

· 临床研究 ·

房颤患者环肺静脉前庭射频消融路径的分析

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【摘要】目的 比较房颤患者中3种不同环肺静脉前庭射频消融路径的消融成功率。**方法** 回顾性分析解放军总医院心血管内科2015年6月至2017年6月住院房颤患者173例, 根据射频消融线所在区域分为心房前庭组61例、肺静脉前庭组47例和前庭组65例, 比较3组患者手术时间、X线曝光时间和消融时间, 以及穿刺房间隔后、术后即刻和术后24 h血浆中C反应蛋白(CRP)、氨基末端B型脑钠肽前体(NT-proBNP)和白细胞介素-6(IL-6)水平。应用SPSS 17.0统计软件对数据进行分析。组间比较采用单因素方差分析、秩和检验或 χ^2 检验。**结果** 所有患者在消融过程中达到完全电隔离的即刻成功率为84.39%(146/173)。心房前庭组患者消融时间明显长于肺静脉前庭组患者[(120.67±13.12) vs (90.17±6.95) min], 差异有统计学意义($P<0.05$)。相比穿刺房间隔后, 3组患者术后即刻和术后24 h IL-6水平升高, 肺静脉前庭组患者术后24 h NT-proBNP水平升高; 肺静脉前庭组患者术后24 h CRP水平相比心房前庭组患者[(1.99±1.09) vs (0.40±0.29) mg/L]升高, 差异均具有统计学意义($P<0.05$)。161例随访12个月, 12例失访, 失访率为6.94%(12/173)。27例房颤复发, 手术成功率为83.23%(134/161), 其中心房前庭组手术成功率[89.83%(53/59) vs 73.33%(33/45)]高于肺静脉前庭组, 差异具有统计学意义($P<0.05$)。**结论** 房颤患者不同环肺静脉前庭射频消融路径中, 心房前庭侧消融路径优于肺静脉前庭消融路径。

【关键词】 心房颤动; 消融; 肺静脉

【中图分类号】 R541.75

【文献标志码】 A

【DOI】 10.11915/j.issn.1671-5403.2019.06.085

Analysis of circumferential pulmonary vein antrum ablation approach for atrial fibrillation

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【Abstract】Objective To compare the success rate of 3 different approaches in circumferential pulmonary vein antrum ablation for atrial fibrillation. **Methods** A retrospective study was carried out on 173 patients with atrial fibrillation admitted in the Cardiology Department of Chinese PLA General Hospital from June 2015 to June 2017. According to the area of radiofrequency ablation line, they were divided into atrial antrum group ($n=61$), pulmonary vein antrum group ($n=47$) and antrum group ($n=65$). The operation time, X-ray exposure time and ablation time, and the plasma levels of C-reactive protein (CRP), N-terminal pro B-type brain natriuretic peptide (NT-proBNP) and interleukin-6 (IL-6) just after atrial septal puncture, immediately and 24 h after operation were compared in the 3 groups. SPSS statistics 17.0 was used to analyze the data. Single factor variance analysis, rank sum test or Chi-square test was employed to analyze the intergroup comparison. **Results** The immediate success rate of complete electrical isolation was 84.39%(146/173) in all patients. The ablation time was significantly longer in the atrial antrum group than pulmonary vein antrum group [(120.67±13.12) vs (90.17±6.95) min, $P<0.05$]. Compared with the levels after atrial septal puncture, the IL-6 level immediately and 24 h after operation were increased in all the 3 groups; the 24 h NT-proBNP level was elevated in the pulmonary vein

收稿日期: 2019-03-23; 接受日期: 2019-04-21

基金项目: 联勤保障部队重大项目(AWS13C008)

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antrum group; and the 24 h CRP level was higher in the pulmonary vein antrum group than the atrial antrum group [(1.99 ± 1.09) vs (0.40 ± 0.29) mg/L, all $P < 0.05$]. Among them, 161 patients were followed up for 12 months, and 12 patients were lost during follow-up, with a rate of 6.94% (12/173). Recurrence of atrial fibrillation was observed in 27 cases. The success rate of operation was 83.23% (134/161), with the rate significantly higher in the atrial antrum group than in the pulmonary vein antrum group [89.83% (53/59) vs 73.33% (33/45), $P < 0.05$]. **Conclusion** The approach of atrial antrum is superior to that of pulmonary vein antrum in circumferential pulmonary vein antrum ablation for atrial fibrillation.

【Key words】 atrial fibrillation; ablation; pulmonary vein

This work was supported by the Major Project of Joint Logistical Support Force (AWS13C008).

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心房颤动(简称房颤)可增加患者脑卒中、心力衰竭等疾病的发生,甚至导致死亡^[1],致残率和致死率都很高^[2]。房颤的治疗包括控制心室率、心律转复和维持以及预防血栓栓塞^[3]。心律转复包括药物复律、电复律和消融复律^[4],其中消融复律可根治房颤,成功率高于药物治疗,在某些情况下已被指南推荐为首选^[5,6],目前众多消融术式中环肺静脉前庭消融术最广泛^[7],本研究结合房颤发病机制和肺静脉前庭解剖特点,回顾性分析了3种环肺静脉前庭消融路径的手术参数,并对手术远期成功率和房颤复发率进行了随访,为探讨如何优化环肺静脉射频消融路径提供依据。

1 对象与方法

1.1 研究对象

回顾性分析解放军总医院心血管内科2015年6月至2017年6月住院房颤患者173例,其中男性135例,女性38例,年龄 (56.2 ± 11.6) 岁。根据射频消融线所在区域分为心房前庭组61例、肺静脉前庭组47例和前庭组65例。纳入标准: >18 岁; <80 岁且有完全行为能力的非瓣膜性心脏病房颤患者;自愿接受射频消融手术;使用Carto 3系统完成全部消融过程。排除标准:有房颤射频消融术禁忌证;房颤射频消融及电复律失败。本研究所有患者和家属均签署手术知情同意书。

1.2 方法

1.2.1 确定肺静脉前庭 患者取平卧位,碘伏消毒颈胸部及双侧腹股沟区,铺无菌巾,1%利多卡因麻醉左锁骨下区域,穿刺左侧锁骨下静脉,送入导丝、血管扩张器以及鞘管。拔出导丝和血管扩张器,沿鞘管将电极送至冠状窦。依法穿刺右股静脉,送入长导丝,沿长导丝将Swartz长鞘送至上腔静脉,撤出长导丝,将房间隔穿刺针送入长鞘,透视下将长鞘回撤至房间隔,右前斜45°透视下行房间隔穿刺。房间隔穿刺后行肺静脉造影,将温控消融电极导管送入左心房,在Carto 3三维导航系统辅助下,快速解剖

建模(fast anatomic mapping, FAM)方式对左心房和肺静脉三维建模,再结合影像融合技术,将Carto 3三维影像图形与患者心房和肺静脉CT图像整合,得到与实际位置误差最小的整合图像。肺静脉前庭需结合X线、数字减影血管造影(digital subtraction angiography, DSA)结果和环状电极标记的腔内心电图和阻抗数值确定。

1.2.2 射频消融路径 回顾Carto 3系统中手术信息,整合三维模式图与消融点,描记消融线,参考上肺静脉、左心房转角处与下肺静脉、左心房转角处连线(肺静脉-左心房分界线, A线),规划通过肺静脉口分叉的平行线(B线),两条直线之间的垂直距离为依据,AB线间为肺静脉前庭, A线以内为前庭范围, B线以外为肺静脉区域,为消融禁忌区域。

1.2.3 射频消融 在Carto 3三维导航系统辅助下行环肺静脉消融隔离术,线性消融左、右肺静脉前庭,前壁温控43℃,能量功率35 W,每点放电30 s,后壁温控43℃,能量功率30 W,每点放电30 s,双侧环肺静脉消融后,送入Lasso(Nav, Biosense Webster)标测电极指导进行补点消融,消融后将消融大头送入两侧肺静脉内显示肺静脉电位消失,提示肺静脉达到完全电隔离。每一点消融终点是前庭局部电位振幅降低 $>80\%$ 或消失(<0.1 mV),起搏不能诱发。由于无法获得人体组织病理标本,故将肺静脉电位达到电隔离作为消融评估终点。冠状窦给予S1S1递增刺激(300、200 ms)未诱发房颤说明达手术终点,拔出电极及鞘管。局部压迫止血,无菌纱布加压包扎。术后平卧12 h,注意观察穿刺处有无渗血。

1.3 监测指标

记录患者实验室检查指标及手术总时间、X线曝光时间、消融时间等参数。消融中(穿刺房间隔后, T1)、术后即刻(T2)和术后24 h(T3)分别通过静脉鞘管或外周静脉抽取血液标本,检测血浆中C-反应蛋白(C-reactive protein, CRP)、氨基末端B型脑钠肽前体(N-terminal pro B-type brain natriuretic peptide, NT-proBNP)和白细胞介素-6(interleukin-6, IL-6)水平。

1.4 随访

门诊、电话和住院相结合随访患者,分别在术后第3、6、9、12个月进行,主要评估有无房颤复发。复发定义为术后3个月(空白期)后发生的快速房性心律失常(包括房性心动过速、心房扑动、房颤等),且持续时间>30 s。

1.5 统计学处理

应用SPSS 17.0统计软件对数据进行分析。正态分布的计量资料用均数±标准差($\bar{x} \pm s$)表示,组间比较采用单因素方差分析。偏态分布的计量资料用中位数(四分位间距)表示,组间比较采用秩和检验。计数资料用例数(百分率)表示,组间比较用 χ^2 检验。 $P<0.05$ 为差异有统计学意义。

2 结果

2.1 3组患者基线资料比较

3组患者一般情况、实验室指标等基线资料差异无统计学意义,具有可比性($P>0.05$;表1)。

2.2 3组患者手术参数比较

所有患者在消融过程中达到完全电隔离的即刻

成功率为84.39%(146/173),未达到肺静脉完全隔离患者,均采用补点消融达到肺静脉电位消失。心房前庭组患者消融时间明显长于肺静脉前庭组患者,差异具有统计学意义($P<0.05$;表2)。

2.3 3组患者炎症因子水平比较

相比穿刺房间隔后,3组患者术后即刻和术后24 h IL-6水平升高,肺静脉前庭组患者术后24 h NT-proBNP水平升高,术后24 h CRP水平相比心房前庭组患者升高,差异均具有统计学意义($P<0.05$;表3)

2.4 随访结果

术后161例完成12个月随访,12例失访,失访率为6.94%(12/173),失访原因为电话无法接通和拒绝随访等。术后12个月27例经心电图和动态心电图证实房颤复发,手术成功率为83.23%(134/161)。其中心房前庭组患者手术成功率89.83%(53/59),肺静脉前庭组患者手术成功率73.33%(33/45),前庭组手术成功率80.70%(46/57),心房前庭组手术成功率高于肺静脉前庭组,差异具有统计学意义($P<0.05$)。

表1 3组患者基线资料比较

Table 1 Comparison of baseline data among three groups

Item	Atrial antrum	Pulmonary vein antrum	Antrum	F/χ^2	P value
	group ($n=61$)	group ($n=47$)	group ($n=65$)		
Age (years, $\bar{x} \pm s$)	56.4±11.9	55.8±11.2	56.1±11.4	0.036	0.88
Male[n (%)]	48(78.69)	36(76.60)	51(78.46)	0.079	0.95
BMI(kg/m^2 , $\bar{x} \pm s$)	25.78±3.51	25.92±3.18	25.83±3.22	0.024	0.91
CAD[n (%)]	14(22.95)	12(25.53)	15(23.08)	0.292	0.97
Hypertension[n (%)]	32(52.46)	16(34.04)	23(35.38)	5.090	0.06
Paroxysmal AF[n (%)]	51(83.61)	39(82.98)	49(75.38)	1.630	0.44
Persistent AF[n (%)]	10(16.39)	8(17.02)	16(24.62)	1.630	0.44
Diabetes mellitus[n (%)]	9(14.75)	5(10.64)	8(12.31)	0.420	0.69
Dyslipidemia[n (%)]	25(40.98)	23(48.94)	28(43.08)	0.712	0.81
BUN(mmol/L , $\bar{x} \pm s$)	4.64±0.91	4.76±1.55	4.79±1.51	0.214	0.84
SCr(mmol/L , $\bar{x} \pm s$)	76.09±13.78	76.34±14.72	75.94±17.11	0.009	0.98
TC(mmol/L , $\bar{x} \pm s$)	4.15±0.99	4.05±0.92	4.11±0.92	0.149	0.70
TG(mmol/L , $\bar{x} \pm s$)	1.41±0.59	1.60±0.90	1.72±1.24	1.659	0.25
HDL-C(mmol/L , $\bar{x} \pm s$)	1.12±0.28	1.04±0.23	1.08±0.25	1.467	0.89
LDL-C(mmol/L , $\bar{x} \pm s$)	2.65±0.93	2.50±0.82	2.46±0.70	0.915	0.50

BMI: body mass index; CAD: coronary artery disease; AF: atrial fibrillation; BUN: blood urea nitrogen; SCr: serum creatinine; TC: total cholesterol; TG: triglycerides; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol.

表2 3组患者手术参数比较

Table 2 Comparison of operative parameters among three groups

($\bar{x} \pm s$)

Group	n	Ablation time (min)	X ray exposure time (min)	Operation time (min)	Point of ablation (point)
Atrial antrum	61	120.67±13.12 *	14.37±2.15	192.40±31.23	62±8
Pulmonary vein antrum	47	90.17±6.95	13.92±2.81	163.75±26.86	56±5
Antrum	65	116.24±18.13	14.28±2.08	185.17±26.51	58±7

Compared with pulmonary vein antrum group, * $P<0.05$.

表 3 3 组患者炎症因子比较
Table 3 Comparison of inflammation factors among three groups

Item	Atrium vestibula (n=61)	Pulmonary venous vestibula (n=47)	Vestibula (n=65)
CRP(mg/L, $\bar{x}\pm s$)			
T1	0.53±0.43	1.10±0.85	0.86±0.54
T2	0.47±0.32	1.14±0.86	0.82±0.59
T3	0.40±0.29	1.99±1.09 [#]	0.95±0.22
NT-proBNP[pg/ml, $M(Q_1, Q_3)$]			
T1	230(185,345)	286(155,304)	310(296,373)
T2	271(231,364)	420(210,607)	373(309,441)
T3	215(134,314)	292(172,412) [*]	253(157,358)
IL-6(mmol/L, $\bar{x}\pm s$)			
T1	1.69±0.31	9.85±8.50	9.64±5.62
T2	3.24±2.25 [*]	14.31±10.86 [*]	9.61±7.72 [*]
T3	4.67±3.57 [*]	11.81±9.30 [*]	12.30±4.70 [*]

T1: after atrial septum puncture; T2: immediately after operation; T3: 24 h after operation; CRP: C-reactive protein; NT-proBNP: N-terminal pro B-type brain natriuretic peptide; IL-6: interleukin-6. Compared with T1, ^{*}*P*<0.05; compared with atrium vestibula group, [#]*P*<0.05.

3 讨 论

肺静脉前庭的异位兴奋灶是诱发阵发性房颤的电生理原因,因此环肺静脉前庭消融术成为了阵发性房颤消融术的主流。Haissaguerre 等^[7]、Ouyang 等^[8]和 Oralh 等^[9]的研究结果表明消融线接近肺静脉易增加术后肺静脉狭窄;消融线靠近心房易造成漏点,增加术后复发率。优化消融线路是目前临床亟待研究的课题。

我们以左心房前庭与肺静脉前庭的外观分界线为依据,对 173 例实施房颤射频消融术的患者进行分组,对比了不同消融路径患者的化验指标、手术参数及远期成功率。通过术后 12 个月的随访发现环肺静脉前庭消融的总成功率为 83.23%,与文献报道一致^[4],心房前庭组成功率显著高于消融线靠近肺静脉侧的肺静脉前庭组,而前庭组的消融线一侧与心房前庭组相近,而另一侧与肺静脉前庭组相近,因此手术效果与心房前庭和肺静脉前庭组差异不显著。

交感神经和副交感神经的交替刺激是房颤重要触发因素,而两种神经纤维同时存在于神经节中,神经节多位于心外膜和心肌中,仅少量存在于心内膜^[10,11],射频消融时能量可透壁损伤神经节。有研究发现靠近心房侧心肌中的神经节数量更多^[12],因此心房前庭组消融线损伤的神经节数量较肺静脉前庭组更多,如此可提高即刻消融成功率和远期成功率。同时心房前庭组消融范围虽然较大,容易漏点,但补点消融可增加更多的消融点。消融后心功能的

恢复是一个慢性过程,左心房和肺静脉前庭的基质在经历节律调整、炎症反应、电学重构等一系列急慢性过程后,左心房的的功能会发生相应变化^[13]。在消融成功、维持窦性心律的前提下,消融点数越多,则毁损组织越多,损伤神经节的数量就多,从而减少交感与副交感交替刺激对心房的影响,提高手术成功率^[14]。

本研究表明心房前庭组消融时间多于肺静脉前庭和前庭组,分析原因为心房前庭组消融线距肺静脉远,消融线路长,点数多,因此耗时更长。术中 X 线透视主要用于房间隔穿刺过程,每例手术的穿刺过程基本相同,所以 3 组 X 线曝光时间差异不明显。

CRP 是重要的炎症标志物,IL-6 是参与机体炎症反应的重要介质,NT-proBNP 与心房重构有重要关系,炎症反应与心房电生理、解剖重构贯穿于房颤及维持的整个过程^[15],所以房颤患者炎症指标明显高于窦性心律人群^[16]。本研究结果表明 3 组患者术后即刻和术后 24 h 的 IL-6 水平分别较穿刺房间隔前明显升高,与既往报道相一致^[17],考虑是射频消融过程中,心房肌在高能量下发生水肿、变性,释放更多的炎症因子所致。既往报道 CRP 体现心房重构中的炎症水平^[18],可用于预测房颤的产生和复发,本研究发现肺静脉前庭组患者术后 24 h CRP 水平高于心房前庭组,与随访复发结果一致。

综上所述,本研究基于前人对肺静脉前庭的研究,对不同位置射频消融线进行了探讨,为今后设计效率更高、并发症更少的消融线提供了参考。

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(编辑: 王彩霞)