

· 临床研究 ·

老年心房颤动患者导管射频消融术后复发现状及其影响因素

韩雅琴, 王怡华*, 宋思嘉

(上海交通大学医学院附属新华医院心血管内科, 上海 200092)

【摘要】 **目的** 研究老年心房颤动(AF)患者导管射频消融术(RFCA)后复发现状及其影响因素。**方法** 选取2019年1月至2019年12月上海交通大学医学院附属新华医院接受RFCA治疗的794例AF患者为样本开展研究,术后采用24h动态心电图随访1年,根据是否复发将患者分为复发组和对照组,分析术后复发危险因素,建立logistic回归模型并评估其预测价值。采用SPSS 23.0软件进行数据分析。根据数据类型,组间比较分别采用 t 检验及 χ^2 检验。采用多因素logistic回归分析研究老年AF患者RFCA术后复发的影响因素。**结果** 794例患者失访8例(1.01%),完成随访的786例患者中复发104例(15.25%)。多因素logistic回归分析显示,年龄($OR=1.113, 95\%CI 1.041\sim 1.190$)、糖尿病($OR=1.697, 95\%CI 1.018\sim 2.831$)、左房内径(LAD; $OR=1.135, 95\%CI 1.025\sim 1.257$)、低密度脂蛋白胆固醇(LDL-C; $OR=1.229, 95\%CI 1.044\sim 1.446$)以及超敏C反应蛋白(hs-CRP; $OR=1.096, 95\%CI 1.004\sim 1.197$)为老年AF患者RFCA术后复发独立危险因素($P<0.05$)。受试者工作特征(ROC)曲线分析结果显示:根据logistic回归模型预测AF患者RFCA术后复发风险的ROC曲线下面积为0.939(95%CI 0.885~0.973; $P<0.001$), Hosmer-Lemeshow检验显示预测值与实际观测值具有良好一致性($\chi^2=1.279; P=0.461$)。**结论** 老年AF患者RFCA术后复发率较高,其中年龄、糖尿病、LAD、LDL-C和hs-CRP是术后复发的独立危险因素,根据上述因素建立的logistic回归模型对预测复发具有良好参考价值。

【关键词】 老年人;心房颤动;导管射频消融术;复发;危险因素**【中图分类号】** R541.7⁺5**【文献标志码】** A**【DOI】** 10.11915/j.issn.1671-5403.2024.07.106

Status quo and influencing factors of atrial fibrillation recurrence in elderly patients after radiofrequency catheter ablation

Han Yaqin, Wang Yihua*, Song Sijia

(Department of Cardiology, Xinhua Hospital Affiliated to Shanghai Jiaotong University School of Medicine, Shanghai 200092, China)

【Abstract】 **Objective** To investigate the status quo and influencing factors of atrial fibrillation (AF) recurrence in the elderly patients after radiofrequency catheter ablation (RFCA). **Methods** A sample of 794 AF patients who received RFCA treatment in Xinhua Hospital Affiliated to Shanghai Jiaotong University School of Medicine from January 2019 to December 2019 were selected in this study. The patients were followed up with 24-hour dynamic electrocardiogram for 1 year, and they were divided into recurrence group and control group according to whether there was recurrence. The risk factors of postoperative recurrence were analyzed. A logistic regression model was established, and its predictive value was evaluated. SPSS statistics 23.0 was used for statistical analysis. Data comparison between two groups was performed using t test or χ^2 test depending on data type. Multivariate logistic regression analysis was performed to investigate the influencing factors of AF recurrence in elderly patients after RFCA. **Results** During 1-year follow-up, 8 (1.01%) of the 794 patients were lost to follow-up, and 104 (15.25%) of the 786 patients who completed the follow-up had recurrence. Multivariate logistic regression analysis showed that age ($OR=1.113, 95\%CI 1.041\sim 1.190$), diabetes mellitus ($OR=1.697, 95\%CI 1.018\sim 2.831$), left atrial diameter (LAD; $OR=1.135, 95\%CI 1.025\sim 1.257$), low-density lipoprotein cholesterol (LDL-C; $OR=1.229, 95\%CI 1.044\sim 1.446$) and high-sensitivity C reactive protein (hs-CRP; $OR=1.096, 95\%CI 1.004\sim 1.197$) were independent risk factors of AF recurrence in elderly patients after RFCA ($P<0.05$). Receiver operating characteristic (ROC) curve analysis showed that the area under the curve in the logistic regression model for predicting the AF recurrence risk in the patients after RFCA was 0.939 (95%CI 0.885~0.973; $P<0.00$), and Hosmer-Lemeshow test indicated a good consistency between the predictive value and the observed value ($\chi^2=1.279; P=0.461$). **Conclusion** The AF recurrence rate after RFCA is high in elderly patients, and age, diabetes mellitus, LAD, LDL-C and hs-CRP are independent risk factors of postoperative recurrence. A logistic regression model based on the above factors has a good reference value in predicting recurrence.

收稿日期: 2023-07-20; 接受日期: 2023-11-08

基金项目: 上海市卫生健康委员会临床研究专项基金(202240458)

通信作者: 王怡华, E-mail: wyh_851005@163.com

【Key words】 aged; atrial fibrillation; radiofrequency catheter ablation; recurrence; risk factors

This work was supported by Special Fund for Clinical Research of Shanghai Municipal Health Commission (202240458).

Corresponding author: Wang Yihua, E-mail: wyh_851005@163.com

心房颤动(atrial fibrillation, AF)常继发于甲亢、冠心病及心力衰竭等病变,导管射频消融(radiofrequency catheter ablation, RFCA)是现阶段治疗AF的首选方案,文献报道老年AF患者行RFCA治疗后的有效率可达83.6%,但其术后复发情况仍然较为普遍^[1-3]。AF术后复发的影响因素较为复杂,老年患者由于各器官功能减退,对手术耐受能力较差,且左房纤维化程度较为严重,因此RFCA术后复发风险相对更高;明确术后复发危险因素是手术风险评估重要内容,对提升治疗效果和安全性具有重要意义^[4-6]。本研究旨在分析老年AF患者RFCA术后复发现状及其影响因素,现将结果报道如下。

1 对象与方法

1.1 研究对象

选取2019年1月至2019年12月上海交通大学医学院附属新华医院接受RFCA治疗的794例AF患者临床资料为样本开展前瞻性研究,其中男性484例,女性310例,年龄60~89(68.31±5.07)岁。本研究经医院伦理委员会批准(伦理批号:201904115),参与者均知情且同意。

纳入标准:(1)经心电图检查确诊为AF并明确为阵发性或持续性^[7];(2)年龄均≥60岁^[8];(3)对至少1种I类或III类抗心律失常药物治疗无效;(4)首次接受RFCA治疗且术后均随访1年时间;(5)临床资料保存完整。排除标准:(1)合并瓣膜病、心肌梗死及心内膜炎等器质性病变;(2)合并心房血栓、左心耳及心力衰竭;(3)无法耐受抗凝药物或术前未开展规范抗凝治疗;(4)合并急性感染、菌血症或败血症;(5)合并严重肝肾功能不全;(6)合并哮喘急性发作、慢性阻塞性肺疾病及肺炎等严重呼吸系统疾病;(7)合并血小板减少症、贫血或凝血障碍等血液系统疾病;(8)合并既往心脏手术病史。

1.2 方法

所有患者均采用RFCA治疗,术后采用24h动态心电图随访1年,根据心电图检查结果判断有无术后复发情况,其中治疗3个月后出现AF、心房扑动或其他心动过速,持续时间≥30s,并记录术后1年内复发率^[7]。利用医院电子病历系统采集患者临床资料,内容包括性别、年龄、体质量指数(body mass index, BMI)等基线资料;心脏彩色多普勒超声、

心电图及实验室检查结果,抗凝药和抗心律失常等术后药物治疗情况。根据AF术后1年复发结果将患者分为复发组和对照组,比较两组各项临床资料。

1.3 统计学处理

采用SPSS 23.0统计软件进行数据分析。符合正态分布的计量资料用均数±标准差($\bar{x} \pm s$)表示,采用 t 检验;计数资料用例数(百分率)表示,采用 χ^2 检验。采用多因素logistic回归分析研究老年AF患者RFCA术后复发影响因素,采用受试者工作特征(receiver operating characteristic, ROC)曲线分析logistic回归模型预测AF患者RFCA术后复发的价值,采用Hosmer-Lemeshow检验分析模型可靠性。 $P < 0.05$ 为差异有统计学意义。

2 结果

2.1 老年AF患者RFCA术后复发现状分析

RFCA术后随访1年显示,794例患者失访8例(1.01%),完成随访患者786例,复发104例(15.25%),其中AF 62例(59.62%)、心房扑动34例(32.69%)、房性心动过速8例(7.69%)。

2.2 老年AF患者RFCA术后复发单因素分析

复发组和对照组年龄、吸烟史、心肌梗死病史、糖尿病、AF病程、左室舒张末期内径(left ventricular end-diastolic diameter, LVDD)、左房内径(left atrial diameter, LAD)、低密度脂蛋白胆固醇(low-density lipoprotein cholesterol, LDL-C)、高敏C反应蛋白(high-sensitivity C-reactive protein, hs-CRP)和N末端脑利钠肽原(N-terminal pro-brain natriuretic peptide, NT-proBNP)比较,差异均有统计学意义($P < 0.05$);其余指标比较,差异无统计学意义(表1)。

2.3 老年AF患者RFCA术后复发多因素logistic回归分析

多因素logistic回归分析显示,年龄、糖尿病、LAD、LDL-C和hs-CRP为老年AF患者RFCA术后复发独立危险因素($P < 0.05$;表2)。

2.4 logistic回归模型建立及评价

根据logistic回归分析建立模型预测AF患者RFCA术后复发风险,ROC曲线分析结果显示AUC为0.939(95%CI 0.885~0.973, $P < 0.001$;图1)。Hosmer-Lemeshow检验显示预测结果与实际观测值具有良好一致性($\chi^2 = 1.279, P = 0.461$;图2)。

表 1 老年 AF 患者 RFCA 术后复发单因素分析

Table 1 Univariate analysis of recurrence in elderly patients with AF after RFCA

Basic data	Recurrence group (n=104)	Control group (n=682)	χ^2/t	P value
Gender [n (%)]				
Male	63 (60.58)	397 (58.21)	0.208	0.648
Female	41 (39.42)	285 (41.79)		
Age (years, $\bar{x}\pm s$)	72.29 \pm 4.32	69.12 \pm 4.05	7.369	<0.001
BMI (kg/m ² , $\bar{x}\pm s$)	23.48 \pm 2.87	23.06 \pm 2.91	1.374	0.170
Smoking history [n (%)]	35 (33.65)	144 (21.11)	8.068	0.005
Drinking history [n (%)]	29 (27.88)	152 (22.29)	1.595	0.207
History of stroke [n (%)]	12 (11.54)	56 (8.21)	1.264	0.261
History of myocardial infarction [n (%)]	14 (13.46)	37 (5.43)	9.605	0.002
Complications [n (%)]				
Hypertension	76 (73.08)	489 (71.70)	0.085	0.771
Diabetes mellitus	43 (41.35)	192 (28.15)	7.495	0.006
Coronary heart disease	41 (39.42)	258 (37.83)	0.097	0.755
AF duration (months, $\bar{x}\pm s$)	7.38 \pm 1.45	6.93 \pm 1.26	3.101	0.002
AF type [n (%)]				
Paroxysmal	89 (85.58)	611 (89.59)	1.491	0.222
Persistent	15 (14.42)	71 (10.41)		
CHA ₂ DS ₂ -VASc score (points, $\bar{x}\pm s$)	1.63 \pm 0.51	1.59 \pm 0.46	0.814	0.416
RFCA regimen [n (%)]				
Pulmonary vein isolation	84 (80.77)	576 (84.46)	0.912	0.340
Pulmonary vein isolation+other procedures	20 (19.23)	106 (15.54)		
Intraoperative electrical cardioversion [n (%)]	28 (26.92)	165 (24.19)	0.363	0.547
Postoperative anticoagulant drug [n (%)]				
Warfarin	9 (8.65)	55 (8.06)	0.158	0.924
Rivaroxaban	54 (51.92)	368 (53.96)		
Dabigatran etexilate	41 (39.42)	259 (37.98)		
Postoperative antiarrhythmic drug [n (%)]	37 (35.58)	283 (41.50)	1.310	0.252
ACEI/ARB [n (%)]	62 (59.62)	397 (58.21)	0.073	0.787
β -blocker [n (%)]	75 (72.12)	461 (67.60)	0.850	0.357
LVDD (mm, $\bar{x}\pm s$)	47.59 \pm 5.34	46.12 \pm 5.06	2.739	0.006
LAD (mm, $\bar{x}\pm s$)	39.26 \pm 4.83	36.81 \pm 4.67	4.961	<0.001
MPAP (mmHg, $\bar{x}\pm s$)	32.98 \pm 5.72	32.05 \pm 6.24	1.431	0.153
T ₄ (pmol/L, $\bar{x}\pm s$)	16.74 \pm 2.19	16.38 \pm 2.13	1.600	0.110
SCr (μ mol/L, $\bar{x}\pm s$)	78.35 \pm 14.58	76.94 \pm 15.26	0.883	0.378
TBIL (μ mol/L, $\bar{x}\pm s$)	13.06 \pm 2.71	13.48 \pm 2.85	1.409	0.159
HDL-C (mmol/L, $\bar{x}\pm s$)	1.08 \pm 0.25	1.12 \pm 0.29	1.333	0.183
LDL-C (mmol/L, $\bar{x}\pm s$)	2.57 \pm 0.63	2.34 \pm 0.56	3.835	<0.001
hs-CRP (mg/L, $\bar{x}\pm s$)	9.36 \pm 2.98	8.23 \pm 2.47	4.221	<0.001
NT-proBNP (ng/L, $\bar{x}\pm s$)	63.82 \pm 12.14	58.97 \pm 11.60	3.947	<0.001
QTc interval prolongation [n (%)]	59 (56.73)	346 (50.73)	1.300	0.254

AF: atrial fibrillation; RFCA: radiofrequency catheter ablation; BMI: body mass index; CHA₂DS₂-VASc: congestive heart failure, hypertension, age \geq 75 years, diabetes mellitus, prior stroke or transient ischemic attack, vascular disease, age 65–74 years, sex category; ACEI: angiotensin-converting enzyme inhibitors; ARB: angiotensin receptor blockers; LVDD: left ventricular end-diastolic diameter; LAD: left atrial diameter; MPAP: mean pulmonary arterial pressure; T₄: thyroxine; SCr: serum creatinine; TBIL: total bilirubin; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol; hs-CRP: high-sensitivity C-reactive protein; NT-proBNP: N-terminal pro-brain natriuretic peptide; QTc: corrected QT interval. 1 mmHg=0.133 kPa.

表 2 老年 AF 患者 RFCA 术后复发多因素 logistic 回归分析

Table 2 Multivariate logistic regression analysis of recurrence in elderly patients with AF after RFCA

Variable	β	SE	χ^2	OR	95% CI	P value
Age	0.107	0.034	9.904	1.113	1.041–1.190	0.002
Smoking history	0.819	0.498	2.705	2.268	0.855–6.020	0.101
History of myocardial infarction	1.046	0.785	1.776	2.846	0.611–13.258	0.183
Diabetes mellitus	0.529	0.261	4.108	1.697	1.018–2.831	0.043
AF duration	0.174	0.129	1.819	1.190	0.924–1.532	0.178
LVDD	0.095	0.056	2.878	1.100	0.985–1.227	0.091
LAD	0.127	0.052	5.965	1.135	1.025–1.257	0.015
LDL-C	0.206	0.083	6.160	1.229	1.044–1.446	0.013
hs-CRP	0.092	0.045	4.180	1.096	1.004–1.197	0.042
NT-proBNP	0.381	0.278	1.878	1.464	0.849–2.524	0.171

Variable assignment: dependent variable "recurrence group" = 1, "control group" = 0; Among the independent variables, smoking history: "Yes" = 1, "No" = 0; Myocardial infarction history: "Yes" = 1, "No" = 0; Diabetes mellitus: "Yes" = 1, "No" = 0. LVDD: left ventricular end-diastolic diameter; LAD: left atrial diameter; LDL-C: low-density lipoprotein cholesterol; hs-CRP: high-sensitivity C-reactive protein; NT-proBNP: N-terminal pro-brain natriuretic peptide.

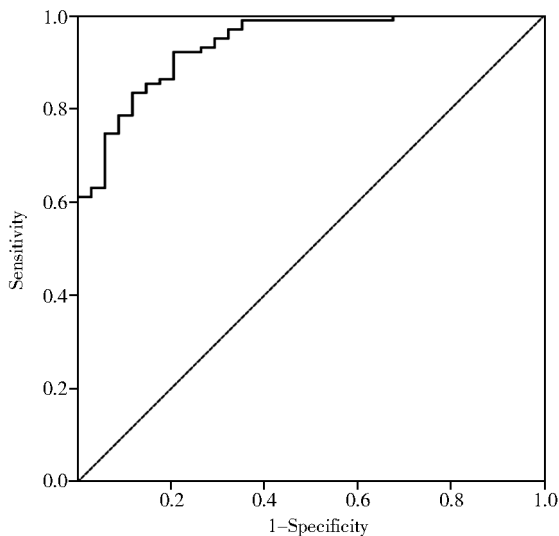


图1 logistic 回归模型预测 AF 患者 RFCA 术后复发的 ROC 曲线

Figure 1 ROC curve of logistic regression model on predicting recurrence after RFCA in patients with AF

AF: atrial fibrillation; RFCA: radiofrequency catheter ablation; ROC: receiver operating characteristic.

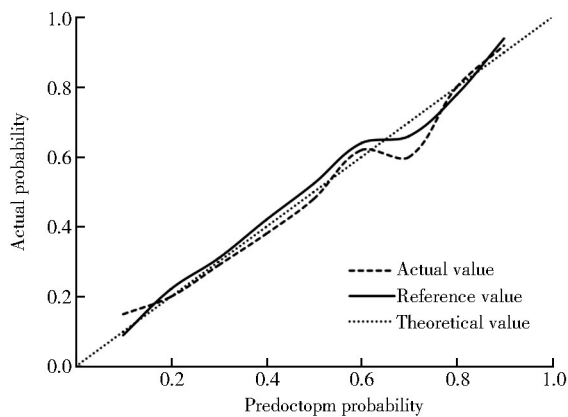


图2 logistic 回归模型预测 AF 患者 RFCA 术后复发的校准曲线

Figure 2 Calibration curve of logistic regression model on predicting recurrence after RFCA in patients with AF

AF: atrial fibrillation; RFCA: radiofrequency catheter ablation; ROC: receiver operating characteristic.

3 讨论

近年来,老年 AF 患者接受 RFCA 治疗的比例快速增加,由于生理特征和基础健康水平与中青年人群差异较大,因此术后复发率及其影响因素也可能存在明显区别。本研究对 794 例老年 AF 患者 RFCA 术后随访 1 年,结果显示 786 例患者完成随访,术后复发 104 例 (15.25%),较孙佳琪等^[9]报道结果显著降低,其原因可能与两者病程差异较大有关;既往研究认为随着病程延长,左房心肌重

构越严重并引起电生理异常,同时可能形成非肺静脉触发灶或折返子波,从而导致术后复发风险升高^[10]。本研究样本病程普遍较短,病情严重程度相对较轻,因此病程对 AF 术后复发的影响相对较小,术后复发率较低,提示 AF 患者早期手术可能有利于减少术后复发。

为明确老年 AF 患者 RFCA 术后复发危险因素,本研究采用多因素 logistic 回归分析,结果显示年龄、糖尿病、LAD、LDL-C 及 hs-CRP 为独立危险因素 ($P < 0.05$),因此可将上述临床特征作为老年 AF 患者监测和干预重点。AF 是由心脏电生理异常引起的病变,而衰老是造成心脏结构和电生理改变的重要原因^[11]。此外年龄还可能与病程密切相关,孙丽霞等^[12]等对 150 例老年 AF 患者进行随访,结果显示年龄 ≥ 75 岁组术后 1 年复发率达 31.8%,而年龄 < 75 岁组为 17.0%,故认为年龄是老年 AF 患者 RFCA 术后复发重要影响因素,且其原因不仅是心功能减退和左房重构加重,还与糖尿病和脑梗死等基础疾病比例更高有关。糖尿病患者不仅存在严重能量代谢障碍,高血糖水平还可促进心肌重构,从而导致电生理活动异常,因此血糖未获得有效控制可能导致术后复发风险明显升高^[13]。LAD 增加提示左房负荷较大,容易引起心房重构和纤维化,且 RFCA 消融面积相应增加,存在消融不完全的风险,术后异常电信号通路恢复的风险也明显升高,因此复发风险增加^[14]。LDL-C 水平升高不仅可导致冠心病严重程度增加,还与心房重构密切相关,因此术后复发危险升高,积极干预血脂代谢可能对预防复发有积极作用。近年来炎症反应在心血管疾病中的作用已获得普遍认可,Meyre 等^[15]以 711 例 AF 患者为样本进行研究显示,治疗前 CRP 水平升高与 RFCA 术后复发风险增加有关。本研究显示 hs-CRP 为老年 AF 患者术后复发独立危险因素,故而减轻炎症反应可能是 AF 术后复发有效预防策略,但是现阶段可能引起心血管炎症的因素较多,因此针对不同患者还需准确识别病因。分析老年 AF 患者 RFCA 术后复发危险因素可为预测复发风险提供参考,本研究中 logistic 回归模型预测复发的 AUC 为 0.939,且预测结果与实际观测值具有良好一致性,但该模型为单中心研究结果,因此可能存在一定偏倚,将来随着研究深入和影响因素细化,其临床价值可进一步提升,对预防 AF 患者 RFCA 术后复发具有重要意义。

综上,现阶段老年 AF 患者 RFCA 术后复发率仍然偏高,其危险因素包括年龄、糖尿病、LAD、LDL-C 及 hs-CRP 等,根据以上因素建立 logistic 回归模型可为预测 RFCA 术后复发提供参考,可能对降低术后复发风险具有积极作用,但如何建立规范干预策略还需要进一步研究。

【参考文献】

- [1] Hindricks G, Potpara T, Dagres N, *et al.* 2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS): the task force for the diagnosis and management of atrial fibrillation of the European Society of Cardiology (ESC) developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC[J]. *Eur Heart J*, 2021, 42(5): 373-498. DOI: 10.1093/eurheartj/ehaa612.
- [2] 李军杰, 孙艳梅, 方舟, 等. "打桩法"消融心房颤动左肺静脉前三角的有效性与安全性[J]. *中华老年多器官疾病杂志*, 2023, 22(7): 516-519. DOI: 10.11915/j.issn.1671-5403.2023.07.106.
- [3] 李世兴, 时向民, 李健, 等. 导管射频消融治疗老年心房颤动单中心经验[J]. *中华老年心脑血管病杂志*, 2021, 23(7): 676-679. DOI: 10.3969/j.issn.1009-0126.2021.07.002.
- [4] Fiedler L, Hallsson L, Tscharré M, *et al.* Upstream statin therapy and long-term recurrence of atrial fibrillation after cardioversion: a propensity-matched analysis[J]. *J Clin Med*, 2021, 10(4): 807. DOI: 10.3390/jcm10040807.
- [5] Kim DY, Kim YG, Choi JI, *et al.* A novel predictive model for late recurrence after catheter ablation for atrial fibrillation using left appendage volume measured by cardiac computed tomography[J]. *Int J Cardiovasc Imaging*, 2021, 37(6): 2063-2070. DOI: 10.1007/s10554-021-02169-4.
- [6] Salih M, Darrat Y, Ibrahim AM, *et al.* Clinical outcomes of adjunctive posterior wall isolation in persistent atrial fibrillation: a meta-analysis[J]. *J Cardiovasc Electrophysiol*, 2020, 31(6): 1394-1402. DOI: 10.1111/jce.14480.
- [7] 中华医学会心血管病学分会, 中国生物医学工程学会心律分会. 心房颤动诊断和治疗中国指南[J]. *中华心血管病杂志*, 2023, 51(6): 572-618. DOI: 10.3760/cma.j.cn112148-20230416-00221.
- [8] 于普林, 王建业, 胡建中, 等. 中国健康老年人标准(WS/T 802—2022)[J]. *中华老年医学杂志*, 2022, 41(11): 1263. DOI: 10.3760/cma.j.issn.0254-9026.2022.11.001.
- [9] 孙佳琪, 梁明, 李赛男, 等. 持续性心房颤动射频导管消融术后1年复发因素分析[J]. *临床军医杂志*, 2021, 49(5): 487-489, 492. DOI: 10.16680/j.1671-3826.2021.05.02.
- [10] 费镇涛, 陈牧, 李毅刚. 心房颤动导管消融后复发机制的研究进展[J]. *内科理论与实践*, 2022, 17(5): 396-399. DOI: 10.16138/j.1673-6087.2022.05.010.
- [11] 褚明, 丁祥伟, 王俊宏, 等. 老年房颤患者导管射频消融疗效及复发相关因素分析[J]. *南京医科大学学报(自然科学版)*, 2020, 40(12): 1796-1799. DOI: 10.7655/NYDXBNS20201210.
- [12] 孙丽霞, 苏霞, 张燕. 老年心房颤动患者射频消融手术后复发及影响因素分析[J]. *老年医学与保健*, 2020, 26(6): 956-960. DOI: 10.3969/j.issn.1008-8296.2020.06.016.
- [13] Creta A, Providência R, Adragão P, *et al.* Impact of type-2 diabetes mellitus on the outcomes of catheter ablation of atrial fibrillation (European Observational Multicentre Study)[J]. *Am J Cardiol*, 2020, 125(6): 901-906. DOI: 10.1016/j.amjcard.2019.12.037.
- [14] Ghafouri K, Franke KB, Foo FS, *et al.* Clinical utility of cardiac magnetic resonance imaging to assess the left atrium before catheter ablation for atrial fibrillation — A systematic review and meta-analysis[J]. *Int J Cardiol*, 2021, 339: 192-202. DOI: 10.1016/j.ijcard.2021.07.030.
- [15] Meyre PB, Sticherling C, Spies F, *et al.* C-reactive protein for prediction of atrial fibrillation recurrence after catheter ablation[J]. *BMC Cardiovasc Disord*, 2020, 20(1): 427. DOI: 10.1186/s12872-020-01711-x.

(编辑: 温玲玲)