2007;36:656–662.
29. Ouyang F, Ernst S, Chun J, et al. Electrophysiological findings during ablation of persistent atrial fibrillation with electroanatomic mapping and double Lasso catheter technique. Circulation 2005;112:3038–3048.
30. Wild D, Nayak US, Isaacs B. How dangerous are falls in old people at home? Br Med J (Clin Res Ed) 1981;282:266–268.