Catheter ablation of atrial fibrillation in the elderly

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Abstract

Background Atrial fibrillation (AF) catheter ablation has emerged as a promising treatment strategy for AF, but has not been widely adopted in the elderly population. The present study aimed to determine the safety and efficacy of AF catheter ablation in the elderly population.

Methods and Results The study population consisted of 316 patients with paroxysmal AF who underwent left atrial ablation. Ninety-five patients were ≥ 65 years (48 males, mean age 68.9 ± 3.0 years old) and 221 patients were < 65 years old (130 males, mean age 52.5 ± 10.4 years old). After a mean follow-up period of 34.0 ± 15.1 months, 55 (57.9%) patients in the elderly group were free from arrhythmia recurrence compared with 149 (67.4%) patients in the younger group (P = 0.169). Procedural complications were uncommon in both study groups. In logistic regression analysis, left atrial diameter (P = 0.003), hypertension (P = 0.001), dyslipidemia (P = 0.039), and coronary artery disease (P = 0.018) were independent predictors of AF recurrence in the elderly population.

Conclusions Catheter ablation of AF is safe and effective in older patients. Invasive strategies should be considered as an alternative choice in symptomatic elderly patients with AF.

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Keywords: Ablation; Atrial fibrillation; The elderly

1 Introduction

Atrial fibrillation (AF) is the most common arrhythmia seen in clinical practice reaching a prevalence of 8% in those aged older than 80 years.[1,2] It has been estimated that the number of patients with AF in 2030 in Europe will be 14–17 million and the number of new cases of AF per year will be 120,000–215,000.[3] With increasing life expectancy, AF in the elderly becomes an important public health concern.[3,4] Older patients with AF are more likely to have co-morbidities including hypertension, diabetes, heart failure, renal failure, and chronic obstructive pulmonary disease placing them at increased risk for thromboembolic events.[3,5–7] In addition, the effect of antiarrhythmic drugs is less predictable in ageing population with more frequent side effect, including pro-arrhythmias.[6–8]

AF catheter ablation has not been widely adopted in the elderly population.[9] Elderly patients were initially excluded from many catheter ablation trials due to concerns about safety and efficacy.[10,11] Progress in catheter ablation techniques and safety have given to the elderly population an additional treatment option for AF.[12] The present study aimed to determine the safety and efficacy of AF catheter ablation in older patients. The predictors of AF recurrence in this specific population were additionally investigated.

2 Methods

2.1 Patients

Consecutive patients with symptomatic, drug-refractory paroxysmal AF who underwent left atrial ablation were included in the present study. Patients were classified as having paroxysmal AF according to the current guidelines.[9] Exclusion criteria were intracardiac thrombi documented by tranesophageal echocardiography, systolic heart failure [left ventricular ejection fraction (LVEF) < 45%, New York Heart Association (NYHA) III-IV], persistent AF, previous left atrial ablation, inadequate follow-up and/or inability to provide informed consent. Transsthoracic and tranesophageal echocardiography was performed in all subjects. LVEF and left atrial diameter (LAD) were calculated. In this study, the elderly population included patients with AF aged 65
years or older. The institutional ethics committee approved the study protocol, and written informed consent was obtained from all patients.

2.2 Catheter ablation procedure

Oral anticoagulation was stopped at 2–3 days before the ablation procedure, and all subjects were anticoagulated with enoxaparin. Antiarrhythmic drug (AAD) treatment was suspended for the day of the ablation procedure and restarted the following day. The ablation procedure has been described in details elsewhere.[13] Following a single transseptal puncture, the three-dimensional geometry of the left atrium was reconstructed using the CARTO 3 navigation system ( Biosense Webster, Inc., Diamond Bar, Calif., USA). Angiography was performed in all patients to verify the pulmonary vein ( PV) ostia. Wide circumferential lesions for isolation of large atrial areas around both ipsilateral PVs ( PV antral isolation) were applied using a 3.5-mm-tip ablation catheter (Thermo Cool Navi-Star, Biosense Webster, Inc., Diamond Bar, Calif., USA). Radiofrequency energy was applied in each spot at 30–35 W with a flow rate of 17–30 mL/min and a target temperature of 43°C for a maximum of 60 s. The power settings of the energy were individualized depending on the ablation sites. The end point of ablation was the absence or dissociation of potentials in the isolated area as documented with the circular mapping catheter (Lasso, Biosense Webster, Inc., Diamond Bar, Calif., USA). All patients were anticoagulated with heparin in order to achieve an activated clotting time between 300 s and 350 s throughout the procedure.

2.3 Post-ablation care and follow-up

After the procedure, warfarin was restarted. Warfarin or novel anticoagulants were continued for at least three months. All subjects underwent ambulatory monitoring the first two post-procedural days. Recurrences during this blanking period were treated with AADs and/or cardioversion if needed. The patients were seen by the referring cardiologist for 24–48 h ambulatory monitoring at the first, third, sixth, ninth and twelfth month after the index procedure. Patients were additionally advised to report any symptoms of arrhythmia between scheduled visits. Documented symptomatic or asymptomatic AF episodes lasting more than 30 s or atrial tachycardias were considered as recurrence after the three month blanking period.

2.4 Statistical analysis

Continuous variables are presented as mean ± SD, while categorical ones are presented as absolute and relative frequencies (percentages). The mean differences between study groups were evaluated by calculating Student’s t-test. Pearson’s chi-square or Fisher’s exact test were used in order to test for any associations between the two categorical variables. Logistic regression analysis was applied in order to evaluate potential predictors of AF recurrence. All analyses were performed with SPSS 17.0 software package (SPSS Inc., Chicago, IL, USA). Double-sided P values less than 0.05 were considered as indicative of statistical significance.

3 Results

The study population consisted of 316 patients (178 males, mean age 57.4 ± 11.6 years, range 20–77 years) with paroxysmal AF who underwent left atrial ablation. Ninety-five patients (48 males, mean age 68.9 ± 3.0 years old) were ≥ 65 years old and 221 (130 males, mean age 52.5 ± 10.4 years old) were < 65 years old. The clinical, echocardiographic, and procedural data of these study groups are depicted in Table 1. Diabetes mellitus, dyslipidemia and coronary artery disease (CAD) were present in 20.0%, 46.4%, and 20.0% of all patients, respectively.

Table 1. Clinical, echocardiographic, and procedural data between patients aged < 65 and ≥ 65 years old.

| Variables                     | Patients ≥ 65 yrs, n = 95 | Patients < 65 yrs, n = 221 | P value |
|-------------------------------|---------------------------|-----------------------------|---------|
| Age, yrs                      | 68.9 ± 3.0                | 52.5 ± 10.4                 | < 0.01  |
| Males, %                      | 48 (50.5)                 | 130 (58.8)                  | 0.173   |
| Height, cm                    | 168.98 ± 8.86             | 174.76 ± 9.76               | < 0.01  |
| Weight, kg                    | 81.18 ± 11.08             | 84.88 ± 16.10               | 0.043   |
| Hypertension, %               | 40 (41.1)                 | 74 (33.5)                   | 0.143   |
| Diabetes mellitus, %          | 19 (20.0)                 | 15 (6.8)                    | < 0.01  |
| Dyslipidemia, %               | 46 (48.4)                 | 57 (25.8)                   | < 0.01  |
| Coronary artery disease, %    | 16 (16.8)                 | 10 (4.5)                    | < 0.01  |
| Duration of history of AF     |                           |                             |         |
| Episodes, years               | 5.87 ± 5.14               | 4.72 ± 4.42                 | 0.045   |
| ACEI/ARBs after AF ablation, %| 40 (42.1)                 | 75 (33.0)                   | 0.166   |
| AADs after AF ablation        |                           |                             |         |
| Class I, %                    | 4 (4.2)                   | 19 (8.6)                    | 0.169   |
| Class III, %                  | 56 (58.9)                 | 108 (48.9)                  | 0.100   |
| LAD, mm                       | 42.61 ± 4.49              | 39.09 ± 4.29                | < 0.01  |
| LVEF, %                       | 61.03 ± 3.76              | 61.12 ± 3.96                | 0.850   |
| Procedure time, min           | 209.94 ± 37.75            | 207.44 ± 45.02              | 0.635   |
| Fluoroscopy time, min         | 19.34 ± 13.83             | 15.52 ± 11.12               | 0.010   |
| Stroke                        | 2 (2.1)                   | 1 (0.5)                     | 0.165   |
| Tamponade                     | 1 (1.1)                   | 3 (1.4)                     | 0.824   |
| Groin hematoma                | 5 (5.3)                   | 4 (1.8)                     | 0.091   |

Data are presented as mean ± SD or n (%). AADs: antiarrhythmic drugs; ACEI: angiotensin converting enzyme inhibitor; AF: atrial fibrillation; ARB: angiotensin II receptor blocker; LAD: left atrial diameter; LVEF: left ventricular ejection fraction.
48.4%, and 16.8% of elderly patients and in 6.8%, 25.8% and 4.5% of younger patients, respectively \((P < 0.01)\). Older patients displayed longer duration of AF episodes \((P = 0.04)\) and increased LAD \((P < 0.01)\) in relation to the younger ones. As shown in Table 1, there were no significant differences regarding procedural complications between study groups. In particular, three elderly patients suffered major complications, including one pericardial effusion \((1.1\%)\) treated with drainage and two transient cerebral thromboembolic events \((2.1\%)\). Five elderly patients suffered minor complications including groin hematomas \((1.8\%)\). No boembolic events \((2.1\%)\). Following a mean follow-up period of 34.0 ± 15.1 months, 55 \((57.9\%)\) patients were free from arrhythmia recurrence in the elderly group compared with 149 \((67.4\%)\) patients in the younger group \((P = 0.169)\). As shown in Table 2, elderly patients with AF recurrence displayed increased LAD \((44.4 ± 2.9\) mm vs. \(41.3 ± 5.0\) mm, \(P = 0.001)\) and were more likely to exhibit hypertension \((P < 0.01)\), diabetes mellitus \((P < 0.01)\), dyslipidemia \((P = 0.002)\) and coronary artery disease \((P < 0.01)\). In logistic regression analysis, LAD \((HR: 0.819, 95\%CI: 0.719–0.933, P = 0.003)\), hypertension \((HR: 0.130, 95\%CI: 0.040–0.426, P = 0.001)\), dyslipidemia \((HR: 0.279, 95\%CI: 0.083–0.940, P = 0.039)\), and CAD \((HR: 0.059, 95\%CI: 0.006–0.617, P = 0.018)\) were independent predictors of AF recurrence after adjustment for all confounders that differs significantly between the study groups.

### Table 3. Summary of atrial fibrillation catheter ablation studies in the elderly.

| Studies                  | Number of patients | Techniques                             | AF Type         | Compared age groups         | Success rate | Major complications in the elderly |
|--------------------------|--------------------|----------------------------------------|-----------------|-----------------------------|--------------|------------------------------------|
| Zado, et al.\[^{15}\]   | 32                 | PVI plus ablation of focal sources     | PAF, PersAF     | < 65 yrs                    | 89%          | 2.9%                               |
|                          |                    |                                        | PersAF          | 65–74 yrs                   | 84%          |                                    |
|                          |                    |                                        | PersAF          | > 75 yrs                    | 86%          |                                    |
|                          |                    |                                        | PersAF          | > 60 yrs                    | 82%          |                                    |
|                          |                    |                                        | PersAF          | < 50 yrs                    | 85%          |                                    |
|                          |                    |                                        | PersAF          | > 75 yrs                    | 61%          |                                    |
|                          |                    |                                        | PersAF          | > 80 yrs                    | 70%          |                                    |
|                          |                    |                                        | PersAF          | 70–79 yrs                   | 72%          | 0.04%                              |
|                          |                    |                                        | PersAF          | 60–69 yrs                   | 74%          |                                    |
|                          |                    |                                        | PersAF          | > 80 yrs                    | 78%          | 0.057%                             |
|                          |                    |                                        | PersAF          | > 60 yrs                    | 75%          |                                    |
|                          |                    |                                        | PersAF          | < 80 yrs                    | 78%          |                                    |
|                          |                    |                                        | PersAF          | > 60 yrs                    | 77%          | 4.53%                              |
|                          |                    |                                        | PersAF          | > 60 yrs                    | 79%          |                                    |
|                          |                    |                                        | PersAF          | ≥ 65 yrs                    | 58%          | 3.2%                               |
|                          |                    |                                        | PersAF          | < 65 yrs                    | 67%          |                                    |
| Bhargara, et al.\[^{14}\]| 103                | PVI                                    | PersAF          | 65–74 yrs                   | 84%          |                                    |
|                          |                    |                                        | PersAF          | > 75 yrs                    | 86%          |                                    |
|                          |                    |                                        | PersAF          | > 60 yrs                    | 82%          |                                    |
|                          |                    |                                        | PersAF          | < 50 yrs                    | 85%          |                                    |
|                          |                    |                                        | PersAF          | > 75 yrs                    | 61%          |                                    |
|                          |                    |                                        | PersAF          | > 80 yrs                    | 70%          |                                    |
|                          |                    |                                        | PersAF          | 70–79 yrs                   | 72%          | 0.03%                              |
|                          |                    |                                        | PersAF          | 60–69 yrs                   | 74%          |                                    |
|                          |                    |                                        | PersAF          | > 80 yrs                    | 78%          | 0.057%                             |
|                          |                    |                                        | PersAF          | > 60 yrs                    | 75%          |                                    |
|                          |                    |                                        | PersAF          | < 80 yrs                    | 78%          |                                    |
|                          |                    |                                        | PersAF          | > 60 yrs                    | 77%          | 4.53%                              |
|                          |                    |                                        | PersAF          | > 60 yrs                    | 79%          |                                    |
| Liu, et al.\[^{20}\]    | 2970               | PVAI                                   | PersAF          | ≥ 65 yrs                    | 58%          | 3.2%                               |
|                          |                    |                                        | PersAF          | < 65 yrs                    | 67%          |                                    |

PAF: paroxysmal atrial fibrillation; PersAF: persistent atrial fibrillation; PVAI: pulmonary vein antral isolation; PVI: pulmonary vein isolation.

Data are presented as mean ± SD or n (%). AADs: antiarrhythmic drugs; ACEI: angiotensin converting enzyme inhibitor; AF: atrial fibrillation; ARB: angiotensin II receptor blocker; LAD: left atrial diameter; LVEF: left ventricular ejection fraction.
4 Discussion

The main findings of the present study include the following: (1) catheter ablation of AF is safe in elderly patients; (2) the success rate of the procedure does not differ significantly between younger and older patients; however, younger patients displayed a better long term outcome; and (3) LAD, hypertension, dyslipidemia and CAD were independent predictors of AF recurrence following a single catheter ablation procedure in elderly patients.

Data on safety and efficacy of left atrial ablation are mainly coming from younger patients without heart disease or co-morbidities. Previous studies have evaluated the safety and efficacy of radiofrequency catheter ablation in the elderly (Table 3). Corrado, et al. have demonstrated a high success rate of 73% in patients older than 75 years after a mean follow-up period of 20 ± 14 months. Zado, et al. compared the efficacy of left atrial ablation in three distinct age groups: < 65 years, 65–74 years, and > 75 years. No significant different were observed between study groups during a mean follow-up of 27 months (89%, 84% and 86%, respectively). Bhargava, et al. reported similar success rates in relatively younger age groups. Kusumoto, et al. showed a success rate of 84% in patients aged 65 to 75 years old following a 12 month follow-up period. Tan, et al. found similar success rates after AF catheter ablation with respect to age (70% in > 80 years, 72% in 70-79 years and 74% in 60-69 years). Bunch, et al. have shown a high success rate of 78% in octogenarians following a 12 month follow-up period. In a recent Chinese study, AF catheter ablation exhibited a significantly lower success rate in the elderly patients (77.3%) compared with the younger ones (79.3%) after a relative short follow-up period. Lin, et al. investigated the differences in clinical presentation and outcomes of AF catheter ablation between pre-menopausal (94 patients, mean age 43.5 ± 7.0 years old) and post-menopausal women (649 patients, mean age 64.2 ± 7.4 years old). After 43 months of follow-up, the success rate was similar between study groups despite the significant difference with respect to age (54.3% in the pre-menopausal group and 54.2% in the post-menopausal group). Promising data have been also reported with cryoballoon ablation in patients aged 70 years or older. After a mean follow-up of 11.5 ± 4.7 months following ablation, 62% of patients did not present recurrence of atrial arrhythmias. In our study, older patients displayed a lower success rate compared with younger ones after a relatively long follow-up period (57.9% vs. 67.4%, respectively). However, this difference didn’t reach statistical significance. In addition, the predictors of arrhythmia recurrence in elderly patients are the same as previously described in younger patients. Complications must be taken into account especially in the elderly population. However, there were no significant differences regarding the complication rates of left atrial ablation between younger and older patients. This is in accordance with previous studies.

Although catheter ablation may eliminate pulmonary vein triggers, the underlying atrial substrate is quite different in the elderly population. Structural and electrophysiologic changes are more prominent in older patients including progression of atrial fibrosis, atrial atrophy caused by loss of overall muscle mass and decreased cellular connectivity. Ageing has been associated with reductions in atrial voltage, increase in atrial effective refractory period and conduction slowing. Patients with recurrent AF display lower LA voltage and more LA scar areas. These structural and electrophysiologic changes might be related to a higher rate of arrhythmia recurrence following catheter ablation in the elderly patients. Previous data as well as our findings support this hypothesis. Finally, we showed that traditional risk factors such as hypertension and dyslipidemia are independent predictors of AF recurrence. It is therefore quite possible that medical treatment of these risk factors may have an impact on the long term success rate of the method.

In conclusion, catheter ablation of AF is safe and effective in older patients. There are several reasons to offer this modality in elderly patients. A rate control strategy may induce excess bradycardia, while a rhythm control strategy with antiarrhythmic drugs may lead to an increased risk for proarrhythmia and drug interactions. Invasive strategies should be therefore considered as an alternative choice in symptomatic elderly patients with AF.

Our study has limitations. First, asymptomatic episodes of AF may not have been recognized because AF recurrence was based on clinical symptoms and ambulatory monitoring for a short period. Although this approach has been adopted in many clinical studies, it is possible that the success rate has been overestimated due to asymptomatic episodes of paroxysmal AF. Second, a small number of elderly patients were included in the present study, and therefore our findings need validation in a larger cohort.

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