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脑磁共振灌注成像在大脑中动脉狭窄与闭塞患者中的应用价值分析*

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摘要 目的:研究脑磁共振灌注成像(PWI)在大脑中动脉(MCA)狭窄与闭塞患者中的应用价值。**方法:**纳入我院从2017年5月~2019年3月收治的单侧MCA狭窄与闭塞患者80例,对所有患者均实施经颅内数字减影血管造影(DSA)以及PWI检查,并将所有患者按照狭窄程度的不同分成轻度/中度组与重度/闭塞组。分析两组患者患侧与健侧大脑半球PWI相关参数,并作相关性分析。此外,分析PWI检查MCA狭窄或闭塞所致脑梗死类型分布情况。**结果:**DSA诊断结果显示:MCA轻度/中度狭窄患者35例,MCA重度/闭塞患者45例,其中MCA重度/闭塞的PWI检出率为100.00%,显著高于MCA轻度/中度狭窄的80.00%($P<0.05$)。MCA轻度/中度组、重度/闭塞组患者患侧大脑半球的平均通过时间(rMTT)、达峰时间(rTTP)均显著高于健侧(均 $P<0.05$)。经Spearman相关性分析可得:MCA患者狭窄程度与患侧大脑半球rMTT、rTTP均呈正相关关系(均 $P<0.05$)。PWI检查结果显示,80例患者共检查出脑梗死患者53例,其中重度/闭塞组脑梗死总检出率以及纹状体内囊区脑梗死检出率分别为82.22%、11.11%,均明显高于轻度/中度组的45.71%、0.00%(均 $P<0.05$)。**结论:**PWI应用于MCA狭窄与闭塞患者中的价值较高,可作为临床诊断MCA狭窄与闭塞的有效手段之一,值得临床推广应用。

关键词:大脑中动脉;脑磁共振灌注成像;狭窄;闭塞;应用价值

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Analysis of the Application Value of Perfusion-weighted Imaging in Patients with Middle Cerebral Artery Stenosis and Occlusion*

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ABSTRACT Objective: To study the value of perfusion-weighted imaging (PWI) in patients with middle cerebral artery (MCA) stenosis and occlusion. **Methods:** 80 patients with unilateral MCA stenosis or occlusion who were admitted to our hospital from May 2017 to March 2019 were included in the study. All patients were examined by intracranial digital subtraction angiography (DSA) and PWI, and they were divided into mild/moderate group and severe/occlusive group according to the degree of stenosis. PWI parameters in the affected and healthy cerebral hemispheres of the two groups were analyzed, and the correlation was analyzed. In addition, the distribution of types of cerebral infarction caused by MCA stenosis or occlusion was analyzed. **Results:** DSA diagnosis showed that 35 patients with mild/moderate MCA stenosis, and 45 patients with severe/occlusive MCA stenosis, among which the detection rate of severe/occlusive MCA stenosis of PWI was 100.00%, which was significantly higher than that of 80.00% of mild/moderate MCA stenosis ($P<0.05$). The mean transit time (rMTT) and time to peak (rTTP) of MCA patients in the mild/moderate group and the severe/occluder group were significantly higher than those in the healthy side (all $P<0.05$). Spearson correlation analysis showed that the stenosis degree of MCA patients were positively correlated with rMTT and rTTP in the affected cerebral hemisphere (all $P<0.05$). PWI showed that there were 53 patients with cerebral infarction in 80 patients, among which the total cerebral infarction detection rate in the severe/occlusive group and the cerebral infarction detection rate in the striatum internal capsule area were 82.22% and 11.11%, respectively, which were significantly higher than the 45.71% and 0.00% in the mild/moderate group (all $P<0.05$). **Conclusion:** PWI is of high value in patients with MCA stenosis and occlusion, and it can be used as an effective means of clinical diagnosis of MCA stenosis and occlusion. It is worthy of clinical application.

Key words: Middle cerebral artery; Perfusion-weighted imaging; Stenosis; Occlusion; Application value

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前言

大脑中动脉(Middle cerebral artery, MCA)主要是指从颈内动脉至单脑前动脉后的直接延续,主要供应大脑半球背侧面的2/3,包括额、顶、颞叶以及岛叶、壳核、苍白球、尾状核等部位^[1,2]。相关报道显示,MCA是脑动脉硬化累及风险最高的部位,且因MCA供血区域相对广泛,从而使得患者的临床表现特征以及脑缺血影像学表现复杂多样^[3-5]。目前,临床上用以诊断MCA狭窄或闭塞的影像学技术包括经颅多普勒、血管内超声、数字减影血管造影(Digital subtraction angiography, DSA)、CT血管造影、磁共振弥散成像、磁共振灌注成像等^[6,7]。其中DSA是目前国内外所公认的评估血管狭窄程度的金标准,可准确反映血管狭窄程度。然而,该诊断技术存在一定的放射性损伤,存在一定的局限性^[8-10]。脑磁共振灌注成像(Perfusion-weighted imaging, PWI)主要是通过外源性对比剂的静脉团注,采用分辨率相对较高且快速的磁共振成像(Magnetic Resonance Imaging, MRI),检测含有对比剂的血液初次流经受检组织致其信号强度随时间变化的情况,进一步反映组织的血流动力学信息,具有检查迅速、无辐射损伤以及空间分辨率较高等特点^[11,12]。鉴于此,本文通过研究PWI在MCA狭窄与闭塞患者中的应用价值,旨在为MCA狭窄与闭塞的临床诊治提供数据支持,现作以下报道。

1 资料与方法

1.1 一般资料

纳入我院从2017年5月~2019年3月收治的单侧MCA狭窄与闭塞患者80例进行研究。其中男性患者51例,女性患者29例,年龄43~87岁,平均年龄(66.23±7.52)岁;病程1~4年,平均病程(2.33±0.35)年。纳入标准:(1)所有患者均经DSA检查确诊为单侧MCA狭窄与闭塞;(2)均拟行PWI检查;(3)年龄均在18周岁以上;(4)无临床病历资料缺失。排除标准:(1)合并严重出血倾向或出血性疾病者;(2)伴有心、肝、肾等重要脏器受损者;(3)脑干功能衰竭或脑疝晚期者;(4)因血管炎、动脉夹层以及血管痉挛等引起的MCA主干狭窄者;(5)伴有系统性红斑狼疮以及红细胞增多等可能引发脑梗死危险因素者。纳入对象均在知情同意书上签字。

1.2 研究方法

(1)DSA检查:使用仪器为GE公司4100型数字减影血管造影系统,检查前实施常规消毒铺巾,选择腹股沟韧带下2cm作为穿刺点,穿刺角度与身体平面呈30~45°,针尖朝内侧倾斜10~20°。以Seldinger法实施股动脉穿刺置管,根据分布造影法观察患者主动脉弓和弓上大血管结构、开口情况,明确血管无狭窄后实施下一步操作。常规采用5F椎动脉导管实施选

择性全脑血管造影。造影剂选用300 mg/mL碘海醇,以高压注射器予以团注,控制流速为3~5 mL/s,充分显示血管影像。(2)PWI检查:使用仪器为飞利浦公司的philips-Ingenu 3.0T二代磁共振扫描仪,取横断面完成扫描基线的定位,扫描范围包括整个大脑、小脑,常规实施横断面T2加权成像,相关参数设置如下:TR/TE=4000/93 ms,视野为230 mm×208 mm,矩阵为227×256。确定无出血性脑血管病后实施脑PWI检测,扫描范围包括整个大脑、小脑,检查前于肘静脉处穿刺留置针,以自由衰减EPI序列,进行50次的扫描,并于第5次采集时,以高压注射器快速团注顺磁性对比剂Gd-DTPA,剂量为0.2 mmol/kg,流速为3 mL/s,注射完毕后通过相同的流率推注等量体积的生理盐水完成冲洗。扫描参数如下:反转角90°,TR/TE=1400/41 ms,层厚取5 mm,层间隔取2.5 mm,视野为230 mm×230 mm,矩阵为128×128。完成扫描后每个扫描层面获取50帧连续图片,用于数据分析。(3)PWI数据分析:将PWI数据传输至西门子影像工作站,通过PWI软件处理,获取时间强度曲线,自动计算获取脑血流量(Cerebral blood flow, rCBF)、脑血容量(Cerebral blood volume, rCBV)、平均通过时间(Mean transit time, rMTT)、达峰时间(Time to peak, rTTP)。由我院2位神经影像学医师共同对脑参数图予以定量和定性分析。(4)分组方式:将所有受试者按照DSA图像分析结果进行分组,狭窄标准采用北美症状新动脉内膜剥脱术试验法进行评估,测量标准如下:狭窄程度=[(狭窄远端动脉直径-最狭窄处直径)/狭窄远端动脉直径]×100%。将狭窄程度<70%记作轻度/中度狭窄,狭窄程度≥70%记作重度/闭塞。

1.3 观察指标

分析MCA狭窄或闭塞患者的DSA、PWI检出情况,对比MCA轻度/中度组、重度/闭塞组患者患侧与健侧大脑半球PWI相关参数,分析MCA患者狭窄程度和患侧大脑半球PWI相关参数的相关性,对比MCA狭窄或闭塞所致脑梗死类型分布情况。

1.4 统计学方法

数据的分析借助SPSS20.0软件完成,计数和(或)计量资料以[n(%)]和(或)($\bar{x} \pm s$)表示,予以 χ^2 和(或)t检验。相关性采用Spearman法进行分析, $P < 0.05$ 表示差异有统计学意义。

2 结果

2.1 MCA狭窄或闭塞患者的DSA、PWI检出情况分析

DSA诊断结果显示:MCA轻度/中度狭窄患者35例,MCA重度/闭塞狭窄患者45例,其中MCA重度/闭塞的PWI检出率为100.00%,显著高于MCA轻度/中度狭窄的80.00%($P < 0.05$),见表1。

表1 MCA狭窄或闭塞患者的DSA、PWI检出情况分析

Table 1 Detection condition analysis of DSA, PWI in patients with MCA stenosis or occlusion

Degree of MCA stenosis	Number of cases detected by DSA	Number of cases detected by PWI	Detection rate of PWI
Mild / moderate stenosis	35	28	80.00%
Severe / occlusion	45	45	100.00%
χ^2	-	-	9.863
P	-	-	0.002

2.2 MCA 轻度 / 中度组、重度 / 闭塞组患者患侧与健侧大脑半球 PWI 相关参数对比 MCA 轻度 / 中度组、重度 / 闭塞组患者患侧的 rMTT、rTTP 均显著高于健侧(均 $P < 0.05$), 见表 2。

表 2 MCA 轻度 / 中度组、重度 / 闭塞组患者患侧与健侧大脑半球 PWI 相关参数对比($\bar{x} \pm s$)

Table 2 Comparison of PWI related parameters between the affected side and the healthy side in MCA mild / moderate stenosis group, severe / occlusion group($\bar{x} \pm s$)

Groups		rCBV(mL/100g)	rCBF(mL/min/100g)	rMTT(s)	rTTP(s)
Mild / moderate group (n=35)	Affected side	1.14± 0.27	1.12± 0.29	1.04± 0.32	0.98± 0.04
	Healthy side	1.28± 0.30	1.27± 0.31	0.92± 0.11	0.92± 0.03
	t	0.665	1.896	2.098	7.099
	P	0.508	0.061	0.040	0.000
Severe / occlusion group (n=45)	Affected side	1.32± 0.34	1.12± 0.32	1.24± 0.33	1.09± 0.08
	Healthy side	1.32± 0.31	1.25± 0.36	0.94± 0.21	0.94± 0.10
	t	0.000	1.811	5.145	7.857
	P	1.000	0.074	0.000	0.000

2.3 MCA 狭窄或闭塞患者狭窄程度和患侧大脑半球 PWI 相关参数的相关性分析 程度与患侧大脑半球 rMTT、rTTP 均呈正相关关系 (均 $P < 0.05$), 见表 3。

经 Spearman 相关性分析可得:MCA 狭窄或闭塞患者狭窄

表 3 MCA 狭窄或闭塞患者狭窄程度与患侧大脑半球 PWI 相关参数的相关性分析

Table 3 Analysis of the correlation between the degree of stenosis and the parameters related to PWI in the affected side cerebral hemisphere in patients with MCA stenosis or occlusion

Parameters related to PWI	Degree of stenosis or occlusion in patients with MCA	
	r	P
rMTT	0.523	0.008
rTTP	0.517	0.015

2.4 MCA 狭窄或闭塞所致脑梗死类型分布情况对比 为 82.22%、11.11%, 均明显高于轻度 / 中度组的 45.71%、0.00%
80 例患者经 PWI 共检查出脑梗死患者 53 例, 其中重度 / (均 $P < 0.05$), 见表 4。
闭塞组脑梗死总检出率以及纹状体内囊区脑梗死检出率分别

表 4 MCA 狭窄或闭塞所致脑梗死类型分布情况对比 [例(%)]

Table 4 The distribution of type of cerebral infarction due to MCA stenosis or occlusion [n(%)]

Groups	n	Lacunar infarction	Watershed cerebral infarction	Cerebral infarction in the vesicle area of striatum	Cerebral infarction in River basin	Total
Mild / moderate group	35	12(34.29)	4(11.43)	0(0.00)	0(0.00)	16(45.71)
Severe / occlusion group	45	23(51.11)	7(15.56)	5(11.11)	2(4.44)	37(82.22)
χ^2	-	2.265	0.283	4.148	1.595	11.736
P	-	0.132	0.596	0.042	0.207	0.001

3 讨论

颅内动脉粥样硬化性狭窄是导致人群缺血性脑卒中的主要原因^[13,14], 特别是 MCA 狭窄在急性脑梗死患者中的发生率高达 35~50%^[15]。相关研究报道表明, MCA 狭窄是影响缺血性脑卒中的常见原因, 且 MCA 狭窄患者往往表现为反复短暂性

脑缺血发作或可逆性缺血性神经功能障碍, 发生完全性脑卒中的风险较高^[16-18]。由此可见, 正确诊断并评估 MCA 狭窄或闭塞程度, 明确其血流动力学状况, 有助于明确其发病机制, 从而为患者个性化治疗方案提供指导^[19-21]。DSA 是目前临床上用以评估脑血管狭窄、闭塞的金标准, 然而该检查方式仅能显示动脉的狭窄程度, 无法为医生提供患者的脑血流动力学信息^[22,23]。

因此,寻找一种更加有效的影像学检查方式显得尤为重要,亦是目前临床研究的热点。随着近年来相关研究的日益深入,越来越多的学者发现 PWI 作为一种新型影像学检查手段,不仅能够有效反映患者解剖以及功能信息,同时对脑组织血流动力学异常具有较高的敏感度^[24-26]。因此,PWI 开始被广泛应用于缺血性脑血管疾病的检查中。

本文结果发现,MCA 重度 / 闭塞的 PWI 检出率为 100.00%,显著高于 MCA 轻度 / 中度狭窄的 80.00% ($P < 0.05$)。赖穗翩的研究结果亦显示^[27]:单侧 MCA 轻中度狭窄患者 PWI 检查的异常灌注率为 80%,而重度狭窄或闭塞患者的 PWI 检查的异常灌注率为 100%。此外,MCA 轻度 / 中度组、重度 / 闭塞组患者患侧的大脑半球 rMTT、rTTP 均显著高于健侧 (均 $P < 0.05$)。分析原因,笔者认为 MCA 轻中度狭窄患者的脑灌注压可通过自身代偿机制维持相对稳定,脑局部微血管无显著扩张或轻度代偿性扩张,然而,该阶段的脑血流动力学已然发生改变。同时,MCA 重度狭窄或闭塞后,患者的脑组织进入失代偿阶段,从而会导致缺血脑组织的血液供应更加减少,进一步引起神经元功能异常的发生,加之脑组织缺血引起星形细胞肿胀压迫局部微血管,最终引起 rMTT、rTTP 的延迟。另有相关研究报道证实^[28,29]:在脑局部微血管因受压变窄或闭塞时,会引起局部微循环障碍,进一步会导致 rCBF、rCBV 的降低,rMTT、rTTP 的延迟。由此,建议在临床工作中可将 PWI 作为评价脑缺血状态的有效技术之一,从而为患者的治疗方案制定提供指导作用。另外,80 例患者共检查出脑梗死患者 53 例,其中重度 / 闭塞组脑梗死总检出率以及纹状体内囊区脑梗死检出率分别为 82.22%、11.11%,均明显高于轻度 / 中度组的 45.71%、0.00% (均 $P < 0.05$)。这也再次证实了 PWI 检查可有效鉴别诊断 MCA 狭窄或闭塞所致脑梗死,具有较高的临床应用价值。这在国外 Sohn 等的报道中也有类似的结论佐证^[30]。

综上所述,PWI 应用于 MCA 狭窄与闭塞患者诊断中的价值较高,可为 MCA 狭窄与闭塞患者的诊治提供参考依据。

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