

DOI: 10.16781/j.CN31-2187/R.20230183

· 论 著 ·

D-二聚体对前循环大血管闭塞急性缺血性脑卒中血管内治疗预后不良的预测价值

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[摘要] **目的** 探索前循环大血管闭塞急性缺血性脑卒中(AIS-LVO)患者行血管内治疗(EVT)后预后不良的危险因素,明确D-二聚体对前循环AIS-LVO行EVT后预后不良的预测价值。**方法** 选取2018年12月至2022年12月在河北省人民医院神经内科住院并行EVT的前循环AIS-LVO患者作为研究对象,根据术后90d改良Rankin量表(mRS)评分分为预后良好组(mRS评分0~2分)和预后不良组(mRS评分3~6分)。收集研究对象的术前Alberta脑卒中计划早期计算机断层扫描评分(ASPECTS)、术前美国国立卫生研究院卒中量表(NIHSS)评分、术前格拉斯哥昏迷量表评分、术后即刻改良脑梗死溶栓(mTICI)分级、一般资料、实验室资料等,采用二元logistic回归方法分析前循环AIS-LVO患者行EVT后预后不良的影响因素,绘制ROC曲线评价D-二聚体对预后不良的预测价值。**结果** 共纳入143例行EVT的前循环AIS-LVO患者,其中预后不良组54例、预后良好组89例。与预后不良组相比,预后良好组患者的年龄小、糖尿病史占比低、术前NIHSS评分低、术前ASPECTS及格拉斯哥昏迷量表评分高、术后即刻mTICI分级为2b~3级的占比高、术前D-二聚体水平低,差异均有统计学意义(P 均 <0.05);二元logistic回归分析显示,术前NIHSS评分($OR=1.096$, 95% CI 1.007~1.193)、术后即刻mTICI分级($OR=19.609$, 95% CI 5.354~71.815)、术前D-二聚体水平($OR=1.310$, 95% CI 1.128~1.521)是前循环AIS-LVO行EVT患者预后不良的独立危险因素;D-二聚体对前循环AIS-LVO患者EVT预后不良的ROC曲线AUC为0.642(95% CI 0.540~0.745)。**结论** 术前NIHSS评分、术后即刻mTICI分级、术前D-二聚体水平升高是前循环AIS-LVO患者行EVT后预后不良的独立危险因素,术前D-二聚体水平升高的AIS-LVO患者行EVT后的预后可能较差。

[关键词] 脑梗死;前循环;大动脉闭塞;血管内治疗;D-二聚体;预后

[引用本文] 解燕昭,马良,韩凝,等. D-二聚体对前循环大血管闭塞急性缺血性脑卒中血管内治疗预后不良的预测价值[J]. 海军军医大学学报, 2023, 44(10): 1179-1185. DOI: 10.16781/j.CN31-2187/R.20230183.

Predictive value of D-dimer for poor prognosis of anterior circulation acute ischemic stroke with large-vessel occlusion after endovascular treatment

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[Abstract] **Objective** To explore the risk factors of poor prognosis of anterior circulation acute ischemic stroke with large-vessel occlusion (AIS-LVO) patients after endovascular therapy (EVT), so as to determine the predictive value of D-dimer for poor prognosis of anterior circulation AIS-LVO patients after EVT. **Methods** Anterior circulation AIS-LVO patients who received EVT and hospitalized in the Department of Neurology, Hebei General Hospital from Dec. 2018 to Dec. 2022 were enrolled. According to the 90-d modified Rankin scale (mRS) score after operation, they were assigned to good prognosis group (mRS score of 0-2) or poor prognosis group (mRS score of 3-6). Preoperative Alberta Stroke Program early computed tomography score (ASPECTS), preoperative National Institutes of Health stroke scale (NIHSS) score, preoperative Glasgow coma scale score, immediate postoperative modified thrombolysis in cerebral infarction (mTICI) grade, general data, and laboratory data of anterior circulation AIS-LVO patients were collected. Binary logistic regression was used to analyze the influencing factors of poor prognosis in anterior circulation AIS-LVO patients after EVT, and receiver operating characteristic (ROC) curve was used to evaluate the predictive value of D-dimer for poor prognosis. **Results** A total of 143 patients with anterior circulation AIS-LVO undergoing EVT were enrolled, with 54 patients in the poor prognosis group and 89 in the good prognosis group. Compared with the poor prognosis group, patients in the good prognosis group had younger age, lower proportion of diabetes mellitus, lower preoperative NIHSS score, higher preoperative ASPECTS and Glasgow coma scale score,

[收稿日期] 2023-04-08

[接受日期] 2023-09-20

[基金项目] 河北省医学科学研究课题(20210914, 20230293)。Supported by Medical Research Project of Hebei Province (20210914, 20230293).

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higher proportion of immediate postoperative mTICI grade 2b-3, and lower preoperative D-dimer level (all $P < 0.05$). Binary logistic regression analysis showed that preoperative NIHSS score (odds ratio [OR] = 1.096, 95% confidence interval [CI] 1.007-1.193), immediate postoperative mTICI grading (OR = 19.609, 95% CI 5.354-71.815) and preoperative D-dimer level (OR = 1.310, 95% CI 1.128-1.521) were independent risk factors for poor prognosis in anterior circulation AIS-LVO patients receiving EVT. The area under the ROC curve value of D-dimer for the the poor prognosis of anterior circulation AIS-LVO patients after EVT was 0.642 (95% CI 0.54-0.745). **Conclusion** Preoperative NIHSS score, immediate postoperative mTICI grading and higher preoperative D-dimer level are independent risk factors for poor prognosis in anterior circulation AIS-LVO patients after EVT. AIS-LVO patients with elevated D-dimer levels before surgery may have a poor prognosis after EVT.

[**Key words**] cerebral infarction; anterior circulation; large artery occlusion; endovascular treatment; D-dimer; prognosis

[**Citation**] XIE Y, MA L, HAN N, et al. Predictive value of D-dimer for poor prognosis of anterior circulation acute ischemic stroke with large-vessel occlusion after endovascular treatment[J]. Acad J Naval Med Univ, 2023, 44(10): 1179-1185. DOI: 10.16781/j.cn31-2187/R.20230183.

脑卒中具有发病率高、致残率高、死亡率高的特点,给社会及患者家庭带来沉重的负担^[1]。在前循环大血管闭塞急性缺血性脑卒中(acute ischemic stroke with large-vessel occlusion, AIS-LVO)患者脑梗死发生的6 h内采用血管内治疗(endovascular treatment, EVT)是目前治疗AIS-LVO的最有效手段,可明显降低致残率^[2-4]。虽然DAWN研究和DEFUSE 3研究将EVT的时间窗从发病6 h延长至24 h^[5-6],但EVT对时间窗、先进仪器设备、高水平手术医师仍存在高度依赖,这导致基层卫生机构尚不具备独立完成EVT的条件,通过EVT受益的AIS-LVO患者数量有限。因此,早期预测AIS-LVO患者预后对患者的转运及干预方法的选择意义重大。本研究通过收集前循环AIS-LVO行EVT患者的一般资料及临床资料,探索AIS-LVO行EVT患者的预后影响因素,明确D-二聚体对前循环AIS-LVO行EVT后预后不良的预测价值,以期为AIS-LVO患者早期治疗方案的选择提供依据。

1 资料和方法

1.1 研究对象 回顾性选择2018年12月至2022年12月在河北省人民医院神经内科住院的143例行EVT的前循环AIS-LVO患者作为研究对象。纳入标准:(1)脑梗死的诊断符合《中国急性缺血性脑卒中诊治指南2018》^[7];(2)年龄18~85岁;(3)发病6 h内,或发病6~24 h、但经严格的影像学筛选符合DAWN研究或DEFUSE 3研究的标准^[5-6];(4)数字减影血管造影(digital subtraction angiography, DSA)证实前循环大血管闭塞;

(5)接受EVT。排除标准:(1)重要器官严重功能障碍;(2)具有明确出血倾向者;(3)患有恶性肿瘤且预期生存时间 < 90 d。

1.2 研究方法

1.2.1 实验分组 将所有入组患者根据术后90 d改良Rankin量表(modified Rankin scale, mRS)评分分为预后良好组(mRS评分0~2分)和预后不良组(mRS评分3~6分)。通过门诊复诊或电话询问的方式获取随访资料。

1.2.2 手术治疗 所有患者在术前完成临床病情及影像学评估,由2名以上神经介入医师及影像科医师共同进行术前评估。充分向患者及家属交代EVT手术风险及获益,签署手术知情同意书。在局部麻醉或全身麻醉下采取右侧股动脉置管术,行全脑DSA检查,明确前循环大血管闭塞情况以及是否为本次脑梗死责任血管,评价患者血管闭塞机制后选取合适微导丝和/或微导管到达目标血管进行EVT。根据EVT后的前向血流情况,酌情进行球囊扩张和/或支架置入。所有患者经DynaCT检查未见颅内出血、严重水肿等情况后,结束手术。见图1。

1.2.3 评价手段 采用美国国立卫生研究院卒中量表(National Institutes of Health stroke scale, NIHSS)评分评估患者脑梗死病情严重程度^[8];采用Alberta脑卒中计划早期计算机断层扫描评分(Alberta Stroke Program early computed tomography score, ASPECTS)评估脑梗死范围及体积^[9];采用格拉斯哥昏迷量表评分评估患者意识障碍程度;机械取栓术后血管再通情况按改良脑梗死溶栓(modified thrombolysis in cerebral infarction, mTICI)分级评价,mTICI 2b、3级定义为血管再

通^[10-11];采用mRS评分衡量脑梗死后患者的神经功能恢复情况。mRS评分0分表示完全无症状,无任何功能受限;1分表示尽管有症状,但未明显残障,能完成所有正常职责和活动;2分表示轻度残障,能独立处理个人事务;3分表示中度残障,生

活需要一些协助,但可独立行走;4分表示重度残障,需在他人辅助下行走,不能照顾自己身体所需;5分表示严重残障,长期卧床,需要持续护理及照顾;6分表示死亡^[12]。

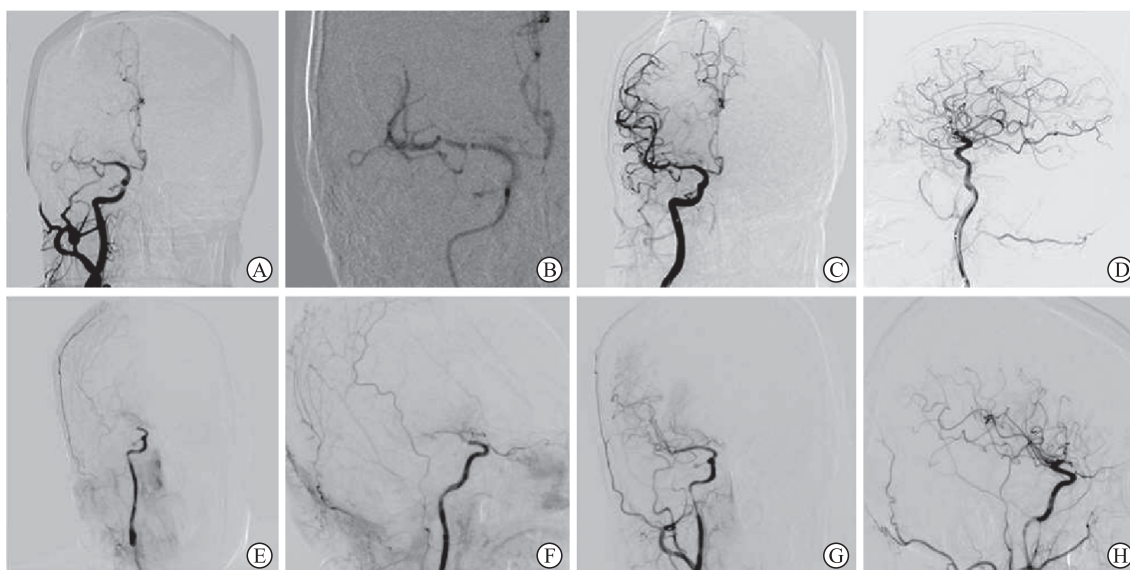


图1 2例前循环 AIS-LVO 患者行 EVT 前后的 DSA 影像图

Fig 1 DSA images of 2 patients with anterior circulation AIS-LVO before and after EVT

A-D: A 63-year-old male patient was unable to move his left limbs for 5.5 h. The pre-onset mRS score was 0, and the baseline NIHSS score was 14. According to the patient’s history of hypertension and smoking, combined with the conditions during surgery, TOAST classification of the patient was considered as large-artery atherosclerosis. A: Preoperative DSA showed the right middle cerebral occlusion; B: After thrombectomy, mTICI grade was 2a, and the right middle cerebral artery also showed severe residual stenosis; C, D: After balloon dilation surgery, blood flow in the middle cerebral artery was free and mTICI grade was 3. E-H: A 56-year-old female patient suffered from a sudden loss of consciousness for 7 h. The pre-onset mRS score was 0, and the baseline NIHSS score was 19. According to the patient’s history of atrial fibrillation and the conditions during surgery, TOAST classification of the patient was considered as cardioembolism. E, F: Preoperative DSA showed the right internal carotid artery occlusion; G, H: After EVT, blood flow in the internal carotid artery was free and mTICI grade was 3. AIS-LVO: Acute ischemic stroke with large-vessel occlusion; EVT: Endovascular treatment; DSA: Digital subtraction angiography; mRS: Modified Rankin scale; NIHSS: National Institutes of Health stroke scale; TOAST: Trial of Org 10172 in Acute Stroke Treatment; mTICI: Modified thrombolysis in cerebral infarction.

1.2.4 资料收集 所有入组患者均在行 EVT 前完成头颅 CT 或 MRI 检查,同时行头颅磁共振血管造影(magnetic resonance angiography, MRA)或计算机断层扫描血管造影(computed tomography angiography, CTA)评估患者颅内大血管情况。收集患者的一般资料如年龄、性别、吸烟史、饮酒史、高血压病史、糖尿病史、冠心病史、心房颤动史、脑卒中史等,收集 EVT 前的 ASPECTS、NIHSS 评分、格拉斯哥昏迷量表评分、发病至血管再通时间(包括成功再通及部分再通)。行 EVT 前采集静脉血,收集血糖、丙氨酸转氨酶、白蛋白、肌酐、尿素、甘油三酯、总胆固醇、高密度

脂蛋白胆固醇、低密度脂蛋白胆固醇、D-二聚体等实验室检查资料,根据 EVT 术中所见进行 Org 10172 急性脑卒中治疗试验(Trial of Org 10 172 in Acute Stroke Treatment, TOAST)病因分型。吸烟史定义为连续吸烟时间>1 年,吸烟≥1 支/d;饮酒史定义为每月饮酒≥1 次或连续饮酒时间>6 个月。

1.3 统计学处理 应用 SPSS 22.0 软件进行统计学分析。符合正态分布的计量资料以 $\bar{x} \pm s$ 表示,两组间比较采用独立样本 *t* 检验;不符合正态分布的计量资料以中位数(下四分位数,上四分位数)表示,两组间比较采用非参数检验。计数资料以例数或百分数表示,两组间比较采用 χ^2 检验。对单因素

分析中差异有统计学意义的变量采用二元 logistic 回归分析,筛选预后的影响因素。使用 ROC 曲线评价影响因素对患者预后不良的预测价值。检验水准 (α) 为 0.05。

2 结果

2.1 一般资料 本研究共纳入 143 例行 EVT 的前循环 AIS-LVO 患者,男 96 例 (67.1%)、女 47 例

(32.9%), 年龄 22~83 岁。根据术后 90 d mRS 评分,分为预后良好组 89 例 (mRS 评分 0~2 分) 和预后不良组 54 例 (mRS 评分 3~6 分)。两组患者的年龄、糖尿病史差异有统计学意义 (P 均 < 0.05), 预后良好组的年龄较小,糖尿病患者比例更低; 两组患者的性别、吸烟史、饮酒史、高血压病史、冠心病史、心房颤动史、脑卒中史的差异无统计学意义 (P 均 > 0.05)。见表 1。

表 1 行 EVT 的两组前循环 AIS-LVO 患者一般资料比较

Tab 1 Comparison of general data between 2 groups of patients with AIS-LVO undergoing EVT

Index	Total N=143	Good prognosis N=89	Poor prognosis N=54	Statistic	P value
Age/year, $M(Q_L, Q_U)$	64.0 (55.0, 70.0)	62.0 (53.0, 68.0)	66.5 (57.0, 76.0)	$Z = -2.652$	0.008
Male, n (%)	96 (67.1)	56 (62.9)	40 (74.1)	$\chi^2 = 1.895$	0.169
Smoking, n (%)	72 (50.3)	47 (52.8)	25 (46.3)	$\chi^2 = 0.57$	0.450
Drinking, n (%)	21 (14.7)	12 (13.5)	9 (16.7)	$\chi^2 = 0.272$	0.602
Hypertension, n (%)	69 (48.3)	44 (49.4)	25 (46.3)	$\chi^2 = 0.133$	0.715
Diabetes mellitus, n (%)	56 (39.2)	28 (31.5)	28 (51.9)	$\chi^2 = 5.865$	0.015
Coronary heart disease, n (%)	61 (42.7)	39 (43.8)	22 (40.7)	$\chi^2 = 0.130$	0.718
Atrial fibrillation, n (%)	30 (21.0)	19 (21.3)	11 (20.4)	$\chi^2 = 0.019$	0.889
Stroke history, n (%)	39 (27.3)	27 (30.3)	12 (22.2)	$\chi^2 = 1.116$	0.291

EVT: Endovascular treatment; AIS-LVO: Acute ischemic stroke with large-vessel occlusion; $M(Q_L, Q_U)$: Median (lower quartile, upper quartile).

2.2 临床资料 与预后不良组比较,预后良好组患者的术前 NIHSS 评分低、术前 ASPECTS 及格拉斯哥昏迷量表评分高、术前 D-二聚体水平低、术后即刻 mTICI 分级 2b~3 级占比高。两组间 TOAST

分型、发病至血管再通时间及术前的空腹血糖、白蛋白、肌酐、尿素、甘油三酯、总胆固醇、高密度脂蛋白胆固醇、低密度脂蛋白胆固醇、丙氨酸转氨酶差异无统计学意义 (P 均 > 0.05)。见表 2。

表 2 行 EVT 的两组前循环 AIS-LVO 患者临床资料比较

Tab 2 Comparison of clinical data between 2 groups of patients with AIS-LVO undergoing EVT

Index	Total N=143	Good prognosis N=89	Poor prognosis N=54	Statistic	P value
Preop NIHSS score, $M(Q_L, Q_U)$	14.00 (10.00, 21.00)	12.00 (8.50, 16.00)	21.00 (13.75, 35.00)	$Z = -4.851$	<0.001
TOAST type, n (%)					
Large-artery atherosclerosis	114 (79.7)	68 (76.4)	46 (85.2)	$\chi^2 = 1.603$	0.206
Cardioembolism	29 (20.3)	21 (23.6)	8 (14.8)		
Immediate Postop mTICI grade 2b-3, n (%)	124 (86.7)	83 (93.3)	41 (75.9)	$\chi^2 = 8.763$	0.003
Preop ASPECTS, $M(Q_L, Q_U)$	8 (7, 10)	9 (7, 10)	8 (5, 10)	$Z = -1.967$	0.049
Preop Glasgow coma scale score, $M(Q_L, Q_U)$	13.0 (9.0, 15.0)	15.0 (11.0, 15.0)	10.0 (4.5, 15.0)	$Z = -4.269$	<0.001
Onset-to-recanalization time/min, $M(Q_L, Q_U)$	429.00 (338.00, 534.00)	424.00 (322.00, 528.50)	435.50 (369.25, 538.25)	$Z = -1.605$	0.108
Preop FBG/(mmol·L ⁻¹), $M(Q_L, Q_U)$	6.20 (5.11, 8.90)	5.94 (5.05, 8.33)	6.48 (5.23, 9.50)	$Z = -0.802$	0.423
Preop ALT/(U·L ⁻¹), $M(Q_L, Q_U)$	16.30 (12.20, 23.60)	15.90 (12.00, 21.35)	17.95 (13.65, 27.23)	$Z = -1.772$	0.076
Preop albumin/(g·L ⁻¹), $\bar{x} \pm s$	37.41 ± 5.30	37.78 ± 4.81	36.81 ± 6.03	$t = 1.056$	0.293
Preop creatinine/(μmol·L ⁻¹), $M(Q_L, Q_U)$	71.00 (61.00, 84.00)	70.20 (61.50, 81.30)	74.30 (58.55, 91.13)	$Z = -0.866$	0.386
Preop urea/(mmol·L ⁻¹), $M(Q_L, Q_U)$	5.07 (4.06, 6.50)	5.20 (3.99, 6.46)	4.87 (4.10, 6.70)	$Z = -0.239$	0.811
Preop TG/(mmol·L ⁻¹), $M(Q_L, Q_U)$	1.17 (0.80, 1.69)	1.18 (0.78, 1.71)	1.16 (0.82, 1.65)	$Z = -0.333$	0.739
Preop TC/(mmol·L ⁻¹), $M(Q_L, Q_U)$	4.22 (3.47, 4.82)	4.10 (3.44, 4.71)	4.30 (3.46, 4.93)	$Z = -0.722$	0.470
Preop HDL-C/(mmol·L ⁻¹), $M(Q_L, Q_U)$	1.02 (0.88, 1.19)	1.02 (0.87, 1.19)	0.97 (0.89, 1.19)	$Z = -0.448$	0.654
Preop LDL-C/(mmol·L ⁻¹), $M(Q_L, Q_U)$	2.77 (2.12, 3.20)	2.77 (2.06, 3.14)	2.77 (2.22, 3.27)	$Z = -0.75$	0.454
Preop D-dimer/(mg·L ⁻¹), $M(Q_L, Q_U)$	1.10 (0.44, 2.71)	0.79 (0.42, 2.10)	2.28 (0.46, 9.50)	$Z = -2.844$	0.004

EVT: Endovascular treatment; AIS-LVO: Acute ischemic stroke with large-vessel occlusion; Preop: Preoperative; NIHSS: National Institutes of Health stroke scale; TOAST: Trial of Org 10172 in Acute Stroke Treatment; Postop: Postoperative; mTICI: Modified thrombolysis in cerebral infarction; ASPECTS: Alberta Stroke Program early computed tomography score; FBG: Fasting blood glucose; ALT: Alanine aminotransferase; TG: Triglyceride; TC: Total cholesterol; HDL-C: High-density lipoprotein cholesterol; LDL-C: Low-density lipoprotein cholesterol; $M(Q_L, Q_U)$: Median (lower quartile, upper quartile).

2.3 预后影响因素的二元 logistic 回归分析 将单因素分析中差异有统计学意义的变量(年龄、糖尿病史、术前 NIHSS 评分、术前 ASPECTS、术前格拉斯哥昏迷量表评分、术后即刻 mTICI 分级、术前 D-二聚体水平)作为自变量,以是否发生不

良预后作为因变量,代入二元 logistic 回归方程,结果显示术前 NIHSS 评分、术后即刻 mTICI 分级、术前 D-二聚体水平是前循环 AIS-LVO 患者行 EVT 预后不良的独立危险因素(P 均 <0.05)。见表3。

表3 前循环 AIS-LVO 行 EVT 患者预后影响因素的二元 logistic 回归分析

Tab 3 Binary logistic regression analysis of prognostic factors in anterior circulation AIS-LVO patients undergoing EVT

Variable	<i>b</i>	<i>SE</i>	Wald	<i>OR</i> (95% <i>CI</i>)	<i>P</i> value
Age	0.022	0.025	0.783	1.022 (0.974, 1.072)	0.376
Preoperative NIHSS score	0.092	0.043	4.492	1.096 (1.007, 1.193)	0.034
Preoperative ASPECTS	0.027	0.127	0.044	1.027 (0.801, 1.316)	0.834
Preoperative Glasgow coma scale score	-0.090	0.096	0.883	0.914 (0.757, 1.103)	0.347
Immediate postoperative mTICI grade	2.976	0.662	20.191	19.609 (5.354, 71.815)	<0.001
Preoperative D-dimer	0.270	0.076	12.538	1.310 (1.128, 1.521)	<0.001
Diabetes mellitus	-0.757	0.514	2.165	0.469 (0.171, 1.286)	0.141

AIS-LVO: Acute ischemic stroke with large-vessel occlusion; EVT: Endovascular treatment; NIHSS: National Institutes of Health stroke scale; mTICI: Modified thrombolysis in cerebral infarction; ASPECTS: Alberta Stroke Program early computed tomography score; *b*: Partial regression coefficient; *SE*: Standard error; *OR*: Odds ratio; *CI*: Confidence interval.

2.4 D-二聚体对患者预后不良的预测价值 绘制 ROC 曲线评价 D-二聚体对前循环 AIS-LVO 患者行 EVT 后预后不良的预测价值,结果显示 AUC 为 0.642 (95% *CI* 0.540~0.745)。见图2。

血性疾病最重要的生物标志物,其体内水平过高时说明体内存在高凝状态,提示机体可能形成活动性血栓^[13]。本研究结果显示,前循环 AIS-LVO 预后不良患者的术前 D-二聚体水平高于预后良好者 ($P<0.01$),且二元 logistic 回归分析提示 D-二聚体水平升高是 AIS-LVO 患者行 EVT 后预后不良的独立危险因素 ($P<0.001$)。ROC 曲线分析显示 D-二聚体预测前循环 AIS-LVO 患者行 EVT 后预后不良的 AUC 为 0.642。

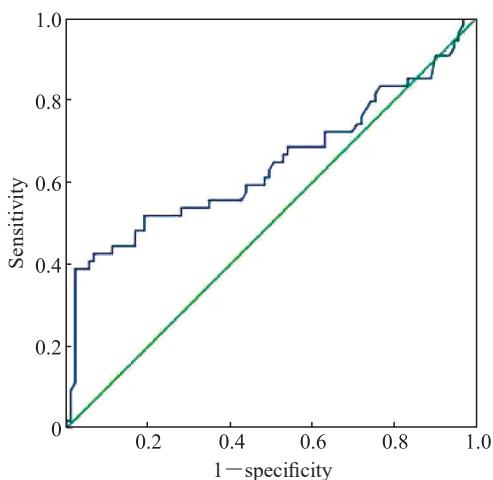


图2 D-二聚体预测前循环 AIS-LVO 患者行 EVT 后预后不良的 ROC 曲线

Fig 2 ROC curve of D-dimer predicting poor prognosis after EVT in anterior circulation AIS-LVO patients

AIS-LVO: Acute ischemic stroke with large-vessel occlusion; EVT: Endovascular treatment; ROC: Receiver operating characteristic.

3 讨论

D-二聚体是纤维蛋白特异性降解产物,是缺

血浆 D-二聚体水平可能会受感染、静脉血栓及 AIS-LVO 引起的脑梗死等各种疾病的影响^[14-16],既往研究结果显示急性脑梗死患者的 D-二聚体水平升高,这与患者脑梗死神经功能损伤程度、急性期死亡率、复发率、梗死面积大小相关^[17-18]。血浆 D-二聚体水平在心源性脑栓塞患者中升高,可能有助于预测急性缺血性脑卒中的亚型^[14-15]。正常生理状态下人体纤溶系统与凝血系统处于动态平衡状态,当血管内形成血栓时,血管内皮细胞释放某种血管激活物,使纤溶酶原转变成具有催化活性的纤溶酶,从而将纤维蛋白水解为纤维蛋白降解产物。因此 D-二聚体水平的升高从侧面反映了患者处于高凝状态,提示血栓正在形成,但血栓形成的活跃程度可能与血栓大小及病理生理特性有关,也可能与 EVT 疗效有关。在行 EVT 取除血栓时,富含纤维蛋白或血小板成分血栓的摩擦系数高于

富含红细胞血栓的摩擦系数,从而导致取栓难度增加,同时使手术成功率降低^[19],因此D-二聚体水平升高可能提示较低的手术成功率,从而影响患者预后。本研究结果与既往研究结果^[20]一致,均提示术前D-二聚体水平升高可作为AIS-LVO患者行EVT后预后不良的预测因子。

本研究结果还显示,前循环AIS-LVO患者行EVT术前NIHSS评分较低者及术后即刻mTICI得分较高者预后较好,这可能是由于脑梗死后NIHSS评分较低者病情严重程度相对较轻,故患者预后较好。而EVT术后前向血流好,血管再通率高,提示手术成功率较高,是预测良好预后的重要因素。mTICI分级是目前常用的评价血管再通的手段,是评价AIS-LVO患者行EVT后血管再通程度的重要工具,具有简单、直观、易实施等特点,在临床应用广泛^[10]。本研究表明mTICI分级低是EVT预后不良的危险因素之一,但mTICI分级越高,梗死脑组织再灌注越好,这是否会造成严重的缺血/再灌注损伤,从而加重脑梗死病情影响预后,尚需更加全面及深入的研究。

综上所述,本研究结果显示年龄、术前NIHSS评分、术前ASPECTS、术前格拉斯哥昏迷量表评分、术后即刻mTICI分级、术前D-二聚体水平是前循环AIS-LVO行EVT患者预后不良的相关危险因素,其中术前NIHSS评分、术后即刻mTICI分级、术前D-二聚体水平是前循环AIS-LVO行EVT患者预后不良的独立危险因素,术前D-二聚体水平升高的患者预后可能较差。但本研究为单中心研究,样本量较小,今后需开展多中心、大样本研究进一步验证本研究结论。

[参考文献]

- [1] 王丽君,袁绘,李凡凡,等.急性缺血性卒中患者认知障碍的危险因素分析[J].海军军医大学学报,2023,44(8):904-910. DOI: 10.16781/j.CN31-2187/R.20230165.
WANG L, YUAN H, LI F, et al. Risk factors of cognitive impairment in patients with acute ischemic stroke[J]. Acad J Naval Med Univ, 2023, 44(8): 904-910. DOI: 10.16781/j.CN31-2187/R.20230165.
- [2] GOYAL M, MENON B K, VAN ZWAM W H, et al. Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials[J]. Lancet, 2016, 387(10029): 1723-1731. DOI: 10.1016/S0140-6736(16)00163-X.
- [3] BADHIWALA J H, NASSIRI F, ALHAZZANI W, et al. Endovascular thrombectomy for acute ischemic stroke[J]. JAMA, 2015, 314(17): 1832. DOI: 10.1001/jama.2015.13767.
- [4] YANG P, ZHANG Y, ZHANG L, et al. Endovascular thrombectomy with or without intravenous alteplase in acute stroke[J]. N Engl J Med, 2020, 382(21): 1981-1993. DOI: 10.1056/NEJMoa2001123.
- [5] NOGUEIRA R G, JADHAV A P, HAUSSEN D C, et al. Thrombectomy 6 to 24 hours after stroke with a mismatch between deficit and infarct[J]. N Engl J Med, 2018, 378(1): 11-21. DOI: 10.1056/NEJMoa1706442.
- [6] ALBERS G W, MARKS M P, KEMP S, et al. Thrombectomy for stroke at 6 to 16 hours with selection by perfusion imaging[J]. N Engl J Med, 2018, 378(8): 708-718. DOI: 10.1056/NEJMoa1713973.
- [7] 中华医学会神经病学分会,中华医学会神经病学分会脑血管病学组.中国急性缺血性脑卒中诊治指南2018[J].中华神经科杂志,2018,51(9):666-682. DOI: 10.3760/cma.j.issn.1006-7876.2018.09.004.
- [8] GARAVELLI F, GHELFI A M, KILSTEIN J G. Usefulness of NIHSS score as a predictor of non-neurological in-hospital complications in stroke[J]. Med Clin (Barc), 2021, 157(9): 434-437. DOI: 10.1016/j.medcli.2020.07.034.
- [9] YOO A J, BERKHEMER O A, FRANSEN P S S, et al. Effect of baseline Alberta Stroke Program early CT score on safety and efficacy of intra-arterial treatment: a subgroup analysis of a randomised phase 3 trial (MR CLEAN) [J]. Lancet Neurol, 2016, 15(7): 685-694. DOI: 10.1016/S1474-4422(16)00124-1.
- [10] 邢鹏飞,李子付,李强,等.支架取栓器械取栓治疗前循环远端血管闭塞的疗效观察[J].第二军医大学学报,2018,39(9):997-1002. DOI: 10.16781/j.0258-879x.2018.09.0997.
XING P F, LI Z F, LI Q, et al. Efficacy of mechanical thrombectomy with stent-retriever for anterior circulation distal vessel occlusion[J]. Acad J Sec Mil Med Univ, 2018, 39(9): 997-1002. DOI: 10.16781/j.0258-879x.2018.09.0997.
- [11] JAYARAMAN M V, GROSSBERG J A, MEISEL K M, et al. The clinical and radiographic importance of distinguishing partial from near-complete reperfusion following intra-arterial stroke therapy[J]. AJNR Am J Neuroradiol, 2013, 34(1): 135-139. DOI: 10.3174/ajnr.a3278.
- [12] WILSON J T, HAREENDRAN A, GRANT M, et al. Improving the assessment of outcomes in stroke: use of a structured interview to assign grades on the modified Rankin scale[J]. Stroke, 2002, 33(9): 2243-2246. DOI: 10.1161/01.str.0000027437.22450.bd.

- [13] MATSUMOTO M, SAKAGUCHI M, OKAZAKI S, et al. Relationship between plasma D-dimer level and cerebral infarction volume in patients with nonvalvular atrial fibrillation[J]. *Cerebrovasc Dis*, 2013, 35(1): 64-72. DOI: 10.1159/000345336.
- [14] RAMOS-PACHÓN A, LÓPEZ-CANCIO E, BUSTAMANTE A, et al. D-dimer as predictor of large-vessel occlusion in acute ischemic stroke[J]. *Stroke*, 2021, 52(3): 852-858. DOI: 10.1161/STROKEAHA.120.031657.
- [15] ZHANG P, WANG C, WU J, et al. A systematic review of the predictive value of plasma D-dimer levels for predicting stroke outcome[J]. *Front Neurol*, 2021, 12: 693524. DOI: 10.3389/fneur.2021.693524.
- [16] LEE E J, BAE J, JEONG H B, et al. Effectiveness of mechanical thrombectomy in cancer-related stroke and associated factors with unfavorable outcome[J]. *BMC Neurol*, 2021, 21(1): 57. DOI: 10.1186/s12883-021-02086-y.
- [17] 王广益,孙良颖,宋明辉,等.血清补体C1q肿瘤坏死因子相关蛋白-3、D-二聚体水平与脑梗死溶栓后超急性期出血转化及脑损伤的相关性分析[J]. *中华全科医师杂志*, 2020, 19(7): 618-623. DOI: 10.3760/cma.j.cn114798-20200106-00013.
- [18] ZHANG J, LIU L, TAO J, et al. Prognostic role of early D-dimer level in patients with acute ischemic stroke[J]. *PLoS One*, 2019, 14(2): e0211458. DOI: 10.1371/journal.pone.0211458.
- [19] DUFFY S, MCCARTHY R, FARRELL M, et al. Per-pass analysis of thrombus composition in patients with acute ischemic stroke undergoing mechanical thrombectomy[J]. *Stroke*, 2019, 50(5): 1156-1163. DOI: 10.1161/STROKEAHA.118.023419.
- [20] 呼延梅华,陈蕾,袁绘,等.凝血功能改变与新型冠状病毒感染后发生急性缺血性脑卒中相关[J]. *海军军医大学学报*, 2023, 44(9): 1045-1049. DOI: 10.16781/j.cn31-2187/R.20230162.
- HUYAN M, CHEN L, YUAN H, et al. Changes of coagulation function are associated with acute ischemic stroke after coronavirus disease 2019[J]. *Acad J Naval Med Univ*, 2023, 44(9): 1045-1049. DOI: 10.16781/j.cn31-2187/R.20230162.

[本文编辑] 商素芳