

• 综述 •

左心房结构相关指标对心房颤动
导管消融术后复发的影响*王喆¹ 陈英伟¹ 董建增^{1,2}

[摘要] 心房颤动(房颤)是严重危害人类健康的心血管疾病之一,导管射频消融术是症状性房颤患者的一线治疗方式,但消融术后复发是不可忽视的问题。左心房内结构复杂,左心房大小、纤维化、形状、低电压,左心耳大小,肺静脉大小和解剖变异、肺静脉间嵴及左心耳嵴结构等与房颤的发生发展密切相关。本文将对影响房颤导管消融术后复发的左心房结构的相关指标作一综述,供临床参考与借鉴。

[关键词] 心房颤动;射频消融;左心房结构;复发

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Summary of left atrial structure-related indexes on the effect of atrial
fibrillation recurrence after catheter ablationWANG Zhe¹ CHEN Yingwei¹ DONG Jianzeng^{1,2}

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Summary Atrial fibrillation (AF) is one of the most serious cardiovascular diseases, and catheter ablation is the main treatment method for patients with AF. However, recurrence after ablation is a problem that cannot be ignored, because left atrial(LA) structure is complex, LA size, fibrosis, the shape, low voltage, size of left atrial appendage(LAA), pulmonary veins size and anatomic variation, ridge between pulmonary vein, LAA ridge and so on are closely related to the development of AF. This review is to illuminate the left atrial structure related indicators affect recurrence after AF ablation for clinical reference.

Key words atrial fibrillation; radiofrequency ablation; left atrial structure; recurrence

心房颤动(房颤)是临床上最常见的心律失常,据统计,2010年美国的房颤患者为270万~610万人,预测2030年美国房颤患者将增加至1210万^[1]。房颤导致左心房不断重构,使充血性心力衰竭、卒中、心血管病死率增加等,风险随年龄增长而明显增加^[2]。左心房是房颤的潜在来源之一,是消

融手术的关键部位,左心房内结构复杂,左心房内复杂的结构阻碍消融导管的精确定位,影响消融手术的成功率^[3]。左心房结构的相关指标是影响房颤消融术后复发的重要因素,现将相关文献概括如下。

1 房颤导管消融的现状

2019年的美国心脏病学会(American College of Cardiology, ACC)/美国心脏协会(American Heart Association, AHA)/心律学会(Heart Rhythm Society, HRS)的房颤指南中将导管消融

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[11] Tsimikas S, Karwatowska-Prokopczuk E, Gouni-Berthold I, et al. Lipoprotein(a) reduction in persons with cardiovascular disease[J]. N Engl J Med, 2020, 382(3):244-255.

[12] ASCEND Study Collaborative Group. Effects of n-3 fatty acid supplements in diabetes mellitus[J]. N Engl J Med, 2018, 379(16):1540-1550.

[13] Bhatt DL, Steg PG, Miller M, et al. Cardiovascular risk reduction with icosapent ethyl for hypertriglyceri-

demia[J]. N Engl J Med, 2019, 380(1):11-22.

[14] Marston NA, Giugliano RP, Im K, et al. Association between triglyceride lowering and reduction of cardiovascular risk across multiple lipid-lowering therapeutic classes: a systematic review and meta-regression analysis of randomized controlled trials[J]. Circulation, 2019, 140(16):1308-1317.

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作为药物难以抑制的阵发性房颤的首选治疗方式(I类推荐)^[4],导管消融作为有症状且药物无效的持续性房颤的IIa类推荐,但对于症状性房颤合并左室射血分数降低的心力衰竭的患者是IIb类推荐。但房颤机制未明,房颤术后1年的复发率达到36%,尤其是持续性房颤复发率更高^[5]。AHA/ACC/HRS的指南^[4]中将房颤导管消融3个月用心电图或动态心电图记录到持续 ≥ 30 s的房颤、心房扑动(房扑)或者房性心动过速(房速)发作,判定为房颤消融术后复发。一项随机对照研究^[6]虽未发现房颤消融治疗组(1108例)相比药物治疗组(1096例)降低主要的死亡、致残性卒中、严重出血或者心脏骤停的复合终点,药物治疗组中部分患者(27.5%)中途接受消融手术可能影响结果,并且随机分组接受导管消融的患者的无事件生存率高于药物组的患者。研究发现导管消融治疗相比药物治疗明显改善心力衰竭合并房颤患者的预后,降低46%的全因死亡率^[7]。房颤合并心力衰竭患者在导管消融术后,患者恢复窦性心律,心脏扩大与心功能能够逆转^[8]。目前房颤导管消融是一种广泛使用的治疗策略,恢复窦性心律可降低卒中风险,改善心脏功能,逆转心脏重构。

2 左心房相关指标对复发的影响

2.1 左心房大小和心房脂肪量

Kranert等^[9]对162例房颤射频消融术后患者随访(22.9 \pm 3.8)个月,未复发组左心房体积相比复发组左心房体积明显减小[(52.5 \pm 19.8) ml:(87.4 \pm 27.2) ml, $P < 0.01$],复发组左心房内径相比未复发组显著增大[(43.4 \pm 7.2) mm:(38.8 \pm 7.0) mm, $P < 0.01$]。Fujino等^[10]研究显示房颤患者左心房内径增大是房颤消融术后复发的独立预测因素($OR = 0.76$; 95% $CI: 0.60 \sim 0.95$; $P = 0.019$)。Sohns等^[11]报道药物难以抑制的症状性房颤患者导管消融术后随访12个月,单因素分析显示左心房体积和左心房内径是房颤消融术后复发的预测因素($P < 0.05$),多因素分析显示左心房体积低于106 ml是房颤术后复发的保护因素($P = 0.042$)。胡晓等^[12]研究表明左心房体积指数(LAVI) ≤ 34 ml/m²组房颤消融术后患者的复发率显著低于LAVI > 34 ml/m²的患者,LAVI是房颤消融术后复发的独立危险因素($OR = 7.672$; 95% $CI: 1.361 \sim 43.243$; $P = 0.021$)。研究显示左房容积指数 > 48.5 ml/m²是房颤消融术后复发的独立危险因素($HR = 3.04$; 95.0% $CI: 1.41 \sim 6.55$; $P = 0.004$)^[13]。Kim等^[14]对665例房颤消融患者进行研究,阵发性房颤患者450例(67.7%),215例(32.3%)患者是持续性房颤,在(19.3 \pm 8.5)个月的随访期间房颤消融的复发率是26.5%,心包脂肪量是预测持续性房颤消融术后复

发的危险因素($P = 0.001$)。Lopez-Canoa等^[15]发现左心房脂肪量和持续性房颤消融术后复发具有独立相关性($OR = 1.37$; 95% $CI: 0.86 \sim 1.00$; $P < 0.05$)。

2.2 左心房形状、低电压和纤维化

研究表明左心房的形状、低电压和纤维化是房颤患者心脏重构的标志物,左心房球形度、左心房低电压和纤维化之间密切相关,参与房颤的发生发展^[16]。心房成纤维细胞增殖和纤维化可导致心房重构进而促进房颤的发展^[17]。DECAAF研究^[18]发现延迟增强磁共振成像识别的左心房组织纤维化是房颤导管消融术后复发心律失常的独立危险因素,心房纤维化的减少可明显改善房颤患者预后。心房成纤维细胞增殖和纤维化可导致心房重构进而促进房颤的发展^[17]。Liu等^[19]认为房颤消融术后随访12个月,扫描核磁共振成像的左心房纤维化和三维标测系统的低电压区域之间具有相关性,高纤维化的房颤患者(8/8;100%)的复发率明显高于低纤维化的房颤患者(5/32;15.6%),循环纤维细胞 $\geq 4.05\%$ 是房颤消融复发独立的预测指标($HR = 1.842$; 95% $CI: 1.001 \sim 3.388$; $P < 0.01$)。研究表明持续性房颤的左心房低电压区域明显高于阵发性房颤的低电压区域($P = 0.001$)^[20]。Huang等^[21]认为左心房低电压区域随着心房纤维化区域增加而增多,左心房低电压的程度与房颤术后复发房性心律失常相关。纳入254例房颤导管消融患者的多中心研究认为左房的形状与球形形状越相似,房颤术后复发率越高($P < 0.05$)^[22]。相关研究表明左心房的球形度是房颤术后复发的独立危险因素^[23-24]。

2.3 左心耳大小

He等^[25]认为左心耳体积、左心房体积的大小和房颤患者消融术后复发相关($P < 0.05$)。Hozawa等^[26]分析得出房颤组的左心耳体积显著大于非房颤组患者。郑桂安等^[27]将62例导管消融的房颤患者纳入前瞻性研究,随访期间有20例(32%)房颤术后复发,左心耳体积是房颤消融术后复发的独立危险因素($HR = 1.32$; 95% $CI: 1.12 \sim 1.51$; $P < 0.01$),ROC曲线分析显示左心耳体积 > 8.80 ml对房颤术后复发的预测价值最高[曲线下面积(AUC) = 0.76,敏感度94%,特异度66%]。

2.4 肺静脉大小和解剖变异

Kiuchi等^[28]连续入组67例导管消融的房颤患者,术后随访(19 \pm 10)个月,18例(27%)复发,右上肺的开口面积大小与消融术后复发相关($OR = 0.41$; 95% $CI: 0.21 \sim 0.77$; $P = 0.006$)。Li等^[29]入选100例阵发性房颤患者,右下肺的开口面积、最大直径、最小直径与房颤消融术后复发具

有相关性($P < 0.05$)。贺吟歌等^[30]认为肺静脉面积越大,肌袖阻滞含量越丰富,更容易形成微折返。研究表明80例导管消融治疗的房颤患者中21例患者(26.3%)出现静脉解剖变异,肺静脉解剖变异相比肺静脉解剖正常的房颤患者消融术后复发率显著增加($HR = 1.90$; 95% CI 0.95~4.15; $P = 0.05$)^[15]。Hunter等^[31]将335例房颤消融患者纳入研究,相比正常肺静脉结构,左肺静脉共干与首次房颤消融手术成功率下降12.8%有关,肺静脉异常结构可导致首次消融手术成功率下降10.5%,多因素分析显示异常的肺静脉结构是首次房颤消融复发的独立危险因素($HR = 1.37$; 95% CI : 1.01~1.96; $P = 0.044$)。

2.5 左心耳嵴和肺静脉间嵴

同侧肺静脉之间狭窄的左心房部位称为肺静脉间嵴,左心耳与左肺静脉间的狭窄肌束部分定义为左心耳嵴,嵴向左心房过渡的部位称为嵴的两端^[32-33]。林明宽等^[32]认为房颤患者消融术后恢复窦性心律,右肺静脉间嵴部宽度显著减小,右肺静脉嵴间宽度可逆转重构。姜其钧等^[33]通过增强心脏CT图像来测量肺静脉间嵴及左心耳嵴的宽度和长度,分析表明肺静脉间嵴宽度越宽,房颤患者消融术后复发率越高($P < 0.05$),左心耳嵴的长度及宽度与房颤消融术后复发不相关。Suenari等^[34]连续纳入54例有症状的难治性阵发性房颤患者,年龄(61 ± 12)岁,复发组左心耳嵴宽度大于未复发组左心耳嵴宽度[(5.58 ± 1.67) mm : (4.20 ± 1.08) mm],左心耳嵴宽度是房颤患者消融术后复发的独立预测因子($HR = 2.058$; 95% CI : 1.029~4.114; $P = 0.041$)。左心耳嵴是房颤消融导管难以获得足够接触力的困难区域,因此需更高质量的临床研究来证实左心耳嵴与房颤术后复发的相关性。

2.6 其他左心房结构相关指标

陈林等^[35]研究认为导管消融术后环肺静脉开口的瘢痕可中断房颤的电传导,患者术后的环肺静脉瘢痕占比越低,术后复发率越高。研究报道左心耳排空速度、左心耳射血分数是阵发性房颤射频消融术后复发的重要因素^[25]。研究表明,Marshall韧带等与房颤消融术后复发相关^[36],Marshall韧带包含丰富的交感和副交感神经,与房颤的发生和维持有关。房颤复发的确切机制尚未清楚,部分左心房结构相关指标对房颤消融术后复发的影响尚不明确,仍需更多的循证医学证据来探讨左心房结构对房颤导管消融术后复发的影响。

综上,目前逐渐认识到房颤患者左心房结构对房颤导管消融治疗的重要作用,充分认识房颤患者的左心房结构,可进一步评估甚至提高房颤射频消融的疗效。通过术前对左心房结构的相关指标的

了解,能更好地指导消融手术的进行,并对房颤消融的手术复发情况进行评估。

利益冲突:所有作者均声明不存在利益冲突。

参考文献

- [1] Correction to: Heart disease and stroke statistics-2018 update: a report from the American Heart Association [J]. *Circulation*, 2018, 137(12): e493.
- [2] Guo Y, Lane DA, Wang L, et al. Mobile health technology to improve care for patients with atrial fibrillation [J]. *J Am Coll Cardiol*, 2020, 75(13): 1523-1534.
- [3] Pitek-Koziej K, Hoda J, Tyrak K, et al. Anatomy of the left atrial ridge (coumadin ridge) and possible clinical implications for cardiovascular imaging and invasive procedures [J]. *J Cardiovasc Electrophysiol*, 2020, 31(1): 220-226.
- [4] January CT, Wann LS, Calkins H, et al. 2019 AHA/ACC/HRS Focused Update of the 2014 AHA/ACC/HRS Guideline for the Management of Patients With Atrial Fibrillation [J]. *Circulation*, 2019, 140(2): e125-e151.
- [5] Pallisgaard JL, Gislason GH, Hansen J, et al. Temporal trends in atrial fibrillation recurrence rates after ablation between 2005 and 2014: a nationwide Danish cohort study [J]. *Eur Heart J*, 2018, 39(6): 442-449.
- [6] Packer DL, Mark DB, Robb RA, et al. Effect of catheter ablation vs antiarrhythmic drug therapy on mortality, stroke, bleeding, and cardiac arrest among patients with atrial fibrillation: The CABANA Randomized Clinical Trial [J]. *JAMA*, 2019, 321(13): 1261-1274.
- [7] Marrouche NF, Brachmann J, Andresen D, et al. Catheter ablation for atrial fibrillation with heart failure [J]. *N Engl J Med*, 2018, 378(5): 417-427.
- [8] 王秀玉, 张虹. 心房颤动性心肌病导管消融治疗 [J]. *临床心血管病杂志*, 2018, 34(6): 545-548.
- [9] Kranert M, Shchetynska-Marinova T, Liebe V, et al. Recurrence of atrial fibrillation in dependence of left atrial volume index [J]. *In Vivo*, 2020, 34(2): 889-896.
- [10] Fujino T, Yuzawa H, Kinoshita T, et al. Clinical factors associated with a successful catheter ablation outcome in elderly patients with atrial fibrillation [J]. *Int Heart J*, 2020, 61(1): 21-28.
- [11] Sohns C, Sohns JM, Vollmann D, et al. Left atrial volumetry from routine diagnostic work up prior to pulmonary vein ablation is a good predictor of freedom from atrial fibrillation [J]. *Eur Heart J Cardiovasc Imaging*, 2013, 14(7): 684-691.
- [12] 胡晓, 谷阳, 蒙涛, 等. 维生素D水平、左房容积指数与阵发性房颤患者射频消融术后复发的相关性研究 [J]. *中国循证心血管医学杂志*, 2019, 11(1): 59-62.
- [13] Istratoaie S, Roçu R, Cismaru G, et al. The impact of pulmonary vein anatomy on the outcomes of catheter

- ablation for atrial fibrillation[J]. *Medicina (Kaunas)*, 2019,55(11):727.
- [14] Kim TH, Park J, Park JK, et al. Pericardial fat volume is associated with clinical recurrence after catheter ablation for persistent atrial fibrillation, but not paroxysmal atrial fibrillation: an analysis of over 600-patients[J]. *Int J Cardiol*, 2014,176(3):841-846.
- [15] Lopez-Canoa JN, Baluja A, Couselo-Seijas M, et al. Plasma FABP4 levels are associated with left atrial fat volume in persistent atrial fibrillation and predict recurrence after catheter ablation[J]. *Int J Cardiol*, 2019,292:131-135.
- [16] den Uijl DW, Cabanelas N, Benito EM, et al. Impact of left atrial volume, sphericity, and fibrosis on the outcome of catheter ablation for atrial fibrillation[J]. *J Cardiovasc Electrophysiol*, 2018,29(5):740-746.
- [17] Marrouche NF, Wilber D, Hindricks G, et al. Association of atrial tissue fibrosis identified by delayed enhancement MRI and atrial fibrillation catheter ablation: the DECAAF study[J]. *JAMA*, 2014,311(5):498-506.
- [18] 魏飞宇,范洁,高田,等. miR-199-3p 通过靶向调控 SP1 促进成纤维细胞增殖对心房颤动心房重构的影响[J]. *临床心血管病杂志*, 2020,36(6):523-530.
- [19] Liu Y, Niu XH, Yin X, et al. Elevated circulating fibrocytes is a marker of left atrial fibrosis and recurrence of persistent atrial fibrillation[J]. *J Am Heart Assoc*, 2018,7(6):e008083.
- [20] Huo Y, Gaspar T, Pohl M, et al. Prevalence and predictors of low voltage zones in the left atrium in patients with atrial fibrillation[J]. *Europace*, 2018,20(6):956-962.
- [21] Huang D, Li JB, Zghaib T, et al. The extent of left atrial low-voltage areas included in pulmonary vein isolation is associated with freedom from recurrent atrial arrhythmia[J]. *Can J Cardiol*, 2018,34(1):73-79.
- [22] Biegling ET, Morris A, Wilson BD, et al. Left atrial shape predicts recurrence after atrial fibrillation catheter ablation[J]. *J Cardiovasc Electrophysiol*, 2018,29(7):966-972.
- [23] Bis Bisbal F, Alarcón F, Ferrero-de-Loma-Osorio A, et al. Left atrial geometry and outcome of atrial fibrillation ablation: results from the multicentre LAGO-AF study[J]. *Eur Heart J Cardiovasc Imaging*, 2018,19(9):1002-1009.
- [24] 杨廷杰,张菲斐. 心房颤动射频消融术后左心房球形度预测复发的价值[J]. *临床心血管病杂志*, 2018,34(10):1006-1010.
- [25] He Y, Zhang B, Zhu F, et al. Transesophageal echocardiography measures left atrial appendage volume and function and predicts recurrence of paroxysmal atrial fibrillation after radiofrequency catheter ablation[J]. *Echocardiography*, 2018,35(7):985-990.
- [26] Hozawa M, Morino Y, Matsumoto Y, et al. 3D-computed tomography to compare the dimensions of the left atrial appendage in patients with normal sinus rhythm and those with paroxysmal atrial fibrillation[J]. *Heart Vessels*, 2018,33(7):777-785.
- [27] 郑桂安,林春艺,翁兰,等. 左心耳体积对心房颤动导管射频消融术后复发的预测价值[J]. *中华心血管病杂志*, 2017,45(11):924-929.
- [28] Kiuchi K, Yoshida A, Takei A, et al. Topographic variability of the left atrium and pulmonary veins assessed by 3D-CT predicts the recurrence of atrial fibrillation after catheter ablation[J]. *J Arrhythm*, 2015,31(5):286-92.
- [29] Li B, Ma H, Guo H, et al. Pulmonary vein parameters are similar or better predictors than left atrial diameter for paroxysmal atrial fibrillation after cryoablation[J]. *Braz J Med Biol Res*, 2019,52(9):e8446.
- [30] 贺吟歌,李凌,袁义强,等. 肺静脉开口面积与持续性心房颤动射频消融术后复发的关系? [J]. *中国心脏起搏与心电生理杂志*, 2019,33(2):29-33.
- [31] Hunter RJ, Ginks M, Ang R, et al. Impact of variant pulmonary vein anatomy and image integration on long-term outcome after catheter ablation for atrial fibrillation[J]. *Europace*, 2010,12(12):1691-1697.
- [32] 林明宽,梁柳丹,孔令兴,等. 心房颤动患者射频消融治疗前后肺静脉间嵴部宽度的变化[J]. *临床放射学杂志*, 2013,32(5):648-651.
- [33] 姜其钧,孟小茜,赵亮,等. 肺静脉和左房内嵴形态与心房颤动射频消融术后早期心律失常的关系[J]. *中国心脏起搏与心电生理杂志*, 2008,22(2):115-118.
- [34] Suenari K, Nakano Y, Hirai Y, et al. Left atrial thickness under the catheter ablation lines in patients with paroxysmal atrial fibrillation: insights from 64-slice multidetector computed tomography[J]. *Heart Vessels*, 2013,28(3):360-368.
- [35] 陈林,林建华,吴梅琼,等. 心房颤动患者导管消融术后环肺静脉疤痕形成情况及其与术后复发的关系[J]. *中国循环杂志*, 2018,33(10):995-1000.
- [36] Valderrábano M, Peterson LE, Bunge R, et al. Vein of Marshall ethanol infusion for persistent atrial fibrillation: VENUS and MARS clinical trial design[J]. *Am Heart J*, 2019,215:52-61.

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