·综述·

颈动脉漂浮血栓相关缺血性卒中诊断与治疗进展

俞淑凤　李宁　徐健　王鹏

【摘要】 颈动脉漂浮血栓与缺血性卒中显著相关，血栓闭塞动脉或脱落致大面积脑梗死或多发栓塞，严重者可出现脑疝甚至死亡，其诊断逐渐以CTA为主，早期识别有助于病因治疗。本文综述颈动脉漂浮血栓的诊断与治疗进展，以提高临床诊断与治疗水平。

【关键词】 颈动脉狭窄；　血栓形成；　卒中；　脑缺血；　计算机体层摄影血管造影术；　综述

Progress on diagnosis and treatment of carotid free-floating thrombous related ischemic stroke

YU Shu-feng[1], LI Ning[2], XU Jian[1], WANG Peng[3]

[1]Department of Radiology, [3]Department of Neurology, Zhejiang Provincial People's Hospital, Hangzhou 310014, Zhejiang, China

[2]Grade 2020, The Second Clinical Medical College of Zhejiang Chinese Medical University, Hangzhou 310053, Zhejiang, China

YU Shu-feng and LI Ning contributed equally to the article

Corresponding author: WANG Peng (Email: 1979wwww@163.com)

【Abstract】 Carotid free-floating thrombus (CFFT) is significantly associated with ischemic stroke. Thrombosis occludes the artery or falls off, leading to massive cerebral infarction or multiple embolism. In severe cases, cerebral hernia or even death may occur. The diagnosis of CFFT is gradually based on CT angiography (CTA). Early identification can help in etiological treatment. This article reviews the progress of the diagnosis and treatment of CFFT, in order to improve chinical diagnosis and treatment.

【Key words】 Carotid stenosis; Thrombosis; Stroke; Brain ischemia; Computed tomography angiography; Review

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颈动脉漂浮血栓（CFFT）系指附着于动脉壁的血栓，其远端周围有动脉血流，周期性运动与心动周期相关，因血栓呈漂浮状态，故称漂浮血栓，也称腔内血栓（ILT）。最早可追溯至1905年，Chiari[1]在尸检中发现一长约1.50 cm的腔内血栓并认为其可能是脑卒中的病因；此后多为神经外科医师在颈动脉手术中发现[2-4]。诊断主要依靠颈动脉双功能超声（CDUS），但受检测者操作技术的限制，存在漏诊、误诊的可能；CTA是常用的临床诊断颈动脉狭窄的无创性方法，可全方位、多角度观察血管细微结构，目前已经成为首选方法[5-7]。基于CTA的研究显示，急性缺血性卒中或短暂性脑缺血发作（TIA）患者颈动脉漂浮血栓发生率约为3.2%[8-9]，引起越来越多学者的关注，但目前国内仅以个案报道为主，尚无统一的诊断标准和治疗原则。随着急性缺血性卒中血管内治疗技术的发展，颈动脉漂浮血栓的血管内治疗成为可能，但应注意与颈动脉溃疡斑块相鉴别[10-12]，二者药物治疗方案完全不同。本文拟对近年来颈动脉漂浮血栓的诊断与治疗进展进行综述，以期提高临床诊断与治疗。

一、颈动脉漂浮血栓的诊断

1. DSA　20世纪70～80年代中期主要在DSA检查中发现颈动脉漂浮血栓，其在缺血性卒中患者

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作者单位：310014 杭州，浙江省人民医院放射科（俞淑凤、徐健），神经内科（王鹏）；310053 杭州，浙江中医药大学第二临床医学院2020级（李宁）

通讯作者：王鹏，Email：1979wwww@163.com

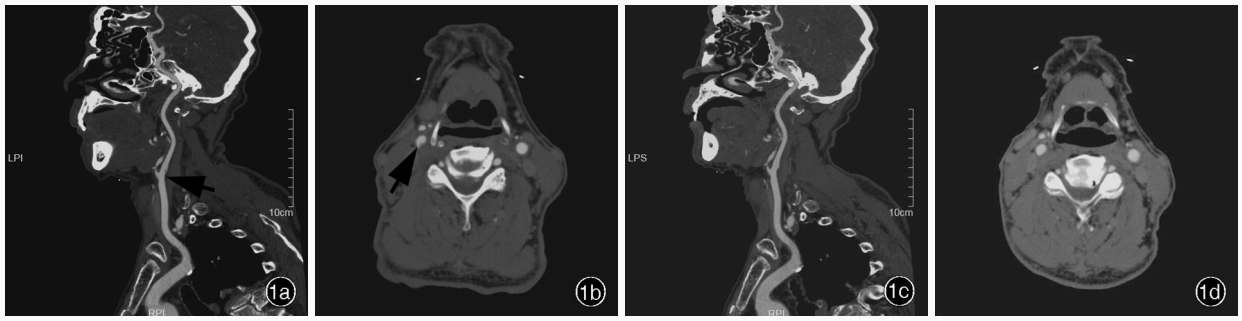

图1　男性患者，79岁，因左侧肢体麻木无力伴言语不清8天入院，临床诊断为右侧脑梗死、右颈总动脉分叉部漂浮血栓，予阿司匹林100 mg/d和氯吡格雷75 mg/d口服抗血小板治疗。治疗前后CTA检查所见　1a　治疗前MIP矢状位重建可见颈动脉漂浮血栓（箭头所示）　1b　治疗前MIP横断面重建可见颈动脉漂浮血栓（箭头所示）　1c　治疗1个月后MIP矢状位重建显示漂浮血栓消失　1d　治疗1个月后MIP横断面重建显示漂浮血栓消失

Figure 1　A 79-year-old male was admitted to the hospital with numbness and weakness of the left limb combined with slurred speech for 8 days. The clinical diagnosis was right cerebral infarction and floating thrombosis of the right CCA bifurcation, was treated with aspirin 100 mg/d and clopidogrel 75 mg/d. CTA findings before and after treatment　Sagittal (Panel 1a) and axial (Panel 1b) MIP reconstruction before treatment showed floating thrombus in the carotid artery (arrows indicate). Sagittal (Panel 1c) and axial (Panel 1d) MIP reconstruction at one month after treatment showed floating thrombus disappearance.

中的检出率为0.4%～1.5%[13-14]。1973年，Roberson等[15]对9例颈总动脉（CCA）或颈内动脉（ICA）狭窄患者分别行股动脉插管和双侧选择性颈总动脉造影术（6例）以及经皮颈动脉插管术（3例），8例检出颈动脉漂浮血栓，并提出血栓周围存在造影剂是诊断颈动脉漂浮血栓的决定性特征，他们还认为，颈动脉漂浮血栓逐渐堵塞血管可能与神经功能缺损进展相关。

2. 颈动脉超声　颈动脉超声是颈动脉狭窄的无创性筛查手段，一项缺血性卒中患者非狭窄颈动脉漂浮血栓超声研究发现，其漂浮血栓检出率为0.18%，典型的颈动脉超声表现为[16]：病变结构相对均质（无高回声区），表面光滑，周围血流速度无明显增快，病变形态细长，较宽处附着于颈动脉球部，随心动周期运动，血栓随时间推移逐渐缩小。

3. CTA　（1）诊断标准：研究显示，CTA原始图像或最大密度投影（MIP）与DSA评估颈动脉狭窄程度的相关性高于血管分析方法，对重度狭窄的诊断灵敏度和特异度分别为75%和96%[7]。2013年，美国神经放射学会（ASNR）、美国放射学会（ACR）和美国神经介入外科学会（SNIS）发表联合声明，推荐CTA作为筛查颈动脉狭窄或闭塞的首选方法[17]；《脑血管病影像规范化应用中国指南》[18]也建议CTA用于评估主动脉弓以上头颈部动脉及其分支狭窄或闭塞，并强烈推荐联合颈动脉超声和CTA以提高诊断准确性，从而进行病因诊断。目前关于颈动脉漂浮血栓的CTA表现尚缺乏一致性指南或共识，其诊断标准主要源自样本量相对较大的病例对照研究。2007年，一项队列研究通过排除起源于或固定于颈动脉的漂浮血栓如栓子、延伸至颈动脉的弓形血栓等，将“颈动脉漂浮血栓”理想定义为附着于动脉壁的细长血栓，其最远端有周围血流，周期性运动与心动周期相关[2]。后续的颈动脉漂浮血栓CTA研究纳入标准主要为，可见残留管腔且呈偏心性狭窄；血栓部分闭塞，未完全堵塞血管；血栓边缘光滑、清晰；管壁无钙化[5-8]（图1）。（2）特征性表现：“线样征（string sign）”[2,19]和“甜甜圈征（donut sign）”[20]是颈动脉漂浮血栓的特征性CTA表现（图2）。2014年，一项队列研究提出“甜甜圈征”并以该征象定义纳入标准，结果显示，近端颈内动脉向颅内方向延伸＞3.8 mm的充盈缺损较复杂溃疡斑块更易发生颈动脉漂浮血栓，从而确定颈动脉漂浮血栓的影像学诊断标准[21]。2021年，Torres等[22]对诊断颈动脉漂浮血栓的充盈缺损长度阈值进行验证，发现充盈缺损长度＞3.8 mm诊断颈动脉漂浮血栓的灵敏度为88%、特异度为83%，且充盈缺损长度每增加1 mm，颈动脉漂浮血栓发生率增加4.6倍。

颈动脉超声、DSA和CTA均是颈动脉漂浮血栓的检查方法，尤以CTA最为常用且最具特异性。颈动脉超声依赖检查者的操作和经验以及检测仪器，存在漏诊、误诊的可能；DSA虽是脑血管病变的诊断“金标准”，但因漂浮血栓有相当一部分游离于管腔，其周围有造影剂充盈，可不表现为典型颈动脉狭窄征象，导致误判的可能；CTA则是一种无创性、

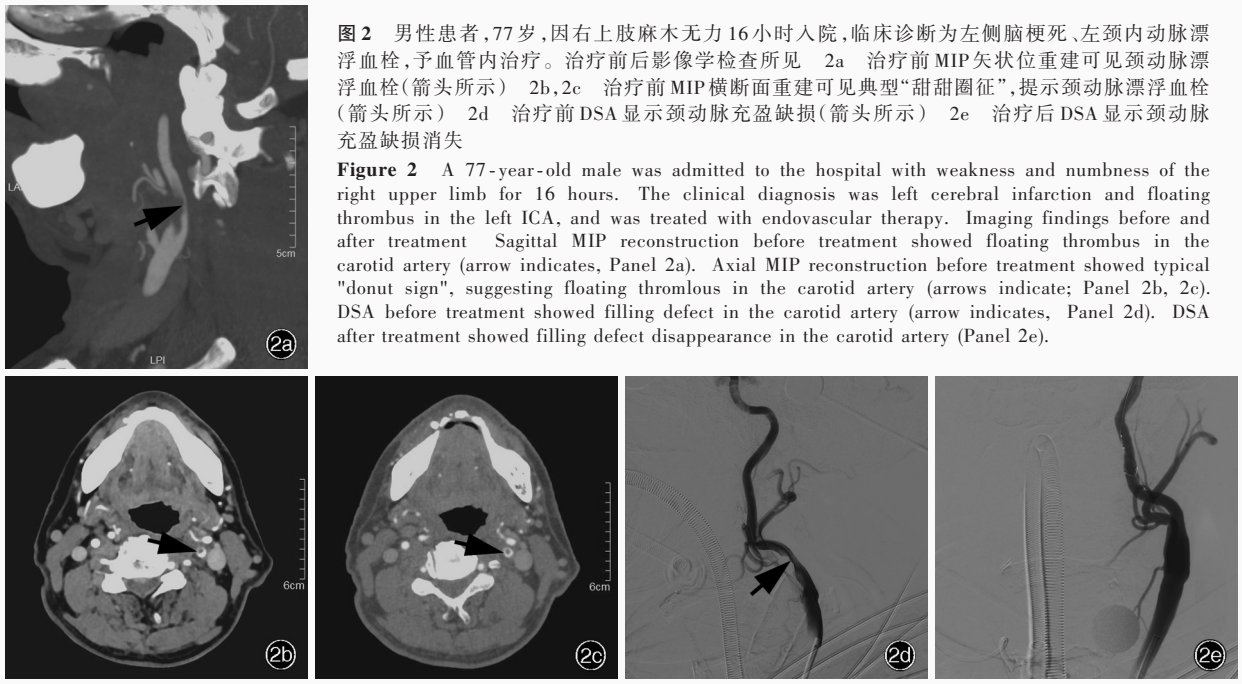

图2　男性患者，77岁，因右上肢麻木无力16小时入院，临床诊断为左侧脑梗死、左颈内动脉漂浮血栓，予血管内治疗。治疗前后影像学检查所见　2a　治疗前MIP矢状位重建可见颈动脉漂浮血栓（箭头所示）　2b，2c　治疗前MIP横断面重建可见典型“甜甜圈征”，提示颈动脉漂浮血栓（箭头所示）　2d　治疗前DSA显示颈动脉充盈缺损（箭头所示）　2e　治疗后DSA显示颈动脉充盈缺损消失

Figure 2　A 77-year-old male was admitted to the hospital with weakness and numbness of the right upper limb for 16 hours. The clinical diagnosis was left cerebral infarction and floating thrombus in the left ICA, and was treated with endovascular therapy. Imaging findings before and after treatment　Sagittal MIP reconstruction before treatment showed floating thrombus in the carotid artery (arrow indicates, Panel 2a). Axial MIP reconstruction before treatment showed typical "donut sign", suggesting floating thromlous in the carotid artery (arrows indicate; Panel 2b, 2c). DSA before treatment showed filling defect in the carotid artery (arrow indicates, Panel 2d). DSA after treatment showed filling defect disappearance in the carotid artery (Panel 2e).

高效诊断方法，可多层面观察血管细微结构，在颈动脉漂浮血栓诊断方面的优势较为突出。

二、颈动脉漂浮血栓的治疗

颈动脉漂浮血栓与颈动脉粥样硬化斑块在CTA上均表现为不同长度和形态的管腔内充盈缺陷，二者鉴别诊断十分必要，关乎治疗的紧迫性和治疗方案的选择，狭窄率＞50%的症状性颈动脉斑块需急性血运重建，但颈动脉漂浮血栓有可能高估狭窄率且常采用药物治疗[23-24]。

1. 药物治疗　2019年，一项基于CTA诊断颈动脉漂浮血栓的回顾性研究显示，颈动脉漂浮血栓最常见于颈内动脉，约占65.6%，累及大脑中动脉（串联病变）较少见，仅占3.3%；病因主要为颈动脉粥样硬化（82.0%），中位狭窄率为68%，故重度颈动脉狭窄更易出现颈动脉漂浮血栓，治疗方面推荐肝素联合1种抗血小板药物，总体预后良好，约75.4%患者预后良好[改良Rankin量表（mRS）评分≤2分]，23%和1.6%患者开始康复治疗前mRS评分3和4分[9]。2019年报道的脑卒中患者颈动脉漂浮血栓发生率为1.3%，2000年以前为0.4%，2000年后因CTA的应用，发生率增至1.6%，但并无证据表明早期抗凝治疗可以降低血管事件或死亡的短期风险[25-26]。对于颈动脉漂浮血栓是否应在急性期进行抗凝治疗，是否应用单一抗血小板或双重抗血小板药物，或者是否应用抗血小板药物联合抗凝药物，未来尚待进一步研究。

2. 血运重建　颈动脉漂浮血栓的外科治疗可以选择颈动脉内膜切除术（CEA），个案报道较多[27-29]，而缺乏随机对照试验、病例对照研究和队列研究。2019年，Tolaymat等[30]报告6例颈动脉漂浮血栓采用颈动脉内膜切除术，均无术后并发症，平均随访252天，其中4例随访中未再发生狭窄、血栓复发、脑卒中恶化或复发。虽然各国指南均不推荐颈动脉内膜切除术作为狭窄率＜50%的症状性颈动脉狭窄的一线治疗方法[31]，但有学者提出由于颈动脉漂浮血栓发生血管事件的风险较高，可考虑伴颈动脉漂浮血栓的狭窄率＜50%的症状性颈动脉狭窄行颈动脉内膜切除术[30-32]。

3. 血管内治疗　随着介入材料的发展，越来越多的颈动脉漂浮血栓采取血管内治疗，早期多采用颈动脉支架成形术（CAS），通常选择术中斑块脱落较少的闭环支架，如Wallstent支架（美国Boston Scientific公司）[33]。随着急性大动脉闭塞血管内治疗的开展以及微创、非植入概念的引入，颈动脉漂浮血栓的血管内治疗（EVT）逐渐开展，2018年Fitzpatrizk等[34]应用颈动脉支架成形术中材料远端保护装置和取栓支架成功治疗4例颈动脉漂浮血栓。本研究团队于2022年采用颈动脉超声辅助血

管内治疗成功治疗1例颈动脉漂浮血栓[35]。

综上所述，颈动脉漂浮血栓发生率并不低，且存在较高的血管事件风险，抗凝、抗血小板或血运重建均预后良好，但何种治疗方案更理想尚待进一步探究。未来的研究应对比分析不同药物（如双重抗血小板药物或抗凝药物）的有效性和安全性。随着研究的深入，未来更多研究将基于CTA诊断标准入组，同时还需提高影像科医师对颈动脉漂浮血栓的重视。

利益冲突　无

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·读者·作者·编者·

《中国现代神经疾病杂志》编辑部关于稿件统计分析方法的要求

《中国现代神经疾病杂志》编辑部对来稿中的统计分析方法一律要求明确研究设计方法，以及详细描述资料性质和结果，具体要求如下：

1.研究设计方法　要求交代研究设计的名称和主要方法。如调查设计应写明是前瞻性、回顾性还是横断面调查研究；实验设计应写明具体设计类型，如自身配对设计、成组设计、交叉设计、析因设计或正交叉设计等；临床试验设计应写明属于第几期临床试验，采用何种盲法措施等。应围绕“重复、随机、对照、均衡”四项基本原则进行概要说明，尤其要说明如何控制重要的非试验因素的干扰和影响。

2.资料及结果的表达与描述　采用均数±标准差（$\bar{x}\pm s$）表示近似服从正态分布的计量资料，采用中位数和四分位数间距[$M(P_{25},P_{75})$]表示呈偏态分布的计量资料；采用相对数构成比（%）或率（%）表示计数资料，用相对数构成比时分母不能小于20。应写明所用统计分析方法的具体名称、统计量具体值，应尽可能给出确切的P值；当涉及总体参数时，在给出显著性检验结果的同时，给出95%CI。