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## 【临床研究】

# 肺癌患者肺切除术后肺部感染危险因素分析

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**摘要:** 目的 探讨肺癌患者肺切除术后肺部感染的发生情况及危险因素,以期为肺癌患者术后并发肺部感染的预防提供依据。方法 选择2013年4月至2020年3月郑州大学第一附属医院收治的730例肺癌患者为研究对象。收集患者的一般临床资料,包括:性别、年龄、民族、婚姻状况、居住地、吸烟史、饮酒史、糖尿病史、高血压病史、肺部相关疾病史、第1秒用力呼气量占用力肺活量的比例( $FEV_1/FVC$ ) ;围手术期临床资料,包括:手术方式、手术时间、手术部位、术中出血量、术后胸腔引流总量、机械通气时间、胸腔引流时间、住院时间。应用全自动微生物鉴别系统检测患者术后3 d 并发肺部感染肺癌患者痰液中的病原菌种类和数量。结果 730例肺癌患者中,术后出现肺部感染82例(感染组),未出现肺部感染648例(对照组)。感染组82例患者中,混合病原菌感染的患者64例(78.05%),单纯病原菌感染的患者18例(21.95%);从感染组患者痰液中共培养出136株病原菌株,其中革兰阴性菌71株(52.20%),主要以溶血不动杆菌和肺炎克雷伯菌为主;革兰阳性菌55株(40.44%),主要以溶血葡萄球菌和金黄色葡萄球菌为主;真菌10株(7.35%)。单因素分析结果显示,年龄、吸烟史、糖尿病史、肺部相关疾病史、手术方式、手术时间、术中出血量、术后胸腔引流总量、机械通气时间、胸腔引流时间、住院时间与肺癌患者术后并发肺部感染有关( $P < 0.05$ );性别、民族、婚姻状况、居住地、高血压病史、 $FEV_1/FVC$ 、手术部位与肺癌患者术后并发肺部感染无关( $P > 0.05$ )。Logistic 回归分析结果显示,年龄 $\geq 60$ 岁、有吸烟史、有糖尿病史、有肺部相关疾病史、手术方式(开胸)、手术时间 $\geq 3$  h、术中出血量 $\geq 200$  mL、术后胸腔引流总量 $\geq 600$  mL、机械通气时间 $\geq 12$  h、胸腔引流时间 $\geq 5$  d、住院时间 $\geq 20$  d是肺癌患者术后并发肺部感染的独立危险因素( $P < 0.05$ )。结论 肺癌患者术后肺部感染的发生率较高,年龄 $\geq 60$ 岁、有吸烟史、有糖尿病史、有肺部相关疾病史、手术方式(开胸)、手术时间 $\geq 3$  h、术中出血量 $\geq 200$  mL、术后胸腔引流总量 $\geq 600$  mL、机械通气时间 $\geq 12$  h、胸腔引流时间 $\geq 5$  d、住院时间 $\geq 20$  d是肺癌患者术后并发肺部感染的独立危险因素。

**关键词:** 肺癌;肺部感染;危险因素

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## Risk factors for pulmonary infection in patients with lung cancer after pulmonary resection

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**Abstract:** **Objective** To investigate the incidence and risk factors of pulmonary infection of patients with lung cancer after pulmonary resection, in order to provide the evidence for the prevention of postoperative pulmonary infection of patients with lung cancer. **Methods** A total of 730 patients with lung cancer admitted to the First Affiliated Hospital of Zhengzhou University from April 2013 to March 2020 were selected as the research subjects. The general clinical data of the patients were collected, including gender, age, ethnicity, marital status, place of residence, smoking history, drinking history, diabetes history, hypertension history, history of lung-related diseases, forced expiratory volume in one second/forced vital capacity( $FEV_1/FVC$ ) ;the perioperative clinical data were collected, including operation method, operation time, surgical site, intraoperative blood loss, total postoperative thoracic drainage, mechanical ventilation time, thoracic drainage time, hospitalization time. The species and quantity of pathogenic bacteria in the sputum of patients with lung cancer complicated with pulmonary infection were detected by the automatic microbiological identification system at 3 days after operation. **Results** Among the 730 patients with lung cancer, 82 patients had pulmonary infection after operation (infection group), and 648 patients did not have pulmonary infection

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(control group). Among the 82 patients in the infection group, 64 (78.05%) patients were infected with mixed pathogens, and 18 (21.95%) patients were infected with pure pathogens; a total of 136 pathogenic strains were cultured from the sputum of patients in the infection group, including 71 (52.20%) strains gram-negative bacteria, mainly included *Acinetobacter hemolyticus* and *Klebsiella pneumoniae*; 55 (40.44%) strains gram-positive bacteria, mainly included *Staphylococcus hemolyticus* and *Staphylococcus aureus*; 10 (7.35%) strains fungi. Univariate analysis showed that the age, smoking history, history of diabetes, history of lung-related diseases, operation method, operation time, intraoperative blood loss, total postoperative thoracic drainage, mechanical ventilation time, thoracic drainage time, hospitalization time were associated with postoperative pulmonary infection of patients with lung cancer ( $P < 0.05$ ); the gender, ethnicity, marital status, place of residence, history of hypertension, FEV<sub>1</sub>/FVC and surgical site were not associated with postoperative pulmonary infection of patients with lung cancer ( $P > 0.05$ ). Logistic regression analysis showed that age  $\geq 60$  years old, history of smoking, history of diabetes, history of lung-related diseases, operation method (thoracotomy), operation time  $\geq 3$  hours, intraoperative blood loss  $\geq 200$  mL, postoperative thoracic drainage volume  $\geq 600$  mL, mechanical ventilation time  $\geq 12$  h, thoracic drainage time  $\geq 5$  days and hospitalization time  $\geq 20$  days were independent risk factors for postoperative pulmonary infection of patients with lung cancer ( $P < 0.05$ ). **Conclusion** The incidence of postoperative pulmonary infection of patients with lung cancer is high, and age  $\geq 60$  years old, history of smoking, history of diabetes, history of lung-related diseases, operation method (thoracotomy), operation time  $\geq 3$  hours, intraoperative bleeding volume  $\geq 200$  mL, postoperative thoracic drainage volume  $\geq 600$  mL, mechanical ventilation time  $\geq 12$  hours, pleural drainage time  $\geq 5$  days and hospitalization time  $\geq 20$  days were independent risk factors for postoperative pulmonary infection of patients with lung cancer.

**Key words:** lung cancer; pulmonary infection; risk factor

肺癌是一种常见的呼吸系统恶性肿瘤,多发于中老年群体,近年来,其发病率呈上升趋势<sup>[1-2]</sup>。肺癌患者早期缺乏典型的临床症状,就诊时往往已处于进展期,治疗方法以手术切除为主。然而,由于肺癌患者的免疫力较弱,极易引发术后感染,不利于患者术后恢复<sup>[3-7]</sup>。目前,肺癌患者术后发生肺部感染的病原菌的分布特点及危险因素尚未完全明确。本研究旨在探讨肺癌患者肺切除术后发生肺部感染的危险因素,以期为肺癌患者术后并发肺部感染的预防提供依据。

## 1 资料与方法

**1.1 一般资料** 选择2013年4月至2020年3月郑州大学第一附属医院收治的肺癌患者为研究对象。病例纳入标准:(1)病历资料完整;(2)经影像学和病理学检查确诊为肺癌患者;(3)卡氏生存质量评分<sup>[8]</sup>  $\geq 60$ 分;(4)术前未接受放射治疗和化学治疗;(5)所有肺癌患者肺切除术均由同一治疗团队完成;(6)预计生存期大于6个月。病例排除标准:(1)肺切除术前已患有肺部感染或者其他部位的慢/(急)性感染并发症;(2)同期接受其他手术治疗者;(3)合并精神类疾病;(4)有严重肝、肾等主要脏器功能障碍;(5)长期采用机械性通气或气管切开等可能会引起继发感染措施的患者;(6)术后死亡的患者。本研究共纳入肺癌患者730例,其中男374例,女356例;年龄40~77(58.69±6.57)岁。

本研究经郑州大学第一附属医院伦理委员会审核批准,患者及家属签署知情同意书。

**1.2 临床资料** 收集患者的一般临床资料,包括:性别、年龄、民族、婚姻状况、居住地、吸烟史、饮酒史、糖尿病史、高血压病史、肺部相关疾病史、第1秒用力呼气量占用力肺活量的比例(forced expiratory volume in one second/forced vital capacity, FEV<sub>1</sub>/FVC);围手术期临床资料,包括:手术方式、手术时间、手术部位、术中出血量、术后胸腔引流总量、机械通气时间、胸腔引流时间、住院时间等。

**1.3 肺部感染诊断标准** 对肺癌患者术后发生肺部感染的诊断依据《医院感染诊断标准》<sup>[9]</sup>:(1)患者体温 $>38$ ℃;(2)外周血白细胞计数 $>15 \times 10^9 \text{ L}^{-1}$ ;(3)出现咳嗽、咳痰等肺部感染的临床症状;(4)肺部有湿啰音;(5)影像学检查显示患者肺部出现了明显的感染病灶。当肺癌患者术后3 d内出现了上述5项诊断标准中的任意4项,即可确诊为肺癌患者术后并发了肺部感染。

**1.4 痰液中病原菌的鉴定** 收集术后并发肺部感染肺癌患者的痰液,并将其培养于麦康凯平板、血琼脂平板、巧克力平板培养,37℃培养24 h后制成1麦氏单位菌悬液,并采用全自动微生物鉴别系统(法国生物梅里埃公司)进行菌株种类和数量鉴定,实验重复2次。同一患者的2次痰液检测结果一致者为1份,不一致者则为2份。

**1.5 统计学处理** 应用SPSS 21.0软件进行数据

统计与分析。计量资料以均数±标准差( $\bar{x} \pm s$ )表示,两组间比较采用t检验;计数资料以例数和百分率表示,两组间比较采用 $\chi^2$ 检验;采用单因素和多因素logistic回归分析影响肺癌患者术后并发肺部感染的危险因素; $P < 0.05$ 为差异有统计学意义。

## 2 结果

**2.1 730例肺癌患者术后并发肺部感染情况** 730例肺癌患者中,术后出现肺部感染82例(感染组),未出现肺部感染648例(对照组)。

**2.2 术后并发肺部感染肺癌患者痰液中病原菌分布情况** 结果见表1。82例感染组患者中,混合病原菌感染患者64例(78.05%),单纯病原菌感染患者18例(21.95%);从感染组患者痰液中共培养出136株病原菌株,其中革兰阴性菌71株(52.20%),以溶血不动杆菌和肺炎克雷伯菌为主;革兰阳性菌55株(40.44%),以溶血葡萄球菌和金黄色葡萄球菌为主;真菌10株(7.35%)。

表1 术后并发肺部感染肺癌患者痰液中病原菌分布情况

**Tab. 1 Distribution of pathogenic bacteria in sputum of patients with lung cancer complicated with postoperative pulmonary infection**

病原菌	菌株数	构成比/%
革兰阴性菌	71	52.20
溶血不动杆菌	26	19.11
肺炎克雷伯菌	17	12.50
大肠埃希菌	11	8.09
铜绿假单胞菌	9	6.62
洋葱伯克霍尔德菌	2	1.47
产气肠杆菌	2	1.47
其他	4	2.94
革兰阳性菌	55	40.44
溶血葡萄球菌	24	17.65
金黄色葡萄球菌	17	12.50
屎肠球菌	8	5.88
肺炎链球菌	4	2.94
其他	2	1.47
真菌	10	7.35
白色念珠菌	3	2.21
其他	7	5.15

**2.3 肺癌患者术后并发肺部感染的影响因素单因素分析** 结果见表2。单因素分析结果显示,年龄、吸烟史、糖尿病史、肺部相关疾病史、手术方式、手术时间、术中出血量、术后胸腔引流总量、机械通气时间、胸腔引流时间、住院时间与肺癌患者术后并发肺部感染有关( $P < 0.05$ ),性别、民族、婚姻状况、居住地、高血压病史、FEV<sub>1</sub>/FVC、手术部位与肺癌患者术后并发肺部感染无关( $P > 0.05$ )。

表2 肺癌患者术后并发肺部感染的单因素分析

**Tab. 2 Univariate analysis of pulmonary infection after surgery in patients with lung cancer**

影响因素	感染组(n=82)	对照组(n=648)	$\chi^2$	P
性别				
男	48(58.54)	326(50.31)		
女	34(41.46)	322(49.69)	1.972	0.160
年龄				
<60岁	21(25.61)	369(56.94)		
≥60岁	61(74.39)	279(43.06)	28.722	0.000
民族				
汉族	77(93.90)	598(92.28)		
其他民族	5(6.10)	50(7.72)	0.274	0.601
婚姻状况				
未婚	6(7.32)	29(4.48)		
已婚	76(92.68)	619(95.52)	1.288	0.390
居住地				
本地	73(89.02)	599(92.44)		
外地	9(10.98)	49(7.56)	1.160	0.281
吸烟史				
无	42(51.22)	489(75.46)		
有	40(48.78)	159(24.54)	21.575	0.000
饮酒史				
无	59(71.95)	429(66.20)		
有	23(28.05)	219(33.80)	1.085	0.298
糖尿病史				
无	58(70.73)	571(88.12)		
有	24(29.27)	77(11.88)	18.455	0.000
高血压史				
无	60(73.17)	461(71.14)		
有	22(26.83)	187(28.86)	0.147	0.702
肺部相关疾病史				
无	47(57.32)	528(81.48)		
有	35(42.68)	120(18.52)	15.414	0.000
FEV <sub>1</sub> /FVC				
<70%	65(79.27)	550(84.88)		
≥70%	17(20.73)	98(15.12)	1.725	0.189
手术方式				
开胸	53(64.63)	175(27.01)		
胸腔镜	29(35.37)	473(72.99)	47.984	0.000
手术时间				
<3 h	61(74.39)	602(92.90)		
≥3 h	21(25.61)	46(7.10)	29.921	0.000
手术部位				
肺叶切除	66(80.49)	515(79.48)		
亚肺叶切除	16(19.51)	133(20.52)	0.046	0.830
术中出血量				
<200 mL	38(46.34)	435(67.13)		
≥200 mL	44(53.66)	213(32.87)	13.79	0.000
术后胸腔引流总量				
<600 mL	20(24.39)	342(52.78)		
≥600 mL	62(75.61)	306(47.22)	23.464	0.000
机械通气时间				
<12 h	31(37.80)	388(59.88)		
≥12 h	51(62.20)	260(40.12)	14.501	0.000
胸腔引流时间				
<5 d	49(59.76)	497(76.70)		
≥5 d	33(40.24)	151(23.30)	11.082	0.001
住院时间				
<20 d	23(28.05)	368(56.79)		
≥20 d	59(71.95)	280(43.21)	24.174	0.000

## 2.4 肺癌患者术后并发肺部感染危险因素 logistic 回归分析

结果见表3。将单因素分析差异有统计学意义的因素进行 logistic 回归分析,结果显示,年龄≥60岁、有吸烟史、有糖尿病史、有肺部相关疾病史。

表3 肺癌患者术后并发肺部感染的危险因素 logistic 回归分析

Tab. 3 Logistic regression analysis of risk factors for postoperative pulmonary infection in patients with lung cancer

因素	B	SE	Wald	P	OR	95% 置信区间	
						下限	上限
年龄≥60岁	2.018	0.514	7.389	0.002	1.741	1.085	2.657
吸烟史	1.437	0.483	9.416	0.003	1.217	1.008	1.972
糖尿病史	0.975	0.095	6.003	0.028	1.459	1.055	2.318
肺部相关疾病史	0.528	0.136	5.861	0.008	1.357	1.074	2.003
手术方式(开胸)	3.168	0.769	18.058	0.000	4.412	2.075	12.866
手术时间≥3 h	1.971	0.415	7.265	0.016	2.027	1.863	4.564
术中出血量≥200 mL	1.057	0.493	8.965	0.006	2.921	1.255	6.879
术后胸腔引流总量≥600 mL	1.085	0.467	6.018	0.022	1.409	1.081	3.885
机械通气时间≥12 h	1.175	0.554	8.835	0.005	2.517	1.289	6.387
胸腔引流时间≥5 d	1.283	0.625	7.548	0.004	2.043	1.067	6.034
住院时间≥20 d	1.519	0.533	7.619	0.002	2.881	1.249	10.361

## 3 讨论

肺癌患者肺切除术后易出现肺部感染,可加速病情的恶化,不利于患者术后恢复,同时也是肺癌患者术后死亡的常见原因<sup>[10-11]</sup>。进展期肺癌患者术后并发的肺部感染往往难以得到很好的控制,通常联合使用病原菌较敏感的抗生素<sup>[6,12]</sup>。另外,还可以采取对症治疗肺癌患者术后并发的肺部感染,如应用止咳化痰及中枢镇咳类药物。此外,提高患者的免疫力对于肺癌患者术后并发肺部感染也至关重要,如可通过注射白蛋白、免疫球蛋白或胸腺肽等提高肺癌患者的免疫力<sup>[13-15]</sup>。

本研究结果显示,纳入的730例肺癌患者中,术后发生肺部感染者82例,感染率为11.23%,这一结果证实肺癌患者术后较易发生肺部感染。本研究发现,82例术后并发肺部感染的肺癌患者中,混合病原菌感染者64例(78.05%),单纯病原菌感染者18例(21.95%),说明混合病原菌感染肺癌患者略多于单纯病原菌感染。本研究通过检测术后并发肺部感染肺癌患者痰液中病原菌类型发现,培养出的136株病原菌株中,革兰阴性菌占52.20%,以溶血不动杆菌和肺炎克雷伯菌为主;革兰阳性菌占40.44%,以溶血葡萄球菌和金黄色葡萄球菌为主;提示在术后并发肺部感染肺癌患者的治疗策略中,应当根据不同的病原菌类型采取针对性的预防及治疗策略。

本研究对肺癌患者术后并发肺部感染的影响因素进行单因素分析和进一步危险因素 logistic 回归分析,结果发现,年龄≥60岁、有吸烟史、有糖尿病史、有肺部相关疾病史、手术方式(开胸)、手术时间≥3 h、术中出血量≥200 mL、术后胸腔引流总量≥600 mL、机械通气时间≥12 h、胸腔引流时间≥5 d、住院时间≥20 d是肺癌患者术后并发肺部感染的独立

史、手术方式(开胸)、手术时间≥3 h、术中出血量≥200 mL、术后胸腔引流总量≥600 mL、机械通气时间≥12 h、胸腔引流时间≥5 d、住院时间≥20 d是肺癌患者术后并发肺部感染的独立危险因素( $P < 0.05$ )。

危险因素。随着年龄增长,肺癌患者自身免疫功能逐渐降低,高龄肺癌患者在手术后更容易出现肺部感染<sup>[8,16]</sup>。长期大量吸烟会严重破坏肺部组织,导致肺密闭容量增大,损伤气管和支气管上皮纤毛,降低支气管黏膜的清除能力,致使呼吸道黏液和分泌物增多,从而导致肺部感染的发生<sup>[17]</sup>。糖尿病患者因长期高血糖导致白细胞功能损害和单核细胞趋化、黏附能力下降,进而降低了机体免疫系统对病原微生物的吞噬杀灭能力;同时,高血糖环境有利于细菌繁殖,更容易发生各种感染性疾病<sup>[18]</sup>。肺部相关疾病史对肺部造成额外的负担,在一定程度上造成了肺部组织损伤,而在肺癌切除术后则会进一步提高患者肺部感染的概率<sup>[19-20]</sup>。手术方式、手术时间、术中出血量、肺腔引流总量、机械通气时间、胸腔引流时间等手术中影响肺癌患者术后并发肺部感染的危险因素,说明胸腔暴露后增加肺部感染的风险,提示在肺癌患者手术过程中应当避免各个环节的暴露风险,这一结果与其他文献结果一致<sup>[8,14]</sup>。住院时间的延长也增加了肺癌患者术后感染的风险,可能是由于患者的心态及免疫力等多方面的影响导致感染风险增加;同时,住院时间的增加会进一步增加患者发生院内交叉感染的可能,从而导致获得性肺炎,尤其是肺癌晚期体质差的患者<sup>[21-22]</sup>。以上研究表明,肺癌患者术后并发肺部感染的危险因素是多方面的,如患者的年龄、疾病史及手术等均会导致术后肺部感染的发生<sup>[23]</sup>。为有效降低肺癌患者术后肺部感染的发生,应当对相关的危险因素进行仔细检查,并进行有效的干预,使影响肺部感染的危险因素尽量排除<sup>[24-25]</sup>。对高龄肺癌患者而言,由于其营养摄取能力差,免疫水平低,肺部内环境未处于良好水平,术后发生感染的概率较高,应当采取合理的饮食结构,必要时给予输液治疗<sup>[24]</sup>。术后还应当针对肺

癌患者的呼吸功能进行有效的改善和干预,做好肺部感染的各项预防措施。同时,应当对肺癌相关手术细节进行优化、改进,对于可能出现感染的各种隐患进行合理规避,在术后对患者进行针对性的护理。

综上所述,肺癌患者术后肺部感染的发生率较高,年龄≥60岁、有吸烟史、有糖尿病史、有肺部相关疾病史、手术方式(开胸)、手术时间≥3 h、术中出血量≥200 mL、术后胸腔引流总量≥600 mL、机械通气时间≥12 h、胸腔引流时间≥5 d、住院时间≥20 d是肺癌患者术后并发肺部感染的独立危险因素;临床医师应针对这些风险因素采取适当的预防及干预策略,从而降低肺癌患者术后发生肺部感染的发生率。

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