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· 心房颤动专题研究 ·

心房颤动导管消融相关食管损伤的保护策略

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【摘要】 导管消融已成为心房颤动的主要治疗手段之一, 手术相关食管损伤是其常见的并发症, 心房食管瘘虽罕见, 但通常是致命的。本文主要综述了导管消融相关食管损伤发生率、损伤机制、危险因素及保护策略等, 并指出更灵敏的食管温度监测、更安全的消融参数和导管、食管冷却及食管移位装置等均可降低食管热损伤发生风险。

【关键词】 心房颤动; 导管消融术; 食管损伤; 心房食管瘘; 保护策略; 综述

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Protective Strategies for Esophageal Injury Associated with Catheter Ablation of Atrial Fibrillation WANG Yifan, ZHANG Jian

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【Abstract】 Catheter ablation has become one of the main methods for the treatment of atrial fibrillation. Operation-related esophageal injury is a common complication, and atri-esophageal fistulas are rare but usually fatal. This paper reviews the incidence, mechanism, risk factors and protection strategies of esophageal injury associated with catheter ablation. More sensitive esophageal temperature monitoring, safer ablation parameters and catheters, esophageal cooling, and esophageal displacement devices can reduce the risk of esophageal heat damage.

【Key words】 Atrial fibrillation; Catheter ablation; Esophageal injury; Atrial esophageal fistula; Protective strategies; Review

流行病学调查显示, 截至2010年全球心房颤动患者估测约为3 350万例^[1], 导管消融是该病重要且广泛应用的治疗策略, 环肺静脉电隔离术是导管消融的基石。由于食管靠近左心房, 食管前壁与左心房内膜的平均距离 $< 5\text{ mm}$ ^[2], 故左心房后壁消融会导致食管损伤, 其中最严重的损伤是心房食管瘘, 其虽为罕见并发症, 但死亡率高达70%^[3]。近年来随着各种食管保护器械的发展, 一些新的方法出现并用于临床, 而熟悉并掌握这些方法对导管消融术中保护食管至关重要。本文主要综述了导管消融相关食管损伤发生率、损伤机制、危险因素及保护策略等, 旨在降低心房颤动患者导管消融过程中食管损伤发生风险。

1 导管消融相关食管损伤的发生率

临床上食管热损伤较为常见, 包括黏膜红斑、糜烂、溃疡及由食管神经丛和血管损伤引起的蠕动障碍。KNOPP等^[4]对425例左心房导管消融术后患者行消化内镜检查, 其中328例(77.2%)胃肠道异常, 包括胃糜烂(22%)、食管红斑(21%)、胃轻瘫(17%)、食管裂孔疝(16%)、反流性食管炎(12%)、

食管热病变(11%)和疑似Barrett食管(5%)。HA等^[5]合并分析25项研究结果显示, 心房颤动患者导管消融术后食管损伤发生率约为11%, 溃疡性食管损伤发生率约为5%。

心房食管瘘为导管消融术的罕见并发症, 其发生率为0.03%~0.11%^[6], 死亡率极高。GANDJBAKHCH等^[7]研究报道, 法国2006—2019年行心房颤动导管消融术的129 286例次患者中心房食管瘘发生率为0.026%, 心房食管瘘死亡率为60%。BARBHAIYA等^[8]通过统计、分析全球191 215例心房颤动导管消融患者发现, 心房食管瘘发生率为0.011%, 死亡率为79%。LI等^[9]回顾性分析我国11家心脏中心2010—2019年行射频消融术的44 794例心房颤动患者发现, 心房食管瘘发生率为0.035%, 心房食管瘘死亡率为75%。

2 导管消融相关食管损伤发生机制

目前, 导管消融相关食管损伤的确切机制尚不清楚, 可能受到多个因素影响, 一种可能机制是射频或冷冻消融能量对食管造成直接损伤, 另一种可能机制是局部缺血重叠消融部位^[10]。食管血供由食管表面的分支动脉系统组成, 消融能量导致小动脉供血闭塞而引起局部缺血。此外, 消融能量还会影响食管上的迷走神经丛, 导致胃轻瘫和胃酸反流。

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3 导管消融相关食管损伤的危险因素

食管损伤的1个主要决定因素是消融电极到食管的距离。低体质指数意味着心包脂肪减少、心房与食管的解剖距离更为接近。研究表明,低体质指数(体质指数 $< 24.9 \text{ kg/m}^2$)可增加食管损伤发生风险^[11]。全身麻醉可能会减少食管的吞咽、蠕动和位移,使局部受热时间延长且患者不能反馈痛感,导致食管损伤概率升高^[12]。研究表明,冷冻消融可能降低心房食管瘘发生风险^[13],但其具体机制尚不清楚。此外,压力感应消融导管在确保导管与组织充分接触并形成透壁损伤的同时,也增加了对食管的附带损伤^[14]。

4 导管消融相关食管损伤的保护策略

4.1 监测食管温度 监测食管温度是目前临床应用最广泛的食管保护策略,其目的是早期发现食管温度升高,以便在食管发生永久性损伤前停止消融。《2017 HRS/EHRA/ECAS/APHRS/SOLAECE 心房颤动导管和外科消融专家共识》^[15]指出,可在心房颤动消融过程中使用食管温度探头监测食管温度,并指导能量输送,射频消融过程中食管温度上升 2°C 或温度超过 $39\sim 40^\circ\text{C}$ 及冷冻消融时食管温度下降 5°C 时停止消融,均可降低食管损伤发生风险且不影响肺静脉隔离成功率。但仍有研究报道,消融过程中未观察到患者食管温度改变,但仍出现了食管损伤和心房食管瘘^[16]。KADADO等^[17]通过合并分析16项使用食管温度监测与不使用食管温度监测行导管消融的研究发现,食管温度监测并未降低心房颤动患者食管损伤发生率,究其原因可能如下:(1)探头可能无法准确记录与左心房相邻的腔外食管壁温度;(2)食管温度探头会限制食管的横向移位,有导致食管损伤的可能。因此,食管温度监测并不能很好地指导导管消融治疗,以避免食管损伤。

4.2 食管冷却 食管冷却的原理是使用冷盐水灌注降低食管腔内温度,从而减少或消除消融期间食管损伤风险,该技术的保护作用已在不同临床试验中得到证实。在一项临床试验中,对318例接受热球囊射频消融的患者食管内灌注含有对比剂和0.9%氯化钠溶液的冷水混合物,不仅降低了食管损伤的发生率,还减轻了食管损伤的严重程度^[18]。近期一项单中心、前瞻性、双盲随机试验探讨了ensoETM设备对保护食管免受热损伤的能力,该设备是在全身麻醉下进行心房颤动射频消融期间将腔内温度保持在 4°C ,消融后7d进行内窥镜检查,结果表明,ensoETM设备能有效减轻心房颤动患者导管射频消融后黏膜热损伤^[19]。

4.3 食管位移 食管与周围组织结构连接松散。研究表明,消融期间食管位置的横向变化可达 4 cm ^[20],尸检结果也证明了食管移动的可行性^[21]。因此,主动改变食管位置以增加其与左心房后壁的距离,可能降低消融期间食管损伤发生风险。目前有多种技术可以实现食管的机械位移,包括使用经食管超声心动图探头、内窥镜及专用仪器。PALANISWAMY等^[22]对114例心房颤动患者使用机械食管偏移装置,结果显示,食管偏离距离与食管温度呈反比,机械性食管偏离肺静脉消融线 $> 20 \text{ mm}$ 可以防止肺静脉隔离期间食管发热,但有3例患者出现了器械相关性损伤。PARIKH等^[23]对687例患者术中使用EsoSure食管偏离装置发现,其可明显降低食管腔

温度,同时未见明确的器械相关并发症,证实食管机械位移技术是安全、有效的。但目前尚不清楚EsoSure食管偏离装置是否会导致食管壁过度拉伸,引起器械相关性损伤。

4.4 质子泵抑制剂 在心房颤动消融前或消融后短期内预防性使用质子泵抑制剂已成为一种公认的防止食管损伤和瘘管形成的策略。研究表明,射频消融术后胃食管反流发生率明显升高^[24],而质子泵抑制剂能有效抑制胃酸反流^[25]。《心房颤动:目前的认识和治疗的建议-2018》^[26]中建议,心房颤动消融术后口服4~6周质子泵抑制剂。但使用质子泵抑制剂预防食管溃疡形成仍存在争议,尚缺乏大型随机试验证据证实。

4.5 其他方法

4.5.1 高功率短时程消融 高功率短时程消融是电阻加热而不是传导加热,故在左心房后壁消融术中的应用越来越多。与传统射频消融相比,高功率短时程消融损伤灶范围更小,深度更浅,故食管损伤发生风险更低^[27]。WINKLE等^[28]研究证实,针对10284例患者行高功率短时程消融后,共4例患者出现并发症,并发症发生率较低。但近期有研究表明,如果高功率短时程消融病变距温度传感器的距离 $< 20 \text{ mm}$,则食管温度会明显升高〔距离 $(8 \pm 2) \text{ mm}$,食管温度升高 $\geq 4^\circ\text{C}$;距离 $(9 \pm 2) \text{ mm}$,食管温度升高 $2\sim 4^\circ\text{C}$;距离 $(13 \pm 2) \text{ mm}$,食管温度升高 $1\sim 2^\circ\text{C}$ 〕^[29]。目前尚无经食管内镜检查以评估高功率短时程消融安全性的研究报道。近期一项荟萃分析结果显示,与传统射频消融相比,高功率短时程消融的食管损伤发生率无明显变化^[30]。综上,尚无数据表明高功率短时程消融是一种可减轻食管损伤的消融策略。

4.5.2 单圈大环隔离肺静脉 单圈大环隔离是传统双圈肺静脉隔离的改良术式,因其不进行左心房后壁的消融,故相关食管损伤发生风险明显降低。一项关于后壁隔离的荟萃分析结果显示,使用单环隔离实现肺静脉和后壁隔离的即刻成功率为 $92\%\sim 99\%$ ^[31]。LIM等^[32]在一项随机对照试验中比较了肺静脉单环隔离与双环隔离的效果,结果显示,80例患者随访2年单环隔离后心房颤动发生率低于双环隔离〔 74% 〔 $95\% \text{ CI } (65\%, 82\%)$ 〕比 61% 〔 $95\% \text{ CI } (51\%, 70\%)$ 〕, $P=0.031$ 〕,房性心律失常发生率相似〔 67% 〔 $95\% \text{ CI } (57\%, 75\%)$ 〕比 64% 〔 $95\% \text{ CI } (54\%, 72\%)$ 〕, $P=0.988$ 〕。唐成等^[33]对5例下肺静脉共干患者行单环消融术式隔离肺静脉,结果显示,5例患者术后10个月随访均无复发。单环消融术式隔离肺静脉的缺点如下:(1)如果消融线有漏点,电生理判断位置比较复杂。(2)1个漏点传导恢复,可能4个肺静脉电位均恢复。(3)如果左心房后壁有心外膜插入点,仍需在后壁补点消融。

4.5.3 脉冲电场消融(pulsed field ablation, PFA) 目前,PFA已用于心房颤动消融,其优势是通过在细胞膜上形成微孔而引起心肌组织特异性死亡,且未损伤包括食管、血管、神经等在内的临近组织。有研究在成功完成肺静脉隔离的81例患者中评估PFA的有效性和安全性,术后行内镜检查显示,25例患者无食管损伤^[34]。

6 小结

综上所述,食管保护策略较多,但效果存在差异,近年来射频期间低流量冲洗及机械食管偏移装置的使用越来越流行,其对食管损伤的保护效果虽然令人鼓舞,但仍有待全面评估。此外,PFA也非常有前景,如果其被证明是有效的,那么将有可能避免心房颤动导管消融过程中的食管损伤。

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本文无利益冲突。

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