

影响重症糖尿病足患者大截肢手术平面的因素分析*

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【摘要】目的 探讨影响重症糖尿病足患者大截肢平面的主要因素。**方法** 用病例对照研究的方法,分析2020年7月-2022年7月于东部战区空军医院重症监护室(ICU)住院的重症糖尿病足大截肢患者临床资料,根据截肢平面高低分为经胫腓骨截肢(TT)组和经股骨截肢(TF)组。对患者的临床资料进行相关性分析,并筛选出影响患者大截肢平面的相关因素进行多因素logistic回归分析。**结果** 共完整收集48例大截肢患者资料,其中TT组有15例,TF组有33例。TT组伴心脑血管并发症比例低于TF组[26.67%(4/15) vs. 57.58%(19/33), $P<0.05$], TT组伴下肢血管介入史比例高于TF组[40%(6/15) vs. 9.09%(3/33), $P<0.05$], TT组肌酐升高比例低于TF组[70.31±22.98 vs. 127.98±108.38, $P<0.05$], 且下肢动脉介入史可能是决定大截肢平面的独立保护因素[比值比(OR)=0.17, 95%可信区间(CI): 0.03~0.91, $P=0.038$]。**结论** 心脑血管疾病史、血肌酐水平和下肢动脉介入史是影响重症糖尿病足患者手术大截肢平面的主要因素,其中下肢动脉介入史可能是一种独立保护因素。

【关键词】 糖尿病足 大截肢 下肢动脉介入史

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【Abstract】 Objective To investigate the main factors affecting the surgical level of major amputations in patients with severe diabetic foot. **Methods** A case-control study was conducted to analyze the clinical data of severe diabetic foot patients who had major amputations and were admitted to the Intensive Care Unit (ICU), Air Force Hospital of PLA Eastern Theater Command between July 2020 and July 2022. According to their surgical level of amputation, patients were divided into transtibial amputation (TT) group and transfemoral amputation (TF) group. Correlation analysis was performed with the clinical data of the patients, and multivariate logistic regression was performed to screen for relevant factors affecting the surgical level of major amputation. **Results** The data of 48 patients with major amputations were collected, including 15 patients in the TT group and 33 patients in the TF group. The proportion of patients who had cardiovascular and cerebrovascular complications in the TT group was lower than that in the TF group (26.67% [4/15] vs. 57.58% [19/33], $P<0.05$), the proportion of patients who had lower extremity arterial intervention history was higher in the TT group than that in the TF group (40% [6/15] vs. 9.09% [3/33], $P<0.05$), and the proportion of patients who had elevated creatinine level was lower in the TT group than that in the TF group (70.31±22.98 vs. 127.98±108.38, $P<0.05$). Moreover, the history of lower extremity arterial intervention may be an independent protective factor for determining the surgical level of major amputations (odds ratio [OR]=0.15, 95% confidence interval [CI]: 0.03-0.72, $P=0.018$). **Conclusion** History of cardiovascular and cerebrovascular diseases, serum creatinine level and history of lower extremity arterial intervention are the main factors affecting the surgical level of major amputations in patients with severe diabetic foot, and the history of lower extremity arterial intervention may be an independent protective factor.

【Key words】 Diabetic foot Major amputation The history of lower extremity arterial intervention

糖尿病足是指糖尿病患者的足部感染、溃疡形成或深部组织破坏,通常伴有神经病变或外周动脉疾病(peripheral arterial disease, PAD),是糖尿病最严重的并发症之一^[1-2]。研究发现,糖尿病足的患病率为4%~10%,以人口为基础的年发病率为1.0%~4.1%,糖尿病患者终生

发病率可能高达25%,给患者及其家庭带来沉重的经济负担^[3]。与其他原因所致的足溃疡相比,糖尿病足溃疡的截肢风险高出15~46倍^[4-5],已成为非创伤性下肢截肢最常见的病因。为了防止全身性感染或严重脓毒症的发生和发展,大截肢可能是重症糖尿病足患者唯一的选择。根据最新定义,小截肢是指经踝关节或远端任何平面的肢体切除;大截肢是指踝关节近端任何平面的肢体切除,

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含经胫腓骨截肢(transtibial amputation, TT)、膝盖截肢(knee disarticulation, KD)、经股骨截肢(transfemoral amputation, TF)^[1]。

目前的研究多是针对糖尿病足截肢的影响因素^[6-8]。但查阅文献后,我们尚未发现有关重症糖尿病足大截肢影响因素的研究。因此,本研究回顾性分析2020年7月-2022年7月在我院ICU接受大截肢手术的糖尿病足患者的临床资料,分析其截肢平面的主要影响因素,为临床预防大截肢及降低大截肢平面提供参考依据。

1 对象与方法

1.1 研究对象及资料收集

回顾性分析2020年7月-2022年7月于东部战区空军医院ICU住院的糖尿病足大截肢患者的临床资料,所有患者均明确诊断为糖尿病足且接受不同平面的下肢截肢手术。本研究经中国人民解放军东部战区空军医院医学伦理委员会批准通过(审批号:202207023-001)。纳入标准:①TT组:患者明确诊断为糖尿病足,手术截肢平面为膝关节(不含)至踝关节处。②TF组:患者明确诊断为糖尿病足,手术截肢平面为膝关节(不含)至股骨近端^[1-2],为方便患者后期安装义肢行走,我院未行KD术式。排除标准:①临床资料不全者;②合并慢性肾功能不全-尿毒症期患者。

1.1.1 基本资料 主要包括:心脑血管并发症、住院次数、ICU天数、年龄、性别、糖尿病足病史、糖尿病病程、下肢动脉介入史。

1.1.2 实验室检查及特殊治疗 心功能指标:心脏左心室射血分数(left ventricular ejection fraction, LVEF)、脑钠肽(brain natriuretic peptide, BNP);生化指标:肌酐、血浆白蛋白、血糖、血乳酸、血pH、血钾、血钠;血常规及感染指标:血红蛋白、白细胞、降钙素原、血液细菌培养、创面分泌物细菌培养;特殊治疗:强心药使用、利尿剂使用、抗生素种类。

1.2 统计学方法

服从正态分布的计量资料采用 $\bar{x} \pm s$ 进行系统描述,组间比较采用 t 检验;不服从正态分布的计量资料采用中位数(四分位间距)进行统计描述,组间比较采用秩和检验;计数资料采用频数(百分比)进行统计描述,组间比较采用 χ^2 检验或Fisher确切概率法。将单因素分析中 $P < 0.05$ 的变量纳入多因素logistic回归分析, $\alpha = 0.05$ 。

2 结果

2.1 基本资料比较

共纳入48例接受下肢大截肢技术的糖尿病足患者,其

中TT组15例,TF组33例;女性21例,男性27例;两组患者的一般情况如表1所示。TT组与TF组在性别、年龄、住院次数、ICU住院天数、糖尿病足病史、糖尿病病程方面差异均无统计学意义。TT组伴心脑血管并发症比例低于TF组($P = 0.046$);TT组伴下肢动脉介入史比例高于TF组($P = 0.018$)。

表 1 TT组与TF组基本资料
Table 1 Basic data of TT group and TF group

Variable	TT group (n=15)	TF group (n=33)	Statistic	P
Cardio-cerebrovascular complications/case (%)			$\chi^2=3.9478$	0.0469
No	11 (73.33)	14 (42.42)		
Yes	4 (26.67)	19 (57.58)		
Times of hospitalization/d	1.40±0.63	1.85±1.56	$Z=-0.6320$	0.5274
ICU length-of-stay/d	3.20±2.01	5.36±4.55	$t=-1.7586$	0.0853
Age/yr.	64.67±9.66	67.12±10.35	$t=-0.7771$	0.4411
Sex/case (%)			$\chi^2=0.0754$	0.7836
Male	8 (53.33)	19 (57.58)		
Female	7 (46.67)	14 (42.42)		
History of diabetic foot/month	3.35±3.70	2.40±2.40	$Z=1.2225$	0.2215
Duration of diabetes/years	12.87±5.18	13.58±8.77	$t=-0.2911$	0.7723
History of lower extremity arterial intervention/case (%)			Fisher's	0.0184
No	9 (60.00)	30 (90.91)		
Yes	6 (40.00)	3 (9.09)		

2.2 临床资料比较

TT组与TF组相比,心脏LVEF, BNP差异无统计学意义;TF组肌酐高于TT组($P = 0.017$);两组间血红蛋白、血浆白蛋白差异无统计学意义;两组间血糖均高于正常值,但两组间血糖差异无统计学意义;两组间血乳酸及PH差异无统计学意义;两组间血钾、血钠差异无统计学意义;两组间白细胞及降钙素原差异无统计学意义,但两组患者白细胞水平均高于正常;两组血液细菌培养、创面分泌物细菌培养差异无统计学意义;强心药、利尿剂及抗生素使用情况差异也无统计学意义。见表2。

2.3 影响大截肢平面的多因素分析

将单因素分析时发现两组差异有统计学意义的3个因素(心脑血管并发症、下肢动脉介入史、肌酐)定义为自变量 $X(X_1、X_2、X_3)$,腿截平面定义为因变量 $Y(Y = 0, TT; Y = 1, TF)$,进行多因素logistic回归分析。由表3可见,下肢动脉介入史是大截肢平面的独立保护因素($OR =$

表 2 TT组与TF组临床资料
Table 2 Clinical data of TT group and TF group

Variable	TT group (n=15)	TF group (n=33)	Statistic	P
LVEF/%	56.73±5.24	54.48±10.00	Z=0.067 7	0.946 0
BNP/(pg/mL)	2 671.93±2 337.93	3 749.79±6 094.78	t=-0.659 4	0.513 0
Cr/(μmol/L)	70.31±22.98	127.98±108.38	Z=-2.380 3	0.017 3
Hb/(g/L)	101.53±19.04	96.45±18.11	t=0.886 6	0.379 9
Albumin/(g/L)	28.99±5.04	27.38±5.48	Z=1.224 0	0.221 0
Glucose/(mmol/L)	10.68±5.19	12.66±6.83	t=-0.993 9	0.325 5
Lac/(mmol/L)	0.95±0.36	1.09±0.48	Z=-0.701 4	0.483 1
Blood pH	7.45±0.04	7.43±0.07	t=1.148 6	0.256 6
K ⁺ /(mmol/L)	3.96±0.33	3.73±0.77	t'=1.475 2	0.147 0
Na ⁺ /(mmol/L)	132.73±3.48	129.40±23.57	t=0.540 3	0.591 6
WBC/(×10 ⁹ L ⁻¹)	14.11±4.40	17.63±10.61	Z=-0.678 6	0.497 4
PCT/(ng/mL)*	0.33±0.41	1.89±4.58	Z=-1.205 5	0.228 0
Blood bacterial culture/case (%)			Fisher's	0.086 1
No	3 (20.00)	12 (36.36)		
Yes	2 (13.33)	0 (0.00)		
Bacterial culture of wound secretion/case (%)			Fisher's	0.905 1
No	5 (33.33)	8 (24.24)		
Yes	8 (53.33)	20 (60.61)		
Unidentified	2 (13.33)	5 (15.15)		
Cardiotonic medication/case (%)			Fisher's	1.000 0
No	12 (80.00)	26 (78.79)		
Yes	3 (20.00)	7 (21.21)		
Diuretic medication/case (%)			Fisher's	0.727 1
No	3 (20.00)	10 (30.30)		
Yes	12 (80.00)	23 (69.70)		
Variety of antibiotics/case (%)			Fisher's	1.000 0
1	2 (13.33)	5 (15.15)		
2	2 (13.33)	5 (15.15)		
3	11 (73.33)	22 (66.67)		
4	0 (0.00)	1 (3.03)		

*: Some severe patients had PCT results from other hospitals and these PCT results were not included in the medical records, which resulted in a small amount of data loss, with TT group missing 1 case and TF group missing 4 cases.

表 3 logistic多元线性回归分析
Table 3 Logistic multivariate linear regression analysis

Variable	Multiple linear regression analysis				
	β	Standard error	Wald χ^2	P	OR (95% CI)
Cardio-cerebrovascular complications (control=no)	1.12	0.81	1.913 6	0.166 6	3.06 (0.63-14.93)
History of lower extremity arterial intervention (control=no)	-1.80	0.87	4.292 7	0.038 3	0.17 (0.03-0.91)
Cr	0.02	0.01	2.218 7	0.136 4	1.02 (0.99-1.04)

β : Partial regression coefficient; OR: Odds ratio; CI: Confidence interval.

0.17, 95% CI: 0.03 ~ 0.91, $P=0.038$)。

3 讨论

3.1 心脑血管并发症和下肢动脉介入史对重症糖尿病足患者大截肢平面的影响

本研究结果显示, TT组伴心脑血管并发症比例显著低于TF组($P<0.05$), TT组伴下肢动脉介入史比例显著高于TF组($P<0.05$), 且下肢动脉介入史是截肢平面的独立保护因素($P<0.05$)。已有研究表明, 糖尿病患者的心血管疾病发生率是非糖尿病患者的2~4倍, 其死亡的主要原因是冠状动脉疾病^[9], 在伴有足部并发症的糖尿病患者中, 既往和新发心脑血管事件的发生率均较高, 心血管损害进展较快且预后较差^[10]。另一项研究同样表明, 伴有糖尿病足的糖尿病患者脑血管风险比无糖尿病足的糖尿病患者高, 心血管危险因素的发生率更高, 新脑血管事件的发生率更高^[11]。这些研究结果同样程度地反映了糖尿病足的高截肢率及高死亡率。对于心脑血管并发症较多且病程较长的糖尿病足患者, 其PAD程度也相对较重, 动脉狭窄明显, 下肢血供更差, 因此大腿截肢率更高。PAD是一种继发于动脉粥样硬化、钙化、高血压、炎症、损伤或吸烟的血管状况不佳的疾病, 导致远端尤其是下肢循环不足^[12]。严重缺血可导致组织缺氧和坏疽发生, 甚至需要手术截肢^[13]。大约50%的糖尿病足患者同时被诊断为PAD, 导致糖尿病足患者下肢感染率增加, 创面愈合时间延长^[14]。已有研究表明, 在糖尿病足合并PAD的患者中, 下肢血管重建可有效地降低截肢风险^[15], 且早期进行血管重建对截肢愈合至关重要^[16]。亦有研究发现, 下肢血管重建可减少糖尿病足合并PAD患者大截肢可能, 降低截肢平面^[8]。本研究发现TT组伴下肢动脉介入史比例显著高于TF组, 且进一步logistic回归分析发现下肢动脉介入史是截肢平面的独立保护因素($P<0.05$), 表明下肢动脉介入可以有效地降低下肢截肢平面, 为患者保留更多的肢体便于后期安装义肢及行走功能恢复, 同时也一定程度地降低了死亡风险。

3.2 肌酐水平对重症糖尿病足患者大截肢平面的影响

在对纳入患者相关检查结果的分析中, 虽然两组间心功能指标差异无统计学意义, 但是TT组心功能指标较TF组更接近正常, 结果符合前文所描述的心脑血管并发症及PAD发生率, TF组的心脑血管及外周血管似乎更差。在大多数研究中, 高血糖水平是影响糖尿病足截肢的重要危险因素之一^[17], 本研究中两组患者血糖均控制较差, 组间差异无明显统计学意义, 表明血糖水平对重症糖尿病足患者大截肢平面似乎没有影响, 但考虑本研究

纳入样本量较少, 后期增大样本量后再行研究。白细胞及降钙素原的组间对比发现, TF组指标更高, 由于本研究对象为重症糖尿病足患者, 入组患者感染指标均异常升高, 因此两组间差异亦不明显。两组间血浆白蛋白、血钾、血钠、血pH、血乳酸水平、血液细菌培养、创面分泌物细菌培养似乎也没有明显差异。对于后期治疗中的利尿剂、强心药、抗生素的使用, 在两组间亦无明显差异。值得注意的是, 肌酐水平可能是影响截肢平面的重要因素。研究发现, 糖尿病合并尿毒症患者下肢截肢的风险比无尿毒症患者高10倍^[18], 其特有的检查指标影响本研究的数据统计, 因此在本研究纳入标准中, 我们将尿毒症患者排除, 但是即便如此, 两组间肌酐水平差异也异常明显, TF组的肌酐明显高于TT组。已有研究表明, PAD、神经病变、易感性、肾脏疾病特有的皮肤病等多种因素共同影响糖尿病伴肾功能不全患者下肢溃疡的发生及其愈合, 且肾脏疾病(ESRD)和慢性肾脏病(CKD)是糖尿病足溃疡发展的独立危险因素, 该类患者截肢率亦明显升高^[19-20]。因此, 肌酐水平也可能是重症糖尿病足患者大截肢平面的重要因素。

综上所述, 本研究将ICU重症糖尿病足大截肢患者进行病例对照研究, 结果发现心脑血管疾病史、下肢动脉介入史及肌酐水平为重症糖尿病足患者截肢平面的重要影响因素, 其中下肢动脉介入史可能是截肢平面的独立保护因素。因此, 在重症糖尿病足患者的诊疗过程中, 临床医生要详细询问患者既往病史, 完善下肢动脉评估, 并密切检测肌酐水平, 这将对患者的预后意义重大。本文作为回顾性研究, 存在不足之处, 因样本量小, 未将住院期间动态临床资料、患者的终末结局等因素纳入分析, 因此得出的结论可能存在偏倚, 需扩大样本量、增加纳入因素得出更可靠的结论。

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利益冲突 所有作者均声明不存在利益冲突

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