·专题综述·

磁共振斑块成像技术临床应用的现在与未来

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【摘要】　磁共振斑块成像技术已被广泛应用于颈动脉粥样硬化斑块特征的研究中。经组织学验证，这些技术能够准确评价斑块负荷、组织成分、纤维帽完整性和炎症反应。本综述将从以下几个方面阐述磁共振斑块成像技术在临床实践中的潜在应用价值：①在易损斑块表面破裂前，磁共振斑块成像能够对其进行早期识别，从而预防缺血性卒中；②颈动脉斑块磁共振特征可能有助于制订临床治疗策略；③磁共振斑块成像是监测颈动脉粥样硬化病变他汀类药物治疗效果的有效手段。

【关键词】　颈动脉；粥样硬化斑块；磁共振成像

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【Abstract】　Magnetic resonance (MR) plaque imaging techniques have been widely used to characterize carotid atherosclerotic plaques. These techniques are capable of accurately evaluating plaque burden measurements, tissue compositions, integrity of fibrous cap and inflammation with histological validation. This review will describe the potential roles of MR plaque imaging techniques in clinical practice from the following aspects: for prevention of ischemic stroke, MR plaque imaging can be used to early detect vulnerable plaques prior to surface disruption; characteristics of carotid plaques determined by MR plaque imaging might be helpful in making strategy of carotid revascularization; MR plaque imaging is a useful tool for monitoring treatment effect of statin in carotid atherosclerosis.

【Key Words】　Carotid artery; Atherosclerotic plaque; Magnetic resonance imaging

　　卒中现已成为我国城市居民致死性疾病的首要原因，如何有效预防与控制卒中是我国目前亟待解决的公共健康问题之一。缺血性卒中（ischemic stroke，IS）的主要责任病变是脑动脉粥样硬化易损斑块。因此，早期识别颈动脉易损斑块并对其进行有效治疗是卒中预防的关键。高分辨率磁共振（magnetic resonance，MR）斑块成像技术自20世纪90年代研发至今，已被广泛应用于颈动脉易损斑块成像的相关研究中。MR斑块成像技术能够准确定性、定量分析颈动脉斑块的负荷和成分特征，被认为是现阶段识别颈动脉易损斑块的最佳无创性影像学手段。研究显示，应用MR斑块成像获得的脑动脉易损斑块特征，对于卒中的病因学诊断、责任病变治疗、预后判断和二级预防均具有重要价值。随着MR斑块成像技术的进一步发展，其临床应用前景会更为广阔。

1　MR斑块成像识别脑血管易损斑块，有效预防缺血性卒中

　　脑血管粥样硬化易损斑块破裂引发的血栓栓塞，是IS的主要病因之一。因此，早期识别易损斑块并对其进行有效干预，有利于IS的预防。引发卒中的责任病变多发生于脑组织上游的动脉血管床，如颅内动脉和颅外颈动脉等。Wong等[1]研究发现，中国人群IS患者中46.6%存在

颅内大动脉狭窄,而西方人群IS多为颅外颈动脉易损斑块所致。此外,一项小样本研究显示,国人症状性颈动脉斑块更多表现为大脂质核、少钙化[2]。这些中西方人群颅内外动脉粥样硬化发病的差异可能与遗传、环境、饮食、他汀类药物使用等因素有关。因此,需要针对中国人群的发病特征制订IS的预防策略。

目前,临床上常应用各种血管成像技术 [如超声 (ultrasound, US)、计算机断层扫描血管造影 (computed tomography angiography, CTA)、磁共振血管造影 (magnetic resonance angiography, MRA)、数字减影血管造影 (digital subtraction angiography, DSA)] 测量动脉管腔狭窄程度,以此判断病变的严重性。然而,由于动脉存在正性重构效应,仅依据管腔狭窄程度常低估动脉粥样硬化病变的严重性[3]。近年有研究表明,多数易损斑块仅造成管腔轻度狭窄[3-5]。Dong等[6]研究发现,狭窄程度为0%的无症状颈动脉中,6%~8%存在易损斑块。因此,学者建议对动脉管壁进行直接成像,通过识别斑块内部的成分特征评价斑块的易损性。

MR斑块成像技术在评价脑血管易损斑块方面具有重要价值。与组织病理学对照研究显示,MR二维、高分辨率斑块成像几乎能够识别易损斑块的所有组织学特征,如大脂质核薄纤维帽、斑块内出血、炎症反应与新生血管化等[7-11]。目前,有学者推荐应用三维成像技术对颈动脉进行成像,与二维技术相比,其纵向覆盖范围可以扩大至250 mm,且扫描时间明显缩短[12]。对于颅内动脉易损斑块成像,多数学者沿用颅外颈动脉MR斑块成像技术[13-18]。有研究发现,症状性大脑中动脉斑块更多表现为正性重构效应[16],斑块内出血发生率达19.6%[18]。然而,由于颅内动脉位置深在、管径小管壁薄、部分节段走行迂曲或缺乏脂肪和脑脊液等天然信号对比,对其管壁成像具有一定的挑战。目前有学者研究开发三维管壁成像技术[19-20],以

加快扫描速度、提高空间分辨率、更好抑制复杂血流,这也是颅内动脉易损斑块成像的未来发展方向。

早期识别易损斑块对于IS的预防具有重要意义。大量横断面研究证实,斑块内出血、纤维帽破裂、表面溃疡、大脂质核等颈动脉复杂斑块磁共振表现特征与脑血管症状密切相关[21-25]。有学者发现,对于无症状人群,颈动脉斑块内出血、纤维帽破裂、大脂质核等斑块特征对于脑血管事件具有一定的预测价值[26-28]。一系列前瞻性研究显示,颈动脉存在斑块内出血或纤维帽破裂的脑血管病患者具有较高的复发风险[29-31]。

应用常规手段对IS患者进行筛查,仍有30%~40%的患者找不到明确原因[32],称为隐源性卒中。近来有学者对32例颈动脉存在偏心性斑块 (<50%狭窄) 的隐源性卒中患者进行MR管壁成像,发现12例 (37.5%) 存在易损斑块[33]。另有研究证实,一部分隐源性卒中患者其主动脉弓存在易损斑块[34]。这些研究结果提示我们,一部分"隐源性卒中"患者通过MR管壁成像有可能找到责任病变。

2 MR斑块成像优化再血管化治疗方案

根据《颅外段颈动脉狭窄治疗指南》,症状性颈动脉重度狭窄的患者需要进行颈动脉内膜剥脱术 (carotid endarterectomy, CEA) 或颈动脉支架植入术 (carotid artery stenting, CAS) [35]。血管的狭窄程度和斑块纤维帽破裂是决定患者是否需要手术治疗的两个主要指征。DSA是颈动脉粥样硬化患者手术适应证选择的主要影像学检查方法。DSA检查的优势在于可以清晰、动态地观察主动脉弓至颅内的血管床的病变情况,并可以将检查与治疗融于一体。但DSA对动脉粥样硬化病变的评估主要是判断血管狭窄程度,而对斑块形态学特点及组成成分的判断能力有限,即使可以显示斑块纤

维帽破裂，其敏感性和特异性也较低[36-37]。

在斜矢状位管壁成像序列的辅助下，颈动脉MR斑块成像能够较为准确地识别颈动脉斑块溃疡[38]。有学者[39]就磁共振成像 (magnetic resonance imaging, MRI) 和DSA对颈动脉粥样硬化患者手术适应证的选择能力进行了比较，发现MR管壁成像较DSA可以更准确地判断管腔狭窄程度，更敏感地检出溃疡斑块，从而有助于协助临床医生准确地确定患者是否需要手术治疗。尤其是当患者管腔狭窄程度为50%~70%时，是否需要手术治疗更主要地取决于是否存在斑块表面溃疡。此时，MRI对斑块表面溃疡的精确检出则有助于医生制订治疗方案。

颈动脉MR斑块成像可能有助于选择再血管化治疗的手术策略。对于颈动脉症状性重度狭窄的患者选择CEA还是CAS手术治疗一直存在争议。有研究表明，斑块内的不稳定成分（如脂质核和斑块内出血），与CAS术中微栓子的形成有密切的关系[40]。因此，通过MR斑块成像准确分析易损斑块特征，有可能预防围术期新发梗死。Yamada等[41]通过分析斑块与胸锁乳突肌的信号干扰比值 (signal to interference ratio, SIR)，发现当SIR≥1.25时，CAS手术出现微栓子的概率要明显高于CEA。研究者分析认为，这种信号强度的斑块多为富含脂质核或具有斑块内出血等成分，并提出对于这种类型的斑块适宜选择CEA。如果该结论能通过大样本的前瞻性研究得到进一步证实，则可借助MR成像对斑块成分的分析，得以指导手术方案的选择，提高患者的预后。

3 MR斑块成像监测颈动脉斑块他汀类药物治疗疗效

对于颈动脉粥样硬化轻中度狭窄的病变，临床一般采用他汀类药物治疗。MR斑块成像因其无创、无X线电离辐射、可重复性好等优势，是目前评价颈动脉斑块药物治疗疗效最为可靠的手段。Corti等[42]最早应用MR成像观察辛伐他汀治疗颈动脉斑块的疗效，经过2年的治疗，斑块的体积明显缩小、管腔增大。West等[43]则应用MR斑块成像观察股浅动脉斑块在单独使用依泽替米贝和联合使用他汀后的变化，结果发现，单独使用依泽替米贝并没有抑制斑块的进展，而在联合使用他汀药物的患者中，MR上测得的斑块体积在2年内没有进展。在Kawahara等[44]的研究中，应用MR斑块成像监测胸主动脉和腹主动脉斑块体积药物治疗前后的变化，结果发现阿托伐他汀和羟乙磷酸盐联合使用的效果要优于单独使用阿托伐他汀。有研究者对接受了半年他汀治疗的动脉粥样硬化患者同时应用超声和MR评估颈动脉斑块的治疗效果，结果发现，超声测得的颈动脉内中膜厚度在治疗前后并无显著性变化，而MR测得的斑块体积则明显缩小，提示MR检查在评价他汀类药物疗效方面可能比超声更有优势[45]。

近些年来随着3.0 T磁共振成像设备的广泛应用，除了斑块形态外，MR还能够准确定量分析斑块内成分，如脂质核、纤维帽、出血等。在一项利用MR监测他汀类药物长期治疗颈动脉粥样硬化病变的研究中，研究者发现，经过3年的治疗，颈动脉斑块内脂质核的体积和比例均明显缩小。其中治疗的第一年和第二年斑块脂质核体积逐渐缩小，而到了第三年，脂质核体积并未继续缩小，这可能会对未来临床制订他汀类药物长期治疗计划有所帮助[46]。此外，MR还可以使用一些特异造影剂观察斑块内特定成分在药物治疗过程中的变化，如用超小顺磁性超氧化铁颗粒 (ultrasmall superparamagnetic iron oxide, USPIO) 观察斑块内巨噬细胞的情况。Patterson等[47]研究表明，在使用阿托伐他汀治疗后，颈动脉斑块对于USPIO的摄取在12周内出现了下降，提示

斑块内炎症反应减弱。最近，有学者应用动态增强MR技术观察颈动脉斑块炎症在他汀类药物治疗前后的变化，经过1年的治疗，Ktrans值明显下降。这一点提示他汀类药物可能会降低斑块新生血管化的程度[48]。

尽管MR斑块成像对动脉粥样硬化斑块治疗具有一定的指导意义，但患者是否具有远期获益、能否明显降低脑血管事件还需大规模、前瞻性研究提供循证医学证据。尤其是对于那些轻中度狭窄但具有易损斑块特征的粥样硬化病变（如大脂质核、斑块内出血），需要临床加以关注。

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【点睛】
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