



多单点穿刺技术改善血液透析患者动静脉移植物内瘘结局的回顾性研究*

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【摘要】 目的 研究多单点穿刺技术(multiple single cannulation technique, MUST)对血液透析患者动静脉移植物内瘘(arteriovenous graft, AVG)临床结局的影响。**方法** 回顾性分析于2018年1月-2021年12月在郑州大学第一附属医院血液净化中心构建AVG患者的临床资料及通路随访资料。按是否采用MUST分为MUST组及非MUST组,对比两组AVG的累积通畅率及并发症情况,并分析AVG采用MUST的影响因素。**结果** MUST组纳入115个AVG,非MUST组纳入122个AVG。MUST组AVG的1年、2年、3年、4年和5年累积通畅率分别为100%、99.1%、95.2%、85.4%和73.2%,而非MUST组的1年、2年、3年、4年和5年累积通畅率分别为97.5%、92.7%、77.7%、69.7%和50.0%,其中第2年和第3年的差异有统计学意义($P=0.022$, $P=0.004$)。MUST组的标化干预率[中位数(四分位间距)]低于非MUST组[0.46(0.00, 0.94) vs. 0.97(0.60, 1.59), $Z=-5.808$, $P<0.001$]。标化干预率高于1.0次/患者年的比例在MUST组为24例(20.9%),而非MUST组为60例(49.2%),两组差异有统计学意义($P<0.05$)。MUST组有3例(2.6%)AVG合并动脉瘤,而非MUST组为7例(5.7%),两组差异有统计学意义($\chi^2=20.737$, $P<0.001$)。MUST组有1例(0.9%)AVG合并感染,而非MUST组为6例(4.9%),两组差异无统计学意义。多因素logistic回归分析结果显示,在联盟单位透析[比值比(odds ratio, OR)=2.713, 95%置信区间(confidence interval, CI): 1.698 ~ 4.336, $P<0.001$]及随访质量优秀(OR=2.189, 95%CI: 1.221 ~ 3.927, $P=0.009$)为AVG采用MUST穿刺的独立影响因素。**结论** MUST可以改善AVG的累积通畅率,降低干预频率和动脉瘤发生率,同时不增加感染率。

【关键词】 动静脉移植物内瘘 穿刺 临床结局 血液透析

Multiple Single Cannulation Technique Improves the Outcomes of Arteriovenous Graft in Hemodialysis Patients: A Retrospective Study WANG Ruimin, WANG Siyan, XUE Xiaoling, YUE Xiaohong, WANG Xinfang, WANG Pei, LIANG Xianhui[△]. Blood Purification Center, The First Affiliated Hospital of Zhengzhou University, Zhengzhou 450052, China

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【Abstract】 Objective To evaluate the effects of the multiple single cannulation technique (MUST) on the outcomes of arteriovenous graft (AVG). **Methods** A retrospective study of AVG created between January 2018 and December 2021 at the First Affiliated Hospital of Zhengzhou University was conducted. The clinical data of patients and their follow-up data for venous access were analyzed. Subjects were divided into the MUST group or the non-MUST group according to whether MUST was used. The cumulative patency rate and complication incidence were compared between the two groups. Logistic regression was applied to analyze the influencing factors of applying MUST in AVG. **Results** The MUST group included 115 AVG and the non-MUST group, 122 AVG. The 1-year, 2-year, 3-year, and 4-year cumulative patency rates of the MUST group were 100%, 99.1%, 95.2%, 85.4%, and 73.2%, respectively, while those for the non-MUST group were 97.5%, 92.7%, 77.7%, 69.7%, and 50.0%, respectively, with the 2-year and 3-year patency rates showing significant difference ($P=0.022$, $P=0.004$). The standard intervention rate expressed in (median [interquartile range]) in the MUST group was significantly lower than that in the non-MUST group (0.46 [0.00, 0.94] vs. 0.97 [0.60, 1.59], $Z=-5.808$, $P<0.001$). A total of 24 (20.9%) AVG in the MUST group and 60 (49.2%) AVG in the non-MUST group had a standard intervention rate >1.0 per patient-year, with significant difference between the two groups. Three (2.6%) AVG in the MUST group and 7 (5.7%) AVG in the non-MUST group were complicated by aneurysm ($\chi^2=20.737$, $P<0.001$). One (0.9%) AVG in the MUST group and 6 (4.9%) AVG in the non-MUST group had graft infection, with the difference between the groups showing no significance ($P=0.121$). Multivariate logistic regression showed that dialysis in the alliance facilities (odds ratio [OR]=2.713, 95% confidence interval [CI]: 1.698-4.336, $P<0.001$), and excellent follow-up [OR=2.189, 95% CI: 1.221-3.927, $P=0.009$] were the influencing factors of applying MUST in AVG. **Conclusion** MUST improves the cumulative patency of AVG and decreases the intervention frequency and the incidence of aneurysm without increasing the risk of graft infection.

【Key words】 Arteriovenous graft Cannulation Clinical outcome Hemodialysis

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维持一条功能良好且并发症较少的血管通路对血液透析患者至关重要。由于血流量充足、近期通畅率较高等优势,动静脉移植体内瘘(arteriovenous graft, AVG)在我国的临床应用日益广泛,也被我国血管通路专家共识推荐为自体动静脉内瘘(arteriovenous fistula, AVF)的替代选择^[1]。AVG每周都要经受多次穿刺,既往研究发现AVG的长期通畅率较低^[2],这与多种因素相关^[3]。

目前AVF的穿刺方法包括绳梯穿刺、扣眼穿刺和区域穿刺。绳梯穿刺为AVG优选穿刺方法^[4]。但绳梯穿刺在临床实践中执行有难度,常常转变为区域穿刺^[5-6]。多单点穿刺技术(multiple single cannulation technique, MUST)是新出现的一种穿刺技术。一项AVF应用MUST的临床研究发现其可改善AVF的通畅率,且简便易行^[7]。本文回顾性分析单中心AVG随访资料,对比MUST与非MUST两种穿刺方法对AVG通畅率及并发症的影响,为临床决策提供参考。

1 资料与方法

1.1 研究对象

本研究纳入2018年1月1日-2021年12月31日在郑州大学第一附属医院血液净化中心构建的AVG为研究对象。排除标准包括:①在首次穿刺前患者死亡或该

AVG废弃;②该AVG未用于血液透析穿刺;③该AVG早期(术后90 d内)失访;④使用即穿型移植体。随访终点为2023年12月31日,该AVG废弃记为终点事件,患者死亡或失访记为删失。本研究为回顾性研究,无需获得患者知情同意。本研究获得郑州大学第一附属医院伦理委员会批准,批准号2024-KY-0848-001。所有研究对象只是在本中心完成AVG构建手术,然后回到当地进行穿刺和透析治疗,定期回到本中心进行复诊和评估,这些研究对象来自河南省及周边省份的126个血液透析室。

1.2 分组

根据AVG是否采用了MUST穿刺分为2组:MUST组和非MUST组。MUST组首次穿刺前由专业的通路护士进行评估。肢体肿胀消失、血管走行可被清晰触及是AVG开始穿刺的标准。MUST适用于可穿刺段较长的AVF或AVG。对于AVG,在动脉穿刺区和静脉穿刺区分别选取数个穿刺点,相邻穿刺位点至少间隔8 mm。这些穿刺点轮换穿刺,确保每个穿刺点被穿刺的间隔超过2周。穿刺示例见图1。非MUST组按照常规标准方法进行穿刺。MUST穿刺在“河南省血液透析联盟”单位进行推广,由通路护士对透析联盟单位的护士进行MUST培训,并在每次诊室复诊时进行穿刺评估和穿刺规划。



图 1 AVG多单点穿刺技术(MUST)示例

Fig 1 Example of AVG multiple single cannulation technique (MUST)

A, A MUST plan was designed for a subject. A total of 9 puncture points were subsequently made in the arterial puncture area of the AVG, which were used for cannulation in rotation in the order of from the bottom one to the top one. The latest cannulation site was the fourth point (enlarged in Fig B). B, Healing status on the first day after puncture. C, Healing status on the 3rd day after puncture. D, Healing on the 5th day after puncture. E, Healing after 1 week after puncture. F, Healing after 2 weeks after puncture.

1.3 随访及事件定义

AVG首次穿刺前及使用中的每个季度进行随访,包括诊室随访和电话随访。诊室随访包括主要透析参数、通路使用情况及干预情况、物理检查及超声检查、必要的数字减影血管造影检查等。电话随访由通路护士进行,主要针对未能及时进行诊室检查的患者,主要内容包括通路使用及干预情况。随访数据及时录入数据库。按随访质量分为3组:①优秀,每季度诊室复诊在随访期间可达到3/4以上;②差:不主动进行诊室复诊,除非出现并发症;③良好,诊室复诊情况介于二者之间。按是否在联盟单位[®]透析分为2组。联盟单位至少1名护士经过至少3 d的AVG穿刺培训。

AVG累积通畅时间:自AVG建立至随访终点的时间间隔。动脉瘤被定义为持续存在的移植物瘤样扩张,瘤体最大内径超过9 mm。感染被限定为移植物感染,主要表现为局部红肿,伴皮肤破溃,或假性动脉瘤形成。

1.4 统计学方法

应用SPSS23.0软件进行数据的统计学处理。呈正态分布的计量资料用 $\bar{x} \pm s$ 形式表示,不符合正态分布的计量资料以中位数(P_{25}, P_{75})形式表示,计数资料以例数和百分比表示,使用Kolmogorov-Smirnov法检验其正态性。符合正态分布的计量资料组间比较采用两独立样本 t 检验,计数资料组间比较用卡方检验或Fisher's精确检验。采用Kaplan-Meier法绘制生存率曲线,log-rank检验比较两组间生存率,并通过Z检验进行不同时间节点的生存率

的比较。 $\alpha=0.05$ 。

2 结果

2.1 研究对象在建立AVG时的基线资料

研究期间共建立了332个AVG,排除78个即穿型移植物,13个首次穿刺前患者死亡或AVG废弃,2个未使用该AVG进行透析治疗,2个在术后早期失访,剩余共计237个AVG被纳入研究。该群研究对象分布于126个血液透析室,年龄(55.55 ± 11.83)岁,男性86例(36.3%),糖尿病93例(39.2%),透析龄2.4(0.8, 3.0)年,吻合血管分别以肱动脉(226个, 95.4%)和肘上贵要静脉(153个, 64.6%)为主,详细资料见表1。115个AVG被纳入MUST组,122个AVG被纳入非MUST组,MUST组的基线透析龄短于非MUST组[2.1(0.7, 2.7)年 vs. 2.6(1.0, 3.8)年, $P=0.011$],两组间性别、年龄、是否合并糖尿病及吻合血管等参数的差异无统计学意义。见表1。

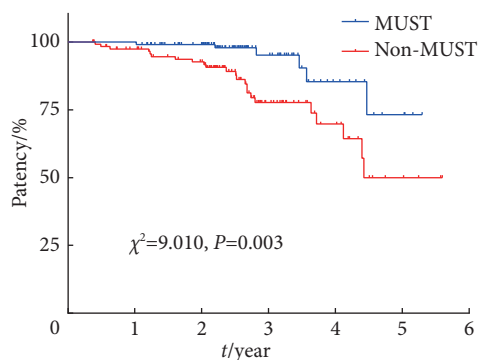
2.2 两组AVG通畅率的比较

MUST组AVG的累积通畅时间优于非MUST组[912(765, 1 161) d vs. 865(732, 1 185) d, $t=-0.757$, $P=0.449$],但差异无统计学意义。MUST组AVG的1年、2年、3年、4年和5年累积通畅率分别为100%、99.1%、95.2%、85.4%和73.2%,而非MUST组的1年、2年、3年、4年和5年累积通畅率分别为97.5%、92.7%、77.7%、69.7%和50.0%,其中第2年和第3年累积通畅率差异有统计学意义($P=0.022$, $P=0.004$)。见图2。

表 1 研究对象在建立AVG时的基线资料
Table 1 Baseline data of the subjects at the time of AVG establishment

Project	Total (n=237)	MUST group (n=115)	Non-MUST group (n=122)	$\chi^2/Z/t$	P
Male/case (%)	86 (36.3)	40 (34.8)	46 (37.7)	0.640	0.219
Age/yr., $\bar{x} \pm s$	55.55 $\pm$ 11.83	55.91 $\pm$ 12.15	55.00 $\pm$ 11.50	0.454	0.650
Diabetes mellitus/case (%)	93 (39.2)	47 (40.9)	46 (37.7)	0.249	0.618
Dialysis vintage/year, median (P_{25}, P_{75})	2.4 (0.8, 3.0)	2.1 (0.7, 2.7)	2.6 (1.0, 3.8)	-2.536	0.011
Anastomosis artery/case (%)				0.043	0.835
Brachial artery	226 (95.4)	110 (95.7)	116 (95.1)		
Other	11 (4.6)	5 (4.3)	6 (4.9)		
Anastomosis vein/case (%)				1.328	0.249
Basilic vein	153 (64.6)	70 (60.9)	83 (68.0)		
Other	84 (35.4)	45 (39.1)	39 (32.0)		
Number of dialysis units	126	62	92	NA	NA

NA: no statistics available.



Number of people at risk at the point in time

MUST	115	115	97	37	12	5	0
Non-MUST	122	110	94	36	17	5	0

图 2 MUST组与非MUST组AVG的累积通畅率比较

Fig 2 Comparison of the cumulative patency rate of AVG between the MUST group and non-MUST group

2.3 两组AVG并发症的比较

MUST组的标准化干预率低于非MUST组[0.46(0.00,

0.94) vs. 0.97(0.60, 1.59), $Z = -5.808$, $P < 0.001$]。标准化干预率 >1.0 次/患者年的比例在MUST组为24例(20.9%),而非MUST组为60例(49.2%),两组间差异有统计学意义($P < 0.05$)。MUST组有3例(2.6%)AVG合并动脉瘤,而非MUST组为7例(5.7%),差异有统计学意义($\chi^2 = 20.737$, $P < 0.001$)。MUST组有1例(0.9%)AVG合并感染,而非MUST组为6例(4.9%),两组的差异无统计学意义($P = 0.121$)。

2.4 AVG采用MUST穿刺的影响因素分析

见表2。单因素logistic回归分析结果显示,是否在联盟透析室治疗及随访质量为AVG采用MUST穿刺的影响因素(均 $P < 0.05$)。多因素logistic回归分析结果显示,在联盟单位透析[比值比(odds ratio, OR) = 2.713, 95%置信区间(confidence interval, CI): 1.698 ~ 4.336, $P < 0.001$]及随访质量优秀(OR = 2.189, 95%CI: 1.221 ~ 3.927, $P = 0.009$)为AVG采用MUST穿刺的独立影响因素。

表 2 AVG采用MUST穿刺的多因素分析

Table 2 Multivariate analysis of applying MUST in AVG

Influencing factor	Single factor analysis		Multi-factor analysis	
	OR (95% CI)	P	OR (95% CI)	P
Age ≥ 60 yr. (yes/no)	1.128 (0.733-1.736)	0.583		
Sex (male/female)	0.870 (0.569-1.328)	0.518		
Comorbid diabetes mellitus (yes/no)	1.022 (0.680-1.534)	0.917		
Union units (yes/no)	3.500 (2.264-5.412)	<0.001	2.713 (1.698-4.336)	<0.001
Ipsilateral mature pathway (yes/no)	0.843 (0.562-1.265)	0.410		
AVG position (left/right)	0.905 (0.486-1.683)	0.752		
Anastomotic artery (brachial artery/other)	0.833 (0.254-2.731)	0.763		
Anastomotic veins (basilic vein/other)	1.154 (0.751-1.772)	0.513		
Aftercare quality (excellent/good/bad)	3.588 (2.096-6.142)	<0.001	2.189 (1.221-3.927)	0.009

3 讨论

本中心自2013年开始使用和推广一种新的穿刺方法——MUST。该技术要求在成熟的内瘘血管或移植术上分别确定数个穿刺点,每个穿刺点间隔8 mm以上,每个穿刺点轮流被用于穿刺。AVG的动脉和静脉穿刺区域通常各确定6~8个穿刺点,每个穿刺点间隔2周以上被穿刺一次。穿刺点选择易于穿刺的血管段,由专业的通路护士来确定,必要时需彩超协助,以避开分叉、狭窄、迂曲、钙化的血管段。定期(3~6个月)由专业的通路护士再次检查,必要时确定新的穿刺点用于轮换。一旦穿刺

点确定,制订穿刺计划表,所有护士按照计划有序轮流穿刺各个穿刺点。MUST让护士清楚知道本次该穿刺哪个点,而这些点本身就是按照绳梯穿刺的原则来确定的,因此本质上是绳梯穿刺的一种特殊类型。但由于穿刺点明确,MUST可降低转变为区域穿刺的风险。需要注意的是MUST与扣眼穿刺有本质不同。扣眼穿刺使用钝针,每周3次在同一个点进行穿刺^[9]。事实上,每个穿刺点都未完全愈合,因此皮肤损伤较重,感染风险较高^[10]。而MUST不使用钝针,每个穿刺点都有1~2周乃至更长的愈合时间,可以在下次穿刺前完全愈合,从而减少感染、瘢痕形成、动脉瘤形成及血管壁增生纤维化的风险。

MUST的缺点是要求可穿刺的血管要足够长。MUST技术在葡萄牙和我国都有应用^[7],其中欧洲正在进行一项评价MUST用于AVF的国际多中心前瞻性平行对照临床研究^[11]。

与AVF相比,AVG移植物材料的愈合特性更差,对穿刺的容错率更低,更易被穿刺损伤、形成动脉瘤或感染^[12]。因此,AVG要求更标准的穿刺技术。AVG采用MUST有先天优势。AVG是人为置于皮下组织的,内径足够,深浅合适,较为平直,且没有分支,在动脉侧和静脉侧分别有7 cm以上的可穿刺段。通路护士在每次复诊时检查穿刺点状况,如果有必要(如损伤、增生、皮肤愈合不良等)则废弃该穿刺点,另补充新的穿刺点用于MUST穿刺。MUST并不复杂,难点在于管理,要求全体护理人员都执行MUST。虽然MUST用于AVG穿刺在国内外的透析室都可以见到,但没有相关临床研究的报道。本研究是首个关于AVG应用MUST的报道。本研究发现MUST组AVG的标化干预率和动脉瘤发生率都低于非MUST组,第2年和第3年的累积通畅率也高于非MUST组。虽然MUST组的感染发生率低于非MUST组,但差异无统计学意义,这是因为本研究的感染发生率总体较低。这些研究都表明MUST是AVG的一种有效穿刺方法。与此前在AVF的研究结果一致^[7]。

本文也对AVG采用MUST穿刺的风险因素进行了分析,发现在联盟单位透析和优秀的复诊为其独立影响因素,表明在联盟单位透析或能够规律复诊的研究对象有更大的概率采用MUST穿刺。本中心自2013年开始依托“河南省血液透析联盟”推广MUST技术,将近一百个透析室的护士接受了相关培训。每次培训3 d,内容包括动静脉内瘘基础知识、内瘘穿刺基础、MUST技术特点及实施方案等。因此,在联盟单位透析的研究对象更有可能采用MUST穿刺。每次诊室复诊都会有专业的通路护士对穿刺情况进行评估,并纠正错误的穿刺方法,或更换出现并发症的穿刺点,因此能够规律复诊的研究对象也更有可能采用MUST穿刺。之前也有研究显示护士培训和通路护士岗位设置对动静脉瘘的穿刺至关重要^[13]。

综上所述,本文是首个介绍MUST技术用于AVG穿刺的临床研究,并且发现MUST可以改善AVG的累积通畅率,降低干预频率和动脉瘤发生率,同时不增加感染率。

* * *

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