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·临床研究·

口腔鳞状细胞癌患者皮瓣修复术后肺部感染多重耐药菌危险因素分析

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【摘要】 目的 探讨口腔鳞状细胞癌（oral squamous cell carcinoma，OSCC）患者皮瓣修复术后肺部感染多重耐药菌的分布类型及危险因素，为OSCC患者皮瓣修复术后感染防治提供参考。**方法** 本研究已通过单位医学伦理委员会批准，回顾性分析109例皮瓣修复OSCC患者的痰培养结果、药敏试验结果和临床资料，卡方检验分析OSCC患者皮瓣修复术后肺部感染病原菌、多重耐药菌的危险因素，多元logistic回归分析OSCC患者皮瓣修复术后肺部感染多重耐药菌的危险因素并构建列线图预测模型，通过受试者操作特征（receiver operating characteristic，ROC）曲线、校准曲线和临床决策曲线分析（decision curve analysis，DCA）评估列线图预测模型的辨别能力、准确性和临床实用性。**结果** 109例患者，52例患者痰培养结果为阴性，57例患者痰培养结果呈阳性，其中14例患者肺部感染多重耐药菌。卡方检验结果显示输血、肺部基础疾病、手术时间≥490 min、术中出血量≥400 mL和BMI异常均为OSCC患者皮瓣修复术后肺部感染多重耐药菌的危险因素（$P<0.05$）。多元logistic回归分析结果显示肺部基础疾病、术中出血量≥400 mL、BMI异常、手术时间≥490 min是OSCC患者皮瓣修复术后肺部感染多重耐药菌的独立危险因素（$P<0.05$）。OSCC患者皮瓣修复术后肺部感染多重耐药菌列线图预测模型的ROC曲线下面积为0.874（95% *CI*：0.775～0.973）。校准图中原始曲线与校准曲线较为贴合。DCA显示当OSCC患者皮瓣修复高风险阈值概率为0.000～0.810时，使用列线图预测模型预测OSCC患者皮瓣修复术后感染多重耐药菌风险更有益。OSCC患者皮瓣修复术后肺部感染的多重耐药菌中，常见的有多重耐药铜绿假单胞菌、多重耐药肺炎克雷伯菌、耐碳青霉烯类鲍曼不动杆菌（carbapenem-resistant *Acinetobacter baumannii*，CRAB）和耐甲氧西林金黄色葡萄球菌（meticillin-resistant *Staphylococcus* aureus，MRSA）。**结论** OSCC患者皮瓣修复术后肺部感染的多重耐药菌主要是革兰氏阴性菌包括CRAB、多重耐药铜绿假单胞菌、多重耐药肺炎克雷伯菌及革兰氏阳性菌耐甲氧西林金黄色葡萄球菌。肺部基础疾病、手术时间≥490 min、术中出血量≥400 mL、BMI异常是OSCC患者皮瓣修复术后肺部感染多重耐药菌的独立危险因素。基于以上4项独立危险因素构建的列线图预测模型，能够较为精准地对OSCC患者皮瓣修复术后肺部感染多重耐药菌的风险作出预测。

【关键词】 口腔鳞状细胞癌；多重耐药菌；术后肺部感染；皮瓣修复；列线图；身体质量指数；耐甲氧西林金黄色葡萄球菌；耐碳青霉烯类鲍曼不动杆菌
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Risk factor analysis for postoperative pulmonary infections with multidrug-resistant bacteria in patients with oral squamous cell carcinoma undergoing flap repair surgery

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【Abstract】 Objective To investigate the distribution patterns and risk factors for multidrug-resistant bacterial pulmonary infections in patients with oral squamous cell carcinoma (OSCC) undergoing flap reconstruction surgery, and to provide evidence for infection prevention and treatment in this population. **Methods** This study was approved by the institutional medical ethics committee. We retrospectively analyzed sputum culture results, antimicrobial susceptibility testing data, and clinical records of 109 OSCC patients undergoing flap reconstruction. Chi-square tests were employed to identify pathogens and risk factors for multidrug-resistant bacteria (MDR) in postoperative pulmonary infections. Multivariate logistic regression analysis was conducted to determine MDR risk factors and establish a nomogram prediction model. The model's discriminatory power, accuracy, and clinical utility were evaluated using receiver operating characteristic (ROC) curves, calibration curves, and decision curve analysis (DCA). **Results** Among the 109 patients, 52 had negative sputum cultures and 57 tested positive, of whom 14 developed multidrug-resistant (MDR) pulmonary infections. Chi-square analysis revealed that blood transfusion, pre-existing pulmonary diseases, operation time ≥ 490 min, intraoperative blood loss ≥ 400 mL, and abnormal BMI were significant risk factors for postoperative MDR infections ($P < 0.05$). Multivariate logistic regression identified pre-existing pulmonary diseases, intraoperative blood loss ≥ 400 mL, abnormal BMI, and operative duration ≥ 490 min as independent risk factors for MDR infections ($P < 0.05$). The nomogram prediction model for MDR infections demonstrated an area under the ROC curve (AUC) of 0.874 (95% *CI*: 0.775-0.973). The calibration plot showed good agreement between predicted and observed outcomes. DCA indicated a net clinical benefit when the threshold probability for high-risk MDR infections ranged from 0.000 to 0.810. Common MDR pathogens included MDR *Pseudomonas aeruginosa*, MDR *Klebsiella pneumoniae*, carbapenem-resistant *Acinetobacter baumannii* (CRAB), and methicillin-resistant *Staphylococcus aureus* (MRSA). **Conclusion** Among OSCC patients undergoing flap reconstruction, MDR pulmonary infections were predominantly caused by gram-negative bacteria (including CRAB, MDR *Pseudomonas aeruginosa*, and MDR *Klebsiella pneumoniae* along with the gram-positive pathogen MRSA. Pre-existing pulmonary comorbidities, prolonged surgery duration (≥ 490 min), significant intraoperative blood loss (≥ 400 mL), and abnormal BMI were confirmed as independent risk factors for these MDR infections. The nomogram predictive model incorporating these four variables demonstrated clinically reliable accuracy in risk stratification for postoperative MDR pulmonary infections in this patient population.

【Key words】 oral squamous cell carcinoma; multidrug-resistant organism; postoperative pneumonia; flap reconstruction; nomogram; body mass index; meticillin-resistant *Staphylococcus aureus*; carbapenem-resistant *Acinetobacter baumannii*
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口腔鳞状细胞癌(oral squamous cell carcinoma,OSCC)是口腔颌面部最常见的恶性肿瘤[1],外科手术是其主要治疗方式[2]。尤其是中晚期OSCC切除术后所导致的组织缺损通常较大,无法直接缝合,多需要进行邻近皮瓣或游离皮瓣转移修复,以充分关闭创面消灭无效腔,避免颌面部畸形,最大程度恢复患者术后功能,提高生活质量[3-4]。术后肺部感染(postoperative pneumonia,POP)是OSCC患者术后最常见的并发症之一[5-6]。据报道,POP的发病率在0.6%~27%,主要取决于手术方式和患者群体[7],Xu等[8]的研究表明,73.3%的病例中可以分离出细菌病原体。然而,由于抗生素滥用等多种原因,多重耐药菌的检出率呈逐年上升趋势[9-10]。术后肺部多重耐药菌感染会导致患者住院时间延长、医疗费用增加,甚至增加死亡率[11-12]。因此,本研究旨在回顾性分析OSCC患者皮瓣修复术后肺部感染多重耐药菌的危险因素及分布类型,并根据危险因素构建列线图,便于临床医生早期识别,以有效避免一些高危患者皮瓣修复术后感染肺部多重耐药菌。

1　资料和方法

本文为回顾性研究,本次研究经中国科学技术大学附属第一医院(安徽省立医院)伦理委员会

的批准(审批号:[2024-RE-274]),已经取得研究对象的知情同意。

1.1　研究对象

选取中国科学技术大学附属第一医院2021年11月至2024年5月接受治疗的OSCC患者为研究对象109例,其中男性78例,女性31例;年龄30~79岁,平均年龄为(56.97±10.55)岁;肿瘤部位包括舌48例、腭8例、牙龈19例、颊癌20例、口底癌14例。

纳入标准:①病理确诊为OSCC;②接受口腔癌根治手术及皮瓣修复手术治疗。

排除标准:①临床资料不完整;②术前存在感染情况;③未接受皮瓣修复;④术后未进行完善的痰培养细菌检测;⑤术前放化疗的患者。

1.2　痰培养及药敏试验

术后1、3、5 d分别采集患者呼吸道或气管切开口分泌的痰液进行痰培养和药敏试验,在上述3次送检过程中,只要有一次检测出多重耐药菌,便判定为肺部感染多重耐药菌。

病原学标本的采集严格参照《全国临床检验操作规程》[13]执行,采用全自动细菌鉴定仪(VITEK 2,梅里埃,法国)对菌种进行鉴定。

药敏试验的操作及结果判读则依据美国临床和实验室标准化协会的相关标准[14]。术后肺部感染多重耐药菌的判定标准:多重耐药菌定义是指对三种或更多不同结构的抗菌药物同时呈现耐药性的细菌[15]。对具有多耐药性(multidrug resistant, MDR)、广泛耐药性(extensive drug resistant, XDR)、全耐药性(pandrug resistant, PDR)的多重耐药菌,按照《以MDR、XDR、PDR多重耐药菌暂行标准定义——国际专家建议》[16]的标准进行分类。记录术后痰培养及药敏试验结果。

1.3　临床资料记录

记录入组患者的临床资料,包括性别、年龄、吸烟、饮酒、糖尿病(对糖尿病患者实施严格血糖管理。术前常规检测五点血糖,待血糖平稳且正常时才安排手术,以此降低手术风险。术后持续检测五点血糖)、气管切开、术前血清白蛋白、皮瓣类型、输血、手术时间、肺部基础疾病(慢性阻塞性肺疾病、肺气肿、间质性肺炎)、术中出血量、身体质量指数(body mass index, BMI)、重症监护室(intensive care unit, ICU)、术后卧床时间、肿瘤大小。

1.4　统计学方法

采用SPSS 26.0软件对数据进行统计分析。分析OSCC患者皮瓣修复术后肺部感染多重耐药菌的危险因素及分布类型。卡方检验进行OSCC皮瓣修复术后肺部感染病原菌、多重耐药菌的危险因素分析。以术后痰培养病原菌的多重耐药情况为因变量,以卡方检验分析所得危险因素(输血、肺部基础疾病、术中出血量、BMI、手术时间)为自变量,进行多元logistic 回归分析。$P<0.05$为差异具有统计学意义。使用R软件包(版本R4.3.3)构建列线图风险预测模型、受试者操作特征(receiver operating characteristic, ROC)曲线、校准曲线和临床决策曲线分析(decision curve analysis, DCA)。

2　结　果

2.1　OSSC患者皮瓣修复术后肺部感染病原菌、多重耐药菌情况及药敏试验结果

2.1.1　肺部感染病原菌、多重耐药菌情况　对109例患者进行了痰培养和药敏试验,其中有52例病原菌培养结果为阴性,57例为阳性,57例的病原菌种类分布:革兰阴性菌占多数,主要包括铜绿假单胞菌35.1%(20/57)、肺炎克雷伯菌17.5%(10/57)、鲍曼不动杆菌14.0%(8/57);革兰阳氏菌主要包括金黄色葡萄球菌5.26%(3/57)。

痰培养阳性的57例中,有14例为多重耐药菌感染,其中革兰氏阴性菌占多数(71.43%,10/14)。多重耐药菌感染呈现显著时间依赖性特征(表1):术后第1天检出2例(14.3%),第3天达高峰,检出8例(57.1%),第5天检出4例(28.6%)。

表1　OSCC患者皮瓣修复术后肺部感染多重耐药菌的时间分布

Table 1　Temporal distribution of postoperative pulmonary infections with multidrug-resistant bacteria in patients with OSCC undergoing flap repair surgery　*n* (%)

Postoperative day	Multidrug-resistant organism infections (*n*=14)
Day 1	2 (14.3)
Day 3	8 (57.1)
Day 5	4 (28.6)

OSCC: oral squamous cell carcinoma

2.1.2　多重耐药菌药敏试验结果　本研究多重耐药菌主要分析了铜绿假单胞菌(3株)、肺炎克雷伯菌(2株)、鲍曼不动杆菌(4株)和金黄色葡萄球菌(3株)的耐药性情况。

革兰氏阴性菌药敏试验结果:铜绿假单胞菌、肺炎克雷伯菌、鲍曼不动杆菌在头孢他啶、头孢吡

肟、青霉素、苯唑西林、亚胺培南、哌拉西林、替卡西林、克林霉素、多西环素、左氧氟沙星、复方新诺明这11种抗生素中表现不同程度的耐药性。3株多重耐药铜绿假单胞菌主要对替卡西林、亚胺培南及头孢他啶表现出耐药性；2株多重耐药肺炎克雷伯菌对头孢他啶、头孢吡肟、替卡西林均表现出耐药性；4株耐碳青霉烯类鲍曼不动杆菌对头孢他啶、亚胺培南、替卡西林及多西环素均表现出耐药性。

革兰氏阳性菌药敏试验结果：3株耐甲氧西林金黄色葡萄球菌主要对苯唑西林、青霉素和克林霉素表现出耐药性。

2.2　OSCC患者皮瓣修复术后肺部感染病原菌危险因素分析

两组在气管切开、术前血清白蛋白、皮瓣类型、术后卧床时间和肿瘤大小方面均无统计学差异；而在性别、年龄、吸烟、饮酒、糖尿病、输血、手术时间、肺部基础疾病、术中出血量、BMI和ICU方面则具有统计学差异（$P < 0.05$）（表2）。

2.3　OSCC患者皮瓣修复术后肺部感染多重耐药

表2　OSCC患者皮瓣修复术后肺部感染病原菌危险因素分析

Table 2　Risk factor analysis for postoperative pulmonary infections with pathogens in patients with OSCC undergoing flap repair surgery　*n* (%)

Variable		No pathogenic bacteria infection (n = 52)	Pathogenic bacteria infection (n = 57)	t/χ^2	P
Sex	Female	22 (71.0)	9 (29.0)	9.4	< 0.001
	Male	30 (38.5)	48 (61.5)		
Age	< 60 years	36 (62.1)	22 (37.9)	10.25	< 0.001
	⩾ 60 years	16 (31.4)	35 (68.6)		
Smoking	No	35 (59.3)	24 (40.7)	6.96	< 0.001
	Yes	17 (34.0)	33 (66.0)		
Drinking	No	37 (57.8)	27 (42.2)	6.35	0.001
	Yes	15 (33.3)	30 (66.7)		
Diabetes	No	47 (51.1)	45 (48.9)	4.22	0.040
	Yes	5 (29.4)	12 (70.6)		
Tracheostomy	No	10 (52.6)	9 (47.4)	0.22	0.640
	Yes	42 (46.7)	48 (53.3)		
Preoperative serum albumin ($\bar{x}\pm s$, g/L)		43.63±4.97	42.92±3.75	0.09	0.770
Flap types	Pedicled flap	11 (47.8)	12 (52.2)		0.950
	Free flap	41 (47.7)	45 (52.3)		
Blood transfusion	No	50 (51.5)	47 (48.5)	5.21	0.020
	Yes	2 (16.7)	10 (83.3)		
Operative time	< 490 min	42 (73.7)	17 (26.3)	28.42	< 0.001
	⩾ 490 min	10 (20.0)	40 (80.0)		
Underlying pulmonary diseases	No	34 (61.8)	21 (38.2)	8.86	< 0.001
	Yes	18 (33.3)	36 (66.7)		
Intraoperative blood loss	< 400 mL	48 (53.3)	42 (46.7)	6.55	0.001
	⩾ 400 mL	4 (21.1)	15 (78.9)		
BMI	Normal	26 (40.0)	39 (60.0)	3.83	0.050
	Abnormal	26 (59.1)	18 (40.1)		
ICU	No	46 (54.8)	38 (45.2)	7.31	0.007
	Yes	6 (24.0)	19 (76.0)		
Postoperative bed rest time	⩽ 3 d	8 (72.7)	3 (27.3)	3.07	0.080
	> 3 d	44 (44.9)	54 (55.1)		
Tumor size	⩽ 4 cm	43 (51.2)	41 (48.8)	1.78	0.180
	> 4 cm	9 (36.0)	16 (64.0)		

BMI: body mass index, normal: 18.5-24 kg/m^2; abnormal: < 18.5, or > 24 kg/m^2. ICU: intensive care unit. OSCC: oral squamous cell carcinoma

菌危险因素分析

两组在性别、年龄、吸烟、饮酒、糖尿病、皮瓣类型、ICU、术后卧床时间、肿瘤大小方面无统计学差异($P > 0.05$)；而在输血、手术时间、肺部基础疾病、术中出血量和BMI方面有统计学差异($P < 0.05$)(表3)。

2.4　OSCC患者皮瓣修复术后肺部感染多重耐药菌危险因素的多元logistic回归分析

研究结果显示肺部基础疾病、术中出血量≥400 mL、BMI异常、手术时间≥490 min是OSCC患者皮瓣修复术后肺部感染多重耐药菌的独立危险因素(表4)。

2.5　OSCC患者皮瓣修复术后肺部感染多重耐药菌的列线图预测模型建立

通过多元logistic回归筛选，本研究确定了4项危险因素(肺部基础疾病、术中出血量≥400 mL、BMI异常、手术时间≥490 min)，并建立了OSCC患者皮瓣修复术后肺部感染多重耐药菌的列线图预测模型(图1a)。

ROC曲线下面积为0.874(95%*CI*：0.775～0.973)，表明该列线图预测模型能够较好地区分多重耐药菌感染患者和非多重耐药菌感染患者(图1b)。

校准图(图1c)显示列线图模型中预测的风险与实际风险之间具有良好的一致性。

DCA曲线显示当OSCC患者皮瓣修复高风险阈值概率为0.000～0.810时，使用列线图预测模型预测OSCC患者皮瓣修复术后感染多重耐药菌风险更有益(图1d)。

该模型在预测OSCC患者皮瓣修复术后肺部感染多重耐药菌具有较高的精准度和区分度。

表3　OSCC患者皮瓣修复术后肺部感染多重耐药菌的危险因素分析

Table 3　Risk factor analysis for postoperative pulmonary infections with multidrug-resistant bacteria in patients with OSCC undergoing flap repair surgery　*n* (%)

Variable		Non-multidrug-resistant organism infection (n = 43)	Multidrug-resistant organism infection (n = 14)	χ^2	P
Smoking	No	20 (83.3)	4 (16.7)	1.39	0.240
	Yes	23 (69.7)	10 (30.3)		
Drinking	No	22 (81.5)	5 (18.5)	1.01	0.320
	Yes	21 (70.0)	9 (30.0)		
Diabetes	No	36 (80.0)	9 (20.0)	2.40	0.121
	Yes	7 (58.3)	5 (41.7)		
Flap types	Pedicled flap	9 (75.0)	3 (25.0)	< 0.01	1.000
	Free flap	34 (75.6)	11 (24.4)		
Blood transfusion	No	39 (83.0)	8 (17.0)	6.60	0.001
	Yes	4 (40.0)	6 (60.0)		
Operative time	< 490 min	14 (73.7)	5 (26.3)	4.42	0.036
	≥ 490 min	29 (76.3)	9 (23.7)		
Underlying pulmonary diseases	No	28 (96.5)	1 (3.5)	7.04	< 0.001
	Yes	15 (53.9)	13(46.1)		
Intraoperative blood loss	< 400 mL	36 (85.7)	6 (14.3)	7.11	< 0.001
	≥ 400 mL	7 (46.7)	8 (53.3)		
BMI	Normal	33 (84.6)	6 (15.4)	4.15	0.040
	Abnormal	10 (55.6)	8 (44.4)		
ICU	No	30 (78.9)	8 (21.1)	0.76	0.380
	Yes	13 (72.2)	6 (27.8)		
Postoperative bed rest time	≤ 3 d	3 (100.0)	0 (0.0)	1.03	0.570
	> 3 d	40 (74.1)	14 (25.9)		
Tumor size	≤ 4 cm	34 (82.9)	7 (17.1)	3.10	0.080
	> 4 cm	9 (56.3)	7 (43.7)		

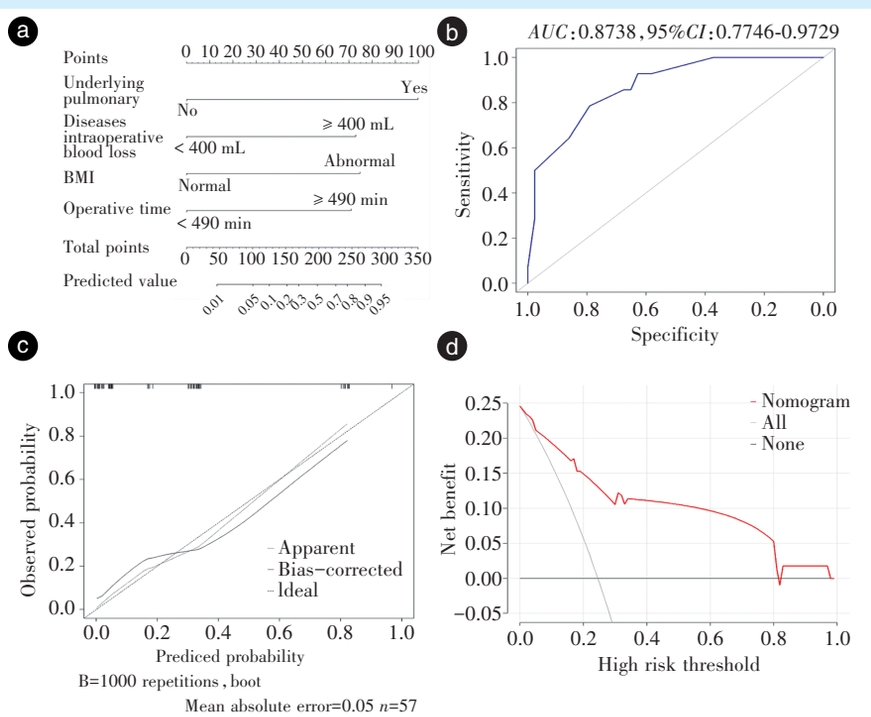
BMI: body mass index, normal: 18.5-24 kg/m^2; abnormal: < 18.5, or > 24 kg/m^2. ICU: intensive care unit. OSCC: oral squamous cell carcinoma

表4　OSCC皮瓣修复患者术后肺部感染多重耐药菌影响因素的多元logistic回归分析

Table 4　Multivariate logistic regression analysis of influencing factors for postoperative pulmonary infections with multidrug-resistant bacteria in patients with OSCC undergoing flap repair surgery

Variable	β	*SE*	*Wals*	*OR*(95%*CI*)	*P*
Intercept	−1.999	1.051	3.617		0.057
Blood transfusion	0.932	0.934	0.996	2.539(0.407−15.829)	0.318
Underlying pulmonary diseases	2.667	1.341	3.965	14.392(1.040−199.217)	0.047
Intraoperative blood loss	2.051	0.921	4.960	7.774(1.279−47.251)	0.026
BMI	2.147	0.983	4.765	8.558(1.245−58.817)	0.029
Operative time	−2.103	1.059	3.948	0.122(0.015−0.972)	0.047

OR: odds ratio. BMI: body mass index, normal: 18.5-24 kg/m^2; abnormal: < 18.5, or > 24 kg/m^2. OSCC: oral squamous cell carcinoma



a: nomogram prediction model constructed based on the clinical data of 109 patients with oral squamous cell carcinoma who underwent skin flap reconstruction. b: ROC curve of the nomogram prediction model. The area under the ROC curve (AUC) was 0.874 (95%*CI*=0.775-0.973), *P* < 0.001. c: calibration curve of the nomogram prediction model. The ideal curve represents the scenario in which the predicted probability is entirely consistent with the actual probability. d: decision curve analysis (DCA) curve of the nomogram prediction model. The clinical decision curve provides a greater net benefit within the range of 0-0.81. OSCC: oral squamous cell carcinoma

Figure 1　Nomogram prediction model for postoperative pulmonary infections with multidrug-resistant bacteria in patients with OSCC undergoing flap repair surgery

图1　OSCC患者皮瓣修复术后肺部感染多重耐药菌的列线图预测模型

3　讨　论

OSCC是最常见的头颈部肿瘤，占口腔恶性肿瘤的90%左右，据统计在全身癌症构成比中约第八位[17]。联合根治性手术治疗是OSCC的最主要的治疗方法，尤其是随着显微外科、修复重建外科理念的建立和技术的成熟，5年生存率得到了明显的提高，患者术后的面容恢复以及生活质量也得到了极大的保证。这种联合根治手术创伤大，时间长，出血量大[18]，而且接受手术的多为老年患者，术后易于发生肺部感染、卧床引起的下肢静脉血栓及其相关的脑梗、心梗、肺梗等严重并发症。而术后继发肺部感染是最常见也是最严重的并发症[19]。究其原因，此类手术的患者需要全身麻醉和气管插管，插管通常会放置在口腔或鼻腔内，而口腔与口咽和呼吸道相通，其潮湿温暖的环境有利于细菌滋生；再加上口腔颌面部腔和鼻窦结构复杂，使得消毒无菌的目的很难达到[20-21]。此外，口腔癌同期行皮瓣移植的患者术后呼吸道分泌物增加，且其短时间内吞咽功能未完全恢复引起误吸，均可能导致术后肺部感染[6]。然而，目前缺乏针对OSCC患者皮瓣修复术后肺部感染多重耐药的预测模型。故本研究构建了可视化的列线图预

测模型，对OSCC患者皮瓣修复术后肺部感染多重耐药菌危险因素进行了分析，结果表明该模型具有良好的临床运用价值，将有助于临床医生有针对性地为患者制定早期干预计划。

本研究结果表明，肺部基础疾病、手术时间≥490 min、术中出血量≥400 mL、BMI异常是OSCC患者皮瓣修复术后肺部感染多重耐药菌的独立危险因素。合并肺部基础疾病的患者术后更易感染肺部多重耐药菌与以往的文献报道一致[22-23]，患有肺部基础疾病者，其气道黏膜通常呈现损伤与炎症浸润状态，由此致使气道纤毛运动功能受损，黏膜分泌功能亢进。上述病理生理改变削弱了呼吸道对病菌的天然防御屏障作用，进而致使肺部感染发生率显著上升，极大增加了此类患者并发肺部感染的风险[24]。随着手术时间的延长，麻醉和机械通气时间也会增加，可能导致吞咽和呼吸异常，而持续较长的机械通气时间与术后肺炎的发病率增加相关[25-26]。其次手术时间的延长，术中液体管理变得更加复杂，同时伴有术后肺部并发症的风险更高[27]。术中出血量≥400 mL提示手术创伤较大，可能抑制机体免疫系统，增加术后肺部感染的风险[28]。BMI异常是患者肥胖或者消瘦的结果，有研究表明肥胖患者术后肺部并发症风险增加[29]，本研究结果与其一致；晚期OSCC患者通常伴发疼痛和吞咽困难，容易导致体重减轻，可使患者BMI值偏低。低BMI值可反映营养不良状态，并可能与患者免疫功能受损有关[30]。

近几十年来，由于预防性抗生素的滥用，细菌病原体的多重耐药性逐渐增加。Moolchandani等[31]发现，在医院获得性感染中，多重耐药性革兰氏阴性杆菌（multidrug - resistant gram-negative bacilli，MDR-GNB）的患病率高达55.7%。这些革兰氏阴性菌如肺炎克雷伯菌、大肠杆菌、铜绿假单胞菌、奇异变形杆菌、鲍曼不动杆菌和肠杆菌属经常与抗微生物耐药性有关[32-34]。尤其是产超广谱β-内酰胺酶和碳青霉烯酶的肠杆菌科以及耐多药铜绿假单胞杆菌和鲍曼不动杆菌株感染已成为严重问题[35-37]。本研究检测出14株多重耐药菌，其中，革兰氏阴性菌占多数（71.43%，10/14）与以往研究较为一致[38]。主要是铜绿假单胞菌和鲍曼不动杆菌，其中，鲍曼不动杆菌对亚胺培南碳青霉烯类抗生素表现出100%的耐药性，为耐碳青霉烯类鲍曼不动杆菌。革兰氏阳性菌主要为金黄色葡萄球菌，对青霉素和苯唑西林表现出较高的耐药性（100%），为耐甲氧西林金黄色葡萄球菌。这些结果与先前的研究结果一致。

本回顾性研究结果提示，结合临床数据开发的列线图可以个性化评估OSCC患者皮瓣修复术后肺部感染多重耐药菌的风险，有助于识别高风险的目标患者。例如，如果患者术前已有肺部基础疾病、BMI正常、出血量为400 mL、手术时长达到500 min，根据该列线图预测模型计算得出的总分约为243.5分，肺部感染多重耐药菌的风险大约为75%。

值得注意的是，本研究通过动态监测发现术后肺部多重耐药菌感染呈现显著的时序分布特征。术后第1天即出现2例感染，其术后第3天感染达高峰（8例），术后第5天出现4例感染。术后第3天出现感染高峰主要与术中出血量≥400 mL、肺部基础疾病及BMI异常相关，同时，有6例患者吸烟，烟草中的有害物质可能损害呼吸道黏膜，降低呼吸道防御功能[39]；3例术后曾在ICU观察1 d，ICU环境中多重耐药菌的暴露机会相对较多[40-42]，这些因素共同作用，导致第3天感染人数增加。

综上，肺部基础疾病、手术时间≥490 min、出血量≥400 mL以及BMI异常（BMI < 18 kg/m^2，或者BMI > 24.5 kg/m^2）是OSCC患者皮瓣修复术后肺部感染多重耐药菌的独立危险因素。该风险预测模型具有较高的准确性和临床应用价值。本研究也存在一定局限性：其一，因患者术后血常规检查时间不统一、数值差异大，无法确定统一检查时间对比，致部分基础值缺失，后续研究将规范检查并纳入血常规数据以提升全面性；其二，未细分患者在ICU停留时间且未考量抗生素使用情况，后续会将此二者充分纳入以增强准确性；其三，本研究为小样本的研究，外部验证比较困难。其缺失外部验证对研究结果可靠性、准确性和推广潜力的影响。后续将纳入多中心大样本深入探究。通过不断完善，有望为OSCC患者皮瓣修复术后康复与感染防控提供更具价值的临床实践参考。

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