

The Value of TCD in Predicting Intracerebral Hemorrhage after Acute Precirculatory Occlusion

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Abstract

Objective: To investigate the value of TCD in predicting intracerebral hemorrhage after acute anterior circulation occlusion. **Methods:** To collect all ischemic stroke patients with precirculatory vascular occlusion (2b-3 cerebral infarction) who were successfully treated with endovascular recanalization in Liaocheng Brain Hospital from November, 2017 to December, 2008. We reviewed their TCD examination of mean flow velocity index (MBF) in the contralateral and intra-operative middle cerebral artery (MCA) after intervention and analyzed its relationship with intracerebral hemorrhage and clinical outcomes after intervention. **Results:** a total of 44 patients were included in this study, 26 (59%) were male, 21 (48%) were middle cerebral occlusion, 9 (20%) were internal carotid artery occlusion, and 14 (32%) were internal carotid artery + middle cerebral artery occlusion. All patients underwent TCD examination within 14.6 ± 4.7 hours after the intervention, and underwent craniocerebral CT or MRI within 16.4 ± 5.8 hours. Among them, 8 patients (18%) had substantial intracerebral hemorrhage after the intervention, all of which occurred on the operative side. In 90 days of MRS, 18 patients recovered well (MRS 0-2), 26 patients had poor prognosis (MRS 3-6), and 4 patients died (MRS 6). Among the patients in the study, admission NIHSS score was higher for bleeding after acute stroke intervention than for non-bleeding patients ($P = 0.034$). There was no significant difference in gender, age, hypertension, diabetes, smoking, drinking and recanalization time between bleeding and non-bleeding patients. In the 90-day prognosis, patients with bleeding had a worse prognosis (MRs 3-6 $P = 0.011$). In the TCD test, the comparison of MBF between the bleeding group and the non-bleeding group was statistically significant (1.45 vs. 1.06 $P < 0.001$). **Conclusion:** MBF velocity index of MCA was higher after treatment of anterior circulation occlusive recanalization, suggesting a lower risk and prognosis of ICH after intervention.

Keywords

Acute Precirculation Occlusion, Transcranial Doppler Ultrasound, Hemodynamics

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TCD在急性前循环闭塞机械取栓术后预测脑出血的价值

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摘要

目的: 探讨TCD对急性前循环闭塞机械取栓术后预测脑出血的应用价值。**方法:** 搜集2017.11~2018.12于聊城市脑科医院所有成功血管内再通治疗前循环血管闭塞(脑梗死2b-3)的缺血性卒中患者。我们回顾了他们介入后对侧和术侧大脑中动脉(MCA)平均血流速度指数(MBF)的TCD检查, 并分析其与介入后脑出血和临床结果的关系。**结果:** 本研究共纳入急性前循环闭塞成功行机械取栓的患者44例, 26例(59%)为男性患者, 纳入的患者中有21例(48%)为大脑中闭塞, 9例(20%)为颈内动脉闭塞, 14例(32%)颈内动脉 + 大脑中动脉闭塞。所有患者在介入术后 14.6 ± 4.7 小时内行TCD检查, 并在 16.4 ± 5.8 小时内行颅脑CT或MRI, 其中有8例(18%)术后出现实质性脑出血, 脑出血均出现在术侧。90天MRS中, 有18例患者恢复良好(MRS 0-2), 26例患者患者预后不良(MRS 3-6), 4例患者最终死亡(MRS 6)。研究的患者中, 急性卒中介入术后出血比非出血的患者入院NIHSS评分更高($P = 0.034$)。出血与非出血患者在性别、年龄、高血压、糖尿病、吸烟、饮酒、再通时间上无统计学意义。在90天预后中, 出血患者的预后更差(MRS 3-6, $P = 0.011$)。TCD检查中, 在出血组和非出血组中, MBF的比较有统计学意义(1.45 vs. 1.06 , $P < 0.001$)。结论: 在前循环闭塞再通治疗后, MCA的MBF速度指数较高, 提示介入后ICH的风险和预后较差。

关键词

急性前循环闭塞, 经颅多普勒超声, 血流动力学

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1. 引言

目前世界上超过 30%的脑卒中是由于大动脉阻塞引起的前循环急性缺血性卒中, 其临床表现更为严重, 预后更差[1] [2]。五大随机试验显示当血管内治疗(EVT)结合静脉溶栓(IVT)与单独静脉溶栓治疗相比, 可以为大动脉阻塞患者带来更好的治疗效果[3] [4] [5] [6] [7]。随着技术的发展, 机械取栓的再通率可高达 90% [8], 但患者仍会出现术后脑出血(ICH), 导致患者预后较差[9] [10]。近年来, 有研究者通过动脉

自旋技术(ASL)探讨急性前循环缺血性脑卒中(AIS)高灌注与出血转化(HT)的关系,发现术后高灌注与出血转化有关[11] [12]。经颅多普勒超声(TCD)可以检测血流动力学,因此作者猜测 TCD 也可以通过术后动态检测患者的血流速度预测患者术后 ICH 的风险及预后。本研究通过 TCD 检测急性前循环缺血性脑卒中患者术后血流速度的变化与 ICH 及预后的关系。

2. 对象及方法

2.1. 对象

回顾性纳入 2017.11~2018.12 于聊城市脑科医院血管外科行支架取栓及桥接取栓的急性前循环闭塞(即颈内动脉和/或大脑中动脉急性闭塞)的患者 44 例,其中男性患者 26 例,女性患者 18 例;年龄 37~82 岁,平均 64 ± 10 岁。经 DSA 证实,颈内动脉闭塞 9 例,大脑中动脉闭塞 21 例,颈内动脉和大脑中动脉串联闭塞患者 14 例。本研究方案经聊城市脑科医院伦理委员会批准,患者或其家属均签署了手术知情同意书。

2.2. 纳入标准及排除标准

纳入标准: 1) 年龄 ≥ 18 岁; 2) 经 DSA 检查证实为前循环大血管闭塞,均为单侧; 3) 发病 ≤ 6 h; 4) 发病前改良 Rankin 量表(mRs)评分 < 2 分; 5) 双侧颞窗透声良好; 6) 经 solitaire 支架取栓后,血流再灌注达改良脑梗死溶栓(mTICI)分级 2b-3 级。排除标准: 1) 经 DsA 检查大脑中动脉为慢性闭塞; 2) 头部 CT 显示出血或大面积脑梗死(超过大脑半球 1/3)。

2.3. TCD 检查方法

TCD 采用 RIMED Digi-lite, 选用 2.0 HZ 探头。由经验丰富的超声科医师于患者的颞窗探查患者大脑中动脉,记录患者术后第 1 天的大脑中动脉的 Vm。为了排除个体间血流速度的生理差异,并排除可能影响单个 MBF 的因素(如红细胞压积、血压、心率),我们还计算了同侧(即再通)的结果除以对侧 MCA Vm 速度。若 DSA 提示患者术后血流通畅(mTICI 2b-3 级),TCD 示血管闭塞或流速较高,由 3 名以上的超声科医师复查,若仍提示狭窄或闭塞或出血风险,则及时复查 CT、CTA 或 DSA。

2.4. 手术方式

取栓操作均由经验丰富的介入放射科医生使用 Solitaire 支架取栓进行,具体手术方式:于股动脉置入 8F 或 6F 股动脉鞘管,将 5F NAVI 或 6F NAVI 中间导管置入颈内动脉,将 Rober18 微导管通过闭塞处,将 Solitaire 支架置入闭塞远端后释放,边抽吸边撤出支架。对介入后残余狭窄 $> 50\%$ 的患者进行球囊扩张,仍局限性狭窄的患者进行支架置入术,介入后再通状态以脑梗死溶栓分级表进行分级。mTICI 等级为 2b-3 个定义为成功再通。所有血管内手术均由专职神经麻醉师在全身麻醉下进行。所有的患者在介入治疗后都在我们的卒中病房或神经重症监护病房接受了密切的血压监测。

2.5. 研究方法及颅内出血(ICH)的定义

所有患者入院后 24 小时及出院时均行颅脑 MRI/CT 检查。如果发生神经功能恶化(1 类中 NIHSS 评分增加 > 2 分或总分增加 4 分),立即行 CT/MRI 排除卒中复发或颅内出血(ICH)。患者出院后 3 个月采用改良 Rankin 量表(mRS)对神经综合征及功能状态进行评估[13]。TCD 在术后 24 H 内评估血管通畅程度和脑血流动力学;再狭窄时,经 CTA/磁共振血管造影确诊。

ICH 是在广泛应用海德堡出血分类(Heidelberg Bleeding Classification HBC)后定义的,将颅内出血分

为出血转化、实质出血、脑室出血、蛛网膜下腔出血和硬膜下出血[14]。有症状性脑出血定义为患者症状的恶化。最近的调查，症状恶化定义为美国国立卫生研究院(National Institutes of Health)脑卒中量表(NIHSS)评分增加 2 分，或总分增加 4 分[14] [15]。

2.6. 统计分析

使用 SPSS 23.0 进行统计分析。分类变量使用 χ^2 比较。对于连续变量，采用 Kolmogorov-Smirnov 检验检验高斯分布。如果确定为高斯分布，则使用 t 检验比较分组(“出血”和“非出血”)。若不服从高斯分布，则采用 Mann-Whitney U 检验。对 MCA MBF 指数采用多元线性 logistic 回归分析，并对所有患者的 MBF 进行回归分析并计算 r 值，P 值 < 0.05 为差异有统计学意义。

3. 结果

本研究共纳入急性前循环闭塞成功行机械取栓的患者 44 例，26 例(59%)为男性患者，纳入的患者中有 21 例(48%)为大脑中闭塞，9 例(20%)为颈内动脉闭塞，14 例(32%)颈内动脉 + 大脑中动脉闭塞。入院 NIHSS 评分中位数为 22(范围 2~40)。入院年龄、性别、高血压、糖尿病、吸烟、饮酒、入院再通时间比较见表 1。

所有患者在介入术后 14.6 ± 4.7 小时内行 TCD 检查，并在 16.4 ± 5.8 小时内行颅脑 CT 或 MRI，其中有 8 例(18%)术后出现实质性脑出血，脑出血均出现在术侧。90 天 MRS 中，有 18 例患者恢复良好(MRS 0-2)，26 例患者预后不良(MRS 3-6)，4 例患者最终死亡(MRS 6)。

本研究的患者中，急性卒中介入术后出血比非出血的患者入院 NIHSS 评分更高(P = 0.034)。出血与非出血患者在性别、年龄、高血压、糖尿病、吸烟、饮酒、再通时间无统计学意义。在 90 天预后中，出血患者的预后更差(MRS 3-6, P = 0.011) (表 2)。

TCD 检查中，在出血组和非出血组中，MBF 的比较有统计学意义(1.45 vs. 1.06, P < 0.001) (表 3)。

Table 1. Comparison of basic data after stent removal in patients with acute precirculation occlusion

表 1. 急性前循环闭塞患者支架取栓术后基础资料比较

临床资料	例数(n = 44)	介入后出血(n = 8)	介入后非出血(n = 36)	P 值
年龄	64.0 ± 10.4	63.3 ± 14.0	64.1 ± 9.8	P = 0.824
男性(n%)	26 (59.0)	4 (50.0)	22 (61.1)	P = 0.563
高血压(n%)	28 (63.6)	7 (87.5)	21 (58.3)	P = 0.121
糖尿病(n%)	9 (20.5)	3 (37.5)	6 (16.7)	P = 0.186
吸烟(n%)	18 (40.9)	2 (25.0)	16 (44.4)	P = 0.312
饮酒(n%)	19 (43.2)	3 (37.5)	16 (44.4)	P = 0.720
大脑中闭塞(n%)	21 (47.7)	3 (37.5)	18 (50.0)	P = 0.522
颈内闭塞(n%)	9 (20.5)	1 (12.5)	8 (22.2)	P = 0.445
大脑中 + 颈内闭塞(n%)	14 (31.8)	4 (50.0)	19 (52.8)	P = 0.222
入院 NIHSS 评分(n%)	22 (6-38)	31.5 (12-38)	22 (2-34)	P = 0.034
再通时间	256 ± 52.31	272.5 ± 40.97	247 ± 52.23	P = 0.070
桥接治疗(n%)	30 (68.2)	5 (62.5)	25 (69.4)	P = 0.702

Table 2. Comparison of 90-day prognosis and mean middle cerebral artery ratio in patients with acute precirculation occlusion
表 2. 急性前循环闭塞患者 90 天预后与平均大脑中动脉比值比较

	例数(%)	介入后出血(%)	介入后非出血(%)	P 值
mRS (0-2)	18 (40.9)	2 (25)	16 (44.4)	P = 0.020
mRS (3-6)	26 (52.3)	6 (37.5)	20 (52.8)	P = 0.011

Table 3. Comparison of mean velocity ratio in the brain after stenting with or without bleeding in patients with acute precirculation occlusion
表 3. 急性前循环闭塞患者支架取栓术后大脑中平均流速比值与是否出血比较

	介入后出血	介入后非出血	P 值
大脑中平均流速比值	1.45 ± 0.08	1.06 ± 0.15	P < 0.001

4. 讨论

近年来机械取栓的安全性、快速性和有效性得到认可,已成为大血管急性闭塞缺血性脑卒中患者的首选治疗方案[3] [4] [5] [6] [7]。然而仍有一定比例的机械取栓患者预后较差,脑卒中再灌注治疗急性期严重并发症(静脉溶栓和机械取栓)为 ICH,其常见原因是血脑屏障破坏和脑血流自动调节功能丧失所致的再灌注损伤[9] [14] [15] [16]。

最近的一项研究探讨血管内治疗急性缺血性脑卒中前循环闭塞患者与术后脑出血的关系。该研究纳入 123 例前循环闭塞并行血管内治疗的患者,术后有 18 例发生脑出血,采用 TCD 监测术后开通侧大脑中动脉 Vm 速度,发现大脑中动脉 Vm 增加与术后脑出血有关[17]。本研究结果中 TCD 显示再通后出现脑出血的患者 MCA MBF 速度指数显著升高,与未出血患者之间的差异具有统计学意义(1.45 VS 1.06, P < 0.001),而且,MBF 速度指数也与患者 90 天预后有关,与其研究结果相符。

研究已经表明,高血压和大面积脑梗死与术后脑出血密切相关[9] [15] [18]。本研究显示高血压与术后脑出血无统计学意义(P = 0.121),可能与术中及术后应用尼莫地平控制血压、缓解脑血管痉挛,术后还应用依达拉奉清除氧自由基,降低了高血压造成术后脑出血的发生。

既往研究认为,TCD 上的血流速度在健康者和急性脑卒中患者中具有较大个体间差异[19] [20]。虽然研究中脑出血患者同侧 MCA 中 Vm 速度显著增加,但很难确定临界点。因此,我们计算了同侧 MCA Vm 速度除以对侧 MCA Vm 速度,发现机械取栓成功治疗急性前循环血管闭塞患者,同侧 MCA MBF 速度升高(平均 39%)与脑出血之间存在显著的相关性。

TCD 已越来越多地应用于脑卒中的研究,早期的研究使用 TCD 评估脑大血管溶栓后的通畅性或烟雾病术后的血流动力学变化[21] [22] [23]。在急性和慢性狭窄闭塞过程中,血管重建后的病理生理机制可能不同。在临床情况下,这两种情况的共同之处在于,都表现出血流动力学失调。在这种情况下,TCD 比 MRI 更容易实施[24] [25],本研究表明 TCD 超声检查可以检测血管内再通治疗后 MCA 的血流动力学变化。

TCD 可以实时监测 MCA 血流动力学,比 MRI 更容易,也可重复检测,与 CTA 具有较高的一致性,但会受到患者颞窗通透性的影响。且早期研究报道,由于导管的局部刺激,局部内皮反应或血管痉挛可以引起 MCA 的血流动力学改变[26] [27]。近来有研究采用 ASL 动脉自旋标记技术,发现术后高灌注与出血转化有关,以后的研究可以将 TCD 与灌注技术结合起来[11] [12]。本研究仅为单中心回顾性研究,样本量较少,有一定的局限性。因此,本研究结果尚有待于进一步探讨和验证。

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