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ORIGINAL ARTICLE

Is Age Associated with Complications of Atrial Fibrillation Catheter Ablation?

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Abstract

Background: Atrial fibrillation (AF) is the most frequent arrhythmia, and its prevalence increases with age. The management of AF in the elderly is challenging, as it is normally associated with comorbidities and frailty. AF catheter ablation (CA) is a safe and superior alternative to antiarrhythmic drugs (AADs) for the maintenance of sinus rhythm.

Objectives: To evaluate the rate of complications associated with CA for AF across different age groups.

Methods: A retrospective analysis of 219 patients who underwent CA for AF between 2016 and 2020 were divided into 3 age groups: less than 60 years, 60 to 70 years, and > 70 years. All the included patients underwent radiofrequency ablation using an electroanatomic mapping system. Categorical variables were evaluated with chi-square and Fisher's test, and continuous variables were evaluated by Kruskal-Wallis and post-hoc Tamhane's T2. P values less than 0.05 were considered significant.

Results: We found an overall total complication rate of 4.6%. The total complication rate was 3.3% in patients < 60 years of age, 5.7% in patients between 60 and 70 years, and 5.2% in patients > 70 years (p = 0.742). No deaths occurred.

Conclusion: There was no significant difference in the AF CA-related complications when comparing the patients by age group.

Keywords: Atrial Fibrilation; Elderly; Catheter Ablation/complications; Comorbidities; Anticoagulants; Echocardiography, Transesophageal/methods.

Introduction

Atrial fibrillation (AF) is the most frequent arrhythmia, and its incidence increases with age. Although AF is not an immediately life-threatening arrhythmia, the management of AF in the elderly is challenging, as it is normally associated with comorbidities and frailty. Treating elderly patients with AF remains challenging, as antiarrhythmic drugs (AADs) are not frequently effective, and they pose risks due to common side effects. Anticoagulation has proven to be effective in preventing ischemic stroke in this population; however, it also imposes a risk of bleeding complications.[1-4]

As AF progression is associated with a decrease in quality of life and, with time, becomes irreversible or less amenable to treatment, rhythm control is a relevant choice. The rhythm control strategy refers to attempts to restore sinus rhythm and may involve a combination of approaches, including cardioversion, antiarrhythmic medication, and catheter ablation (CA). The primary indication for rhythm control is to reduce the AF burden and its effects, including AF-related symptoms, stroke, heart failure, hospitalizations, and poor quality of life.[5-10]

The state-of-the-art management of AF, as recommended by the guidelines, supports the implementation of the AF Better Care (ABC) holistic Pathway (A, anticoagulation/

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avoid stroke; B, better symptom management; C, cardiovascular and comorbidity optimization), which has been associated with a lower risk of all-cause death. The ABC Pathway streamlines the integrated care of patients with AF across all healthcare levels and among different specialties.[5-9]

CA emerged more than 20 years ago, and its technology has advanced significantly. It is considered an important and effective approach to maintain a normal sinus rhythm. When performed by appropriately trained operators, AF CA is a safe and superior alternative to AADs for maintenance of sinus rhythm.[11] However, the safety and efficacy of CA in elderly patients with AF have been questioned. Several cardiologists have doubts about offering ablation to elderly patients due to fear of complications.

The present study sought to evaluate the rate of complications of CA for AF across various age groups.

Methods

Study population

This single-center study retrospectively analyzed the outcome of CA for AF in patients categorized into different age groups, namely less than 60 years, between 60 and 70 years, and more than 70 years old. We included all patients who underwent radiofrequency CA for AF between 2016 and 2020 using an electroanatomic mapping system.

We excluded patients with missing data regarding age or complications related to CA. The study was approved by the local ethics committee.

CA

All patients underwent ablation using an uninterrupted oral anticoagulation protocol and underwent transesophageal echocardiography or angiotomography of the left atrium before the procedure for thrombus exclusion.

CA was performed under general anesthesia, guided by an anesthesiologist. Three catheters were positioned within the coronary sinus and left atrium through three punctures via the femoral vein. Intracardiac echocardiography was performed at the discretion of the operator. A transseptal puncture was performed via the femoral vein under fluoroscopic or intracardiac echocardiography guidance using a modified Brockenbrough technique and an 8.5-French transseptal sheath (SL1, St. Jude Medical, Inc., St. Paul, MN, USA). Before the transseptal puncture, heparin was administered at 30-minute intervals, targeting an activated clotting time of 300 to 400 seconds. Our aim was to isolate a wide antral circumferential portion of the pulmonary veins guided by circular and contact-force catheters using a 3D electroanatomic mapping system. Cavotricuspid isthmus ablation was performed in case of flutter. Additional left atrial lesions were performed according to the operator's judgment.

In approximately half of the ablations included, radiofrequency energy was delivered at a power of 40 W for an average time of 6 to 8 seconds and 5 to 10 g of contact on the posterior walls of both sides and the atrial roof. On the anterior wall, we used 50 W with an estimated force of 10 to 20 g for an average time of 6 to 8 seconds. The irrigation pump flow was programmed to be 35 mL/min, regardless of the power. The other half, before 2018, had a standard radiofrequency setting of 30 W at the anterior wall and 20 W at the posterior wall. Ablation was continued until complete pulmonary vein isolation (PVI) was achieved. Acute electrical PVI was confirmed by the presence of an entrance block 30 minutes after the complete isolation of all pulmonary veins. All the patients underwent continuous esophageal temperature monitoring to prevent esophageal heating and complications.

Post-ablation care and follow-up

Following ablation, the patients were discharged the day after the procedure, with the exception of complications. All the patients were treated with proton-pump inhibitors twice daily for 4 weeks plus sucralfate. Anticoagulation was maintained for at least 3 months and reassessed according to the CHA_2DS_2-VASc score. A 12-lead surface electrocardiogram was performed prior to discharge.

The patients were followed up during regular visits scheduled 7 days after ablation, and data regarding CA were collected. Additional outpatient clinic visits were included, if required. AAD management was individualized according to each patient's clinical aspects.

Outcomes

The outcome was safety and included any complications related to the procedure itself or during post-procedure hospitalization before discharge and follow-up.

Complications

A major complication was considered to be serious if it resulted in death or functional disability, warranted an intervention, or resulted in or prolonged hospitalization of more than 24 hours. The major adverse events included at least one of the following: cardiac tamponade and pericardial effusion, diaphragmatic paralysis, pulmonary embolism, stroke or transient ischemic attack, acute myocardial infarction, cardiogenic shock, atrial-esophageal fistula, and vascular complications requiring surgical repair. Other complications were considered minor.

Statistical analysis

The distribution of continuous variables was evaluated with the Kolmogorov-Smirnov test. Categorical variables are presented as absolute frequency and percentage, and continuous variables as median and interquartile range, due to the asymmetric distribution. Differences between groups were assessed using chi-square, Fisher's exact, and Kruskal-Wallis tests as appropriate, using adjusted residual analysis to identify differences. Continuous variables were analyzed using adjusted residual analysis and Tamhane's T2 test. The analyses were processed using SPSS software, version 20 (IBM®, Chicago, IL, USA), and $p < 0.05$ was established as a limit of statistical significance.

Results

Between April 2016 and April 2020, we evaluated 219 patients who underwent AF ablation. Table 1 shows the demographic characteristics and comorbidities of the patients. The majority of the patients were men (73.1%), white (73.1%), and older than 60 years (58.4%; median age: 63 [54 to 71] years). The group > 70 years of age represented 26.5% of the total patients; 32% of the patients were between 60 and 70 years of age; 41.6% were under the age of 60 years, and 10 patients were octogenarians. Approximately one third of the patients were overweight. A history of hypertension was documented in 64.7% of the patients, diabetes mellitus in 19.8%, stable coronary artery disease in 19.1%, and a previous history of stroke or transient ischemic attack in 10.5%. All the patients demonstrated a normal left ventricular ejection fraction and a mean left atrial diameter of 43 mm (38 to 48 mm). The median CHA_2DS_2-VASc score was 2 (1 to 4), and 70.7% had a score higher than 2. Most of the patients (63.8%) presented with paroxysmal AF; 21.6% had persistent AF for less than 1 year, and 14.6% of the patients had long-standing persistent AF. The medications used are presented in Table 2.

The ablation characteristics and complications are presented in Tables 3 and 4. Most of the patients were in their first ablation (89.4%), and a PVI-only strategy was used as the most frequent procedure approach (57.1%), yielding an average of 68 minutes spent in the left atrium and 96 minutes as the total ablation time. An average of 86.2% of the patients had their esophagus monitored with a single-probe thermometer, and 44.7% of the patients had elevated temperature.

During the follow-up, there were no cases of atrial-esophageal fistula or death. A total of 10 patients (4.6%) were observed to have complications. The type and characteristics of each patient with major or minor complications are described in Table 4.

The patients were classified according to age range as follows: 41.6% < 60 years, 32.0% between 60 and 70 years, and 26.5% > 70 years. Comparative analysis showed a higher prevalence of women, hypertension, coronary artery disease, previous electric cardioversion, presence of thrombus at screening, and higher CHA_2DS_2-VASc scores between the oldest groups (Table 1). Additionally, the patients aged > 70 years had a shorter time from the first diagnosis of AF to the ablation date.

Amiodarone use was more frequent among older adults (Table 2). No other differences were found in the demographics, comorbidities, or medications among the groups.

In Table 3, the PVI-only strategy was more common in the younger group. No other differences in the ablation procedure were observed between the groups. The frequency of major or minor complications did not differ between the groups (Table 3). The distribution of the complication rates by age is shown in Figure 1.

Discussion

The study's main finding was no significant differences in AF CA-related complications when comparing patients by age group, and the rate of complications obtained in this study was low.

AF is the most common arrhythmia in the elderly population; moreover, its prevalence is expected to increase exponentially over the following years.[3] This

Table 1 – Demographic and comorbidity profile of total population according to age ranges

	N	Total	< 60 years	60 – 70 years	> 70 years	P
Age, years	219	63.0 (54.0 – 71.0)	52.0 (46.0 – 57.0)[a]	66.0 (63.0 – 68.0)[a]	74.0 (72.0 – 79.0)[a]	**0.000**
Men, n (%)	219	160 (73.1)	74 (81.3)*	53 (75.7)	33 (56.9)*	**0.004**
White, n (%)	171	125 (73.1)	48 (66.7)	41 (75.9)	36 (80.0)	0.244
BMI, kg/m^2	148	27.5 (24.8 – 30.1)	27.9 (23.9 – 30.5)	27.4 (25.1 – 30.1)	26.7 (24.2 – 29.9)	0.798
Obesity, n (%)	148	45 (30.4)	21 (33.3)	12 (27.3)	12 (29.3)	0.785
AF type	185					0.198
Paroxysmal, n (%)		118 (63.8)	55 (74.3)	35 (57.4)	28 (56.0)	
Persistent < 1 year, n (%)		40 (21.6)	11 (14.9)	16 (26.2)	13 (26.0)	
Persistent > 1 year, n (%)		27 (14.6)	8 (10.8)	10 (16.4)	9 (8.0)	
AF time, months	162	14.0 (6.0 – 26.0)	14.0 (7.0 – 24.0)	19.0 (6.0 – 37.0)	10.0 (4.5 – 20.0)	**0.046**
Smoker	186	39 (21.0)	15 (19.5)	14 (25.0)	10 (18.9)	0.673
HTN, n (%)	184	119 (64.7)	38 (48.7)*	40 (71.4)	41 (82.0)*	**0.000**
Stroke/TIA, n (%)	181	19 (10.5)	4 (5.3)	6 (10.7)	9 (18.0)	0.077
Diabetes, n (%)	187	37 (19.8)	13 (16.5)	12 (21.1)	12 (23.5)	0.589
Heart failure, n (%)	186	25 (13.4)	9 (11.4)	9 (16.4)	7 (13.5)	0.709
CAD, n (%)	178	34 (19.1)	5 (7.0)*	8 (14.3)	21 (41.2)*	**0.000**
CKD, n (%)	184	5 (2.7)	0 (0.0)	2 (3.5)	3 (5.9)	0.123
OSA, n (%)	145	92 (63.4)	39 (65.0)	24 (54.5)	29 (70.7)	0.286
COPD, n (%)	167	9 (5.4)	1 (1.5)	6 (11.1)	2 (4.4)	0.061
Previous ECV, n (%)	155	84 (54.2)	24 (40.0)*	33 (64.7)	27 (61.4)	**0.018**
CHADS-VASc	188	2 (1 – 4)	1 (0 – 2)*	3 (2 – 3)*	4 (3 – 5)*	**0.000**
CHADS-VASc ≥ 2 , n (%)	188	133 (70.7)	31 (39.2)*	51 (87.9)*	51 (100)*	**0.000**
Echocardiogram						
LA (mm)	157	43.0 (38.0 – 48.0)	41.0 (37.0 – 45.0) [a]	44.5 (40.0 – 49.2)	43.0 (38.0 – 48.0)	**0.035**
LVEF %	156	64.0 (56.0 – 69.0)	64.0 (59.0 – 68.0)	64.0 (50.0 – 69.0)	66.0 (55.8 – 70.0)	0.240
Thrombus at screening, n %	174	8 (4.6)	0 (0.0)*	3 (5.5)	5 (10.6)*	**0.024**

** Significant difference (adjusted residual). a Significant difference (Tamhane's T2) versus other groups. AF: atrial fibrillation; BMI: body mass index; CAD: coronary artery disease; CKD: chronic kidney disease; COPD: chronic obstructive pulmonary disease; ECV: electrical cardioversion; HTN: hypertension; LA: left atrium; LVEF: left ventricular ejection fraction; N: number; OSA: obstructive sleep apnea; TIA: transient ischemic attack*

type of arrhythmia by itself is a strong independent factor for stroke, with a 5-fold increased risk of thromboembolic events in patients of all ages, with up to 30% of cerebrovascular accidents in the elderly being attributed to AF.[4]

The management of patients with AF can be divided into rate control or rhythm control strategies. Elderly patients frequently benefit from rate control; however, there is a subset of patients who can become very symptomatic. As such, a rhythm control strategy might

Table 2 – Medications between age ranges and total population

	N	Total	< 60 years	60 – 70 years	> 70 years	P
Amiodarone, n (%)	174	91 (52.3)	28 (38.9)*	32 (59.3)	31 (64.6)*	**0.010**
Propafenone, n (%)	176	52 (29.5)	26 (35.6)	17 (30.4)	9 (19.1)	0.153
Sotalol, n (%)	170	13 (7.6)	7 (9.9)	2 (3.8)	4 (8.7)	0.430
Betablocker, n (%)	170	69 (40.6)	25 (35.2)	25 (47.2)	19 (41.3)	0.404
Digoxin, n (%)	171	2 (1.2)	2 (2.8)	0 (0.0)	0 (0.0)	0.240
Verapamil/diltiazem, n (%)	171	3 (1.8)	1 (1.4)	0 (0.0)	2 (4.3)	0.246
ACE inhibitor/ARB, n (%)	170	74 (43.5)	28 (39.4)	21 (39.6)	25 (54.3)	0.223
Diuretics, n (%)	169	41 (24.3)	14 (20.0)	11 (20.8)	16 (34.8)	0.148
Dabigatran, n (%)	171	79 (46.2)	29 (40.3)	24 (45.3)	26 (56.5)	0.223
Rivaroxaban, n (%)	171	44 (25.7)	20 (27.8)	15 (28.3)	9 (19.6)	0.534
Apixaban, n (%)	171	31 (18.1)	14 (19.7)	10 (18.5)	7 (15.2)	0.823
Edoxaban, n (%)	175	12 (6.9)	7 (9.5)	2 (3.7)	3 (6.4)	0.440
Warfarin, n (%)	177	5 (2.8)	2 (2.7)	1 (1.9)	2 (4.0)	0.808
ASA, n (%)	186	14 (7.5)	6 (7.7)	6 (10.3)	2 (4.0)	0,459
Clopidogrel, n (%)	185	7 (3.8)	2 (2.6)	1 (1.7)	4 (8.0)	0,181

** Significant difference. ACE: angiotensin converting enzyme; ARB: angiotensin receptor blocker; ASA: acetylsalicylic acid; N: number.*

Table 3 – Ablation characteristics and outcomes of patients between age ranges

	N	Total	< 60 years	60 – 70 years	> 70 years	P
First ablation, n (%)	189	169 (89.4)	69 (89.6)	55 (91.7)	45 (86.5)	0.677
Strategy	177					**0.014**
PVI only, n (%)		101 (57.1)	48 (69.6)	25 (43.9)	28 (54.9)	**0.014**
PVI plus lines, n (%)		76 (42.9)	21 (30.4)	32 (56.1)	23 (45.1)	
LA total time (min),	152	68.0 (56.0 – 86.0)	70.0 (60.0 – 90.0)	66.0 (55.0 – 85.0)	66.5 (49.8 – 82.8)	0.206
Ablation total time (min),	154	96.0 (78.0 – 118.5)	98.0 (80.8 – 120.5)	91.0 (75.0 – 112.5)	96.0 (76.0 – 110.0)	0.368
Esophagus temperature probe	174	150 (86.2)	60 (84.5)	49 (87.5)	41 (87.2)	0.864
Esophageal temperature elevation	150	67 (44.7)	28 (46.7)	19 (38.0)	20 (50.0)	0.483
Total complications	219	10 (4.6)	3 (3.3)	4 (5.7)	3 (5.2)	0.742
Major complications	219	7 (3.2)	3 (3.3)	1 (1.4)	3 (5.2)	0.486
AF recurrence	142	12 (8.5)	5 (8.6)	3 (6.7)	4 (10.3)	0.839

AF: atrial fibrillation; LA: left atrium; N: number; PVI: pulmonary vein isolation.

Table 4 – Age and sex of each patient who had major or minor complications

Patient	Age	Sex	Major complication	Minor complication
1	54	M	Vascular (surgical repair)	-
2	56	F	Pericardial tamponade	-
3	60	F	Diaphragmatic paralysis	-
4	66	M	-	Femoral hematoma
5	67	F	Pericardial tamponade	-
6	68	M	-	Femoral hematoma
7	69	F	-	Pseudoaneurysm
8	73	F	Stroke	-
9	80	F	Pericardial tamponade	Femoral hematoma
10	82	M	Pericardial tamponade	-

F: female; M: male.

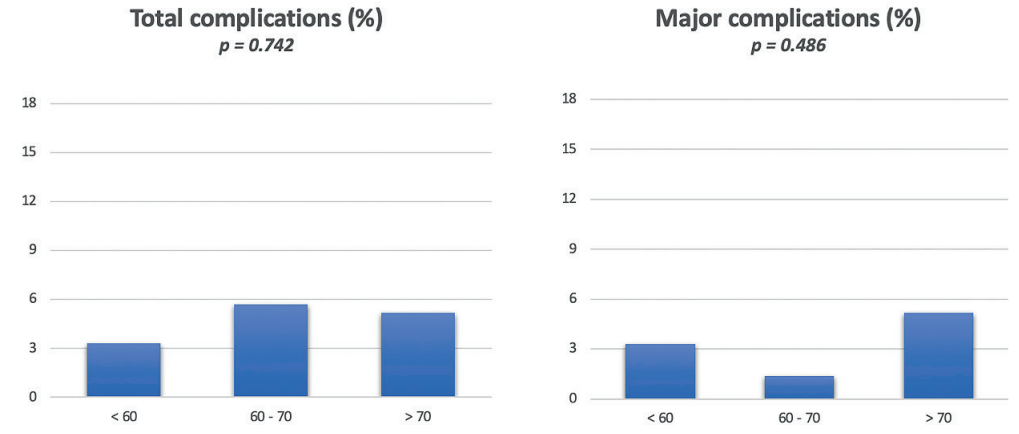

Figure 1 – AF CA complications rate by age range. No significant difference was observed in the AF CA-related complications when comparing the patients by age group.

be a reasonable option upfront. Given the high prevalence of comorbidities in this population, the use of AAD might pose a particular challenge and increase the incidence of side effects; therefore, CA for AF can become a reasonable treatment, as it has been shown to be more effective than AAD in maintaining sinus rhythm as well as improving functional status and quality of life.[11,12] However, current studies show that the safety of this procedure in the elderly population is somewhat controversial.

Some studies indicate that there is no evidence of an increased risk of major complications in older patients.[12-15] Moreover, a retrospective study with a large group of 86,119 patients, 3,482 of whom were octogenarians, with AF ablation as the primary diagnosis, examined the outcomes including mortality, and concluded that there was no significant difference in the mortality outcomes between the octogenarian population and those aged less than 80 years.[16]

On the contrary, other studies showed relatively higher vascular bleeding complications, both acutely (4%) and within 30 days after the procedure (2.6%).[17] For instance, one group observed a total of 137 procedures

in a population of subjects older than 75 years of age, with 8 major (5.8%), and 26 minor (19%) periprocedural complications.[18] Another study reported a higher rate of complications in patients aged ≥ 70 years than in the younger population (6.7% versus 1.0 %, P < 0.001). The most worrisome complication was the increased rate of periprocedural stroke (3.3% versus 0.7%, P = 0.058).[19] Our analyses showed very low incidence of stroke (1 patient). The reasons for the reported difference in procedure-related complications are unclear and may be multifactorial, including the risk profile of each patient, anticoagulation management, and different ablation techniques and tools. Aging is associated with aortic stiffening, myocardial hypertrophy, myocardial fibrosis, and frequently, cardiac amyloidosis. The complex interactions between the cardiovascular aging process and cardiovascular risk factors determine the left ventricular remodeling pattern.[20] It is controversial whether this aging process implies greater risk during the CA procedure.

It should be noted that aging is not a homogenous process. The myocardial aging process is determined by a balanced interaction between collagen, fibroblasts, cardiomyocytes, capillary vessels, and interstitial fibrosis. During the pathological aging process, the myocardium undergoes important tissue composition and remodeling changes (hypertrophy, interstitial and replacement fibrosis, and so on), causing myocardial frailty. A healthy aging process has a more balanced interaction between myocardial components without a predominance of fibrosis and fibroblasts. The aging process is genetically programmed, but it is modified by environmental influences, with the result that the rate of aging can vary widely among people. Therefore, it is controversial whether exclusively the aging process implies higher risk during the CA procedure. Figure 2 illustrates the cardiovascular aging process.

We studied a group of patients with AF who underwent ablation, separated into 3 groups by age to evaluate procedural safety. The oldest group presented higher prevalence of hypertension and coronary artery disease, higher CHA_2DS_2-VASc scores (all patients ≥ 2), and a higher incidence of thrombus at screening in comparison to the other 2 groups.

The incidence of thrombus at screening before ablation was higher in the group ≥ 70 years. As the presence of thrombus was higher in the oldest group, the occurrence of stroke would have higher chances; however, a low incidence was observed, with only 1 case reported and no difference in the rate of serious cerebrovascular and cardiac complications in the elderly patients, despite a significantly higher thromboembolic risk. All the patients underwent ablation with anticoagulation therapy.

The total ablation time and time spent in the left atrium were similar between the groups; however, in the younger group, the PVI-only approach was higher, possibly because of the higher prevalence of paroxysmal AF and less atrial disease extension. Despite the high-power energy delivery, only 45% exhibited esophageal temperature elevation, and no patient had atrial-esophageal fistula during the follow-up; additionally, there were no complications directly related to the radiofrequency applications. Of the total of 7 major complications, 4 were due to cardiac tamponade: 1 in the group < 60 years, 1 in the group 60 to 70 years, and 2 in the group over 70 years. The other 3 major complications were due to vascular injury with surgical correction, stroke, and diaphragmatic paralysis, and only 1 of these was in the older group. The low incidence of complications, as well as the small sample of patients, may be responsible for the lack of statistical significance in this comparison of groups.

The total complication rates in our patients were 3.3% (< 60 years), 5.7% (60 to 70 years), and 5.2% (> 70 years), without statistical difference. The major complications were also not statistically different between the groups, reaching a total of 3.2%. Additionally, no major complications had an impact on the functional status of the patients after hospital discharge. All major and minor complications were completely resolved during hospitalization, and no patient died due to the procedure. Despite a high-power energy delivery, no complications were directly related to the radiofrequency applications.

Not all elderly patients are the same; therefore, the ablation strategy can change. For instance, previous research concluded that octogenarians referred for CA of AF were more frequently women, with a higher rate of associated comorbidities and more frequent non-pulmonary vein triggers; therefore, more ablation was needed.[21] However, more data are necessary to better understand the main predictors of AF ablation complications. Our study included a population with fewer comorbidities, predominantly composed of patients with paroxysmal AF; hence, PVI-only ablation was the most frequent approach. Careful patient selection is crucial.

Importantly, whether the safety of CA for AF in elderly patients could be generalized to all institutions (high or low-volume centers) or to less experienced operators

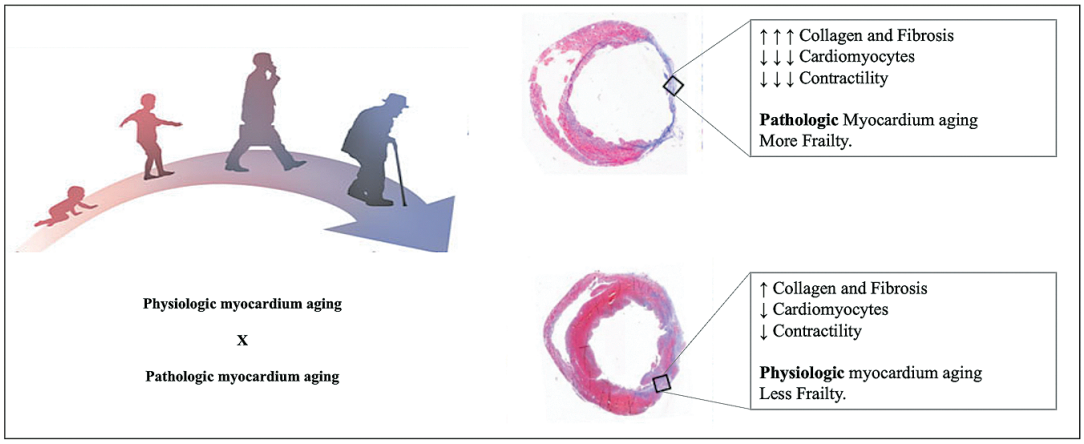

Figure 2 – Cardiovascular aging process. Aging is not a homogenous process. Myocyte loss occurs through apoptotic and/or necrotic pathways, and this results in hypertrophy of remaining myocytes and replacement fibrosis. The changes with age occur in everyone, but not necessarily at the same rate, therefore accounting for the difference seen in some people between chronologic age and physiologic age.

warrants further investigation. According to a recent meta-analysis,[22] there is an inverse relationship between both the hospital and operators of AF ablation volume and the incidence of complications. Hospitals performing ≥ 50 procedures/year demonstrated significantly lower mortality compared with those performing < 50 procedures/year (0.16% versus 0.55%, odds ratio = 0.33, 95% confidence interval 0.26 to 0.43, P < 0.001. A similar relationship existed between an operator experience volume of < 50 procedures/year and the incidence of complications (3.75% versus 12.73%, P < 0.001; odds ratio = 0.27, 95% confidence interval 0.23 to 0.32).[21] Our team performed more than 100 AF ablations in 2020 and is in accordance with the current evidence with low complication rates independent of patient age, thus leading us to question whether age is a determinant variable for ablation complications in not very elderly patients.

Elderly populations are more sensitive to the impacts of both disease and treatment; therefore, medical decisions are more difficult. Cardiac aging is characterized by a series of complex events of ventricle and valvular changes identified at structural, cellular, molecular, and functional levels, making the aged myocardium more susceptible to stress and leading to a high prevalence of cardiovascular diseases in the elderly population.[20] Our data analysis, for our demographic patient and procedure profile, indicates that AF ablation might be a good treatment without adding additional risk than the disease itself, thereby raising the hypothesis that the benefit of offering ablation for sinus rhythm maintenance outweighs the risk of AF. Figure 3 illustrates an AF ablation guided by a 3D electroanatomic mapping system.

Study limitations

This was a single-center retrospective assessment of the safety of CA for AF in elderly patients that showed no differences between the elderly and younger patients with regard to procedural safety. However, due to the significant under-representation of the elderly in our series of patients referred for CA of AF, our analysis might be underpowered to disclose the differences in the procedural outcomes between the groups. Moreover, as it is a retrospective study, we had missing data on some variables, mainly on demographic characteristics, but we were careful to inform the number of variables collected according to the number of patients to expose this limitation.

Considering the low frequency of complications, our sample size was small, limiting the power. Moreover, there were few patients > 80 years of age; therefore, the results should not be extrapolated to this population.

Conclusion

The AF CA treatment demonstrated no significant differences in procedure-related complications when comparing patients by age group. The rate of the general complications obtained in this study was low, which may suggest that CA is a safe procedure in elderly patients.

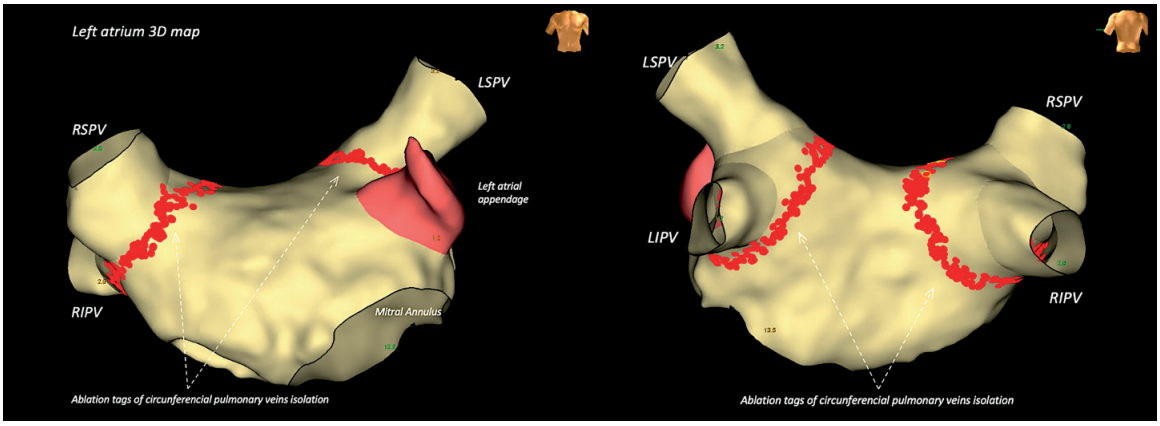

Figure 3 – Left atrium 3D electroanatomic map. Left atrium 3D electroanatomic map of an 81-year-old male patient, with persistent AF for 3 years and reduced left ventricle ejection fraction (LVEF = 40%). Left: anterior view. Right: posterior view. LIPV: left inferior pulmonary vein; LSPV: left superior pulmonary vein; RIPV: right inferior pulmonary vein; RSPV: right superior pulmonary vein. Red dots: tags of radiofrequency ablation.

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Author Contributions

Conception and design of the research: Lovatto CAV, Serpa E, Carloni H, Cunha C, Calil O; acquisition of data: Lovatto CAV, Vassallo F, Simões A, Carloni H, Cunha C; analysis and interpretation of the data: Lovatto CAV, Vassallo F, Serpa E, Simões A; statistical analysis: Lovatto CAV; writing of the manuscript: Lovatto CAV, Simões A, Carloni H, Barbosa R; critical revision of the manuscript for intellectual content: Lovatto CAV, Vassallo F, Serpa E, Simões A, Carloni H, Cunha C, Barbosa R, Calil O, Serpa R, Barbosa LF.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the EMESCAM, Santa casa de Vitória, under the protocol numbe CAAE 36012620.9.0000.5065. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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