

doi: 10.13241/j.cnki.pmb.2021.12.018

呼吸道感染患者多重耐药菌肺炎克雷伯菌的耐药及危险因素分析*

高琳 李倩 王丽 雷靖 谭焰[△]

(南京医科大学附属南京医院呼吸内科 江苏 南京 210000)

摘要 目的:探讨与分析呼吸道感染患者多重耐药菌肺炎克雷伯菌的耐药及危险因素。**方法:**选择2015年1月到2020年2月本院诊治的呼吸道感染患者65例作为研究对象,收集患者的临床样本进行细菌分离与耐药分析,调查患者的临床资料并进行危险因素分析。**结果:**在呼吸道感染患者65例中,分离出多重耐药菌肺炎克雷伯菌32株,占比49.2%,其中下呼吸道、上呼吸道、灌洗液、血液标本分别占50.0%、9.4%、25.0%、6.3%。32株多重耐药菌肺炎克雷伯菌对头孢曲松、头孢吡肟、氨苄西林、头孢吡肟、头孢噻肟的耐药率分别为71.9%、87.5%、96.9%、84.4%、81.3%,对阿米卡星、头孢替坦、左氧氟沙星、亚胺培南、环丙沙星的敏感率分别为59.4%、68.8%、81.3%、75.0%、81.3%。非条件Logistic回归分析显示血型A型、碳青霉烯类抗菌药物使用、引流、机械通气、糖尿病等为导致多重耐药菌肺炎克雷伯菌感染的独立危险因素($P<0.05$)。**结论:**多重耐药菌肺炎克雷伯菌感染在呼吸道感染患者中比较常见,对头孢吡肟、氨苄西林的耐药率比较高,对左氧氟沙星、环丙沙星的敏感率比较高,血型A型、碳青霉烯类抗菌药物使用、引流、机械通气、糖尿病等为导致多重耐药菌肺炎克雷伯菌感染的独立危险因素。

关键词:呼吸道感染;多重耐药菌肺炎克雷伯菌;耐药;危险因素;血型

中图分类号:R563.1;R969.3 **文献标识码:**A **文章编号:**1673-6273(2021)12-2280-04

Analysis of Drug Resistance and Risk Factors of Multidrug Resistant Bacteria *Klebsiella Pneumonia* in Patients with Respiratory Tract Infection*

GAO Lin, LI Qian, WANG Li, LEI Jing, TAN Yan[△]

(Department of Respiratory Medicine, Nanjing Hospital Affiliated to Nanjing Medical University, Nanjing, Jiangsu, 210000, China)

ABSTRACT Objective: To explore and analysis the drug resistance and risk factors of multidrug resistant bacteria *Klebsiella pneumoniae* in patients with respiratory tract infections. **Methods:** From January 2015 to February 2020, 65 cases of patients with respiratory tract infection who were admitted to the Department of Respiratory Medicine of our hospital were selected as the research objects. Clinical samples of the patients were collected for bacterial isolation and drug resistance analysis, and the clinical data of the patients were investigated and the risk factors were analyzed. **Results:** There were 32 strains of multi-drug resistant bacteria *Klebsiella pneumoniae* were isolated in the 65 patients, accounted for 49.2%, of which the lower respiratory tract, upper respiratory tract, lavage fluid, and blood samples accounted for 50.0%, 9.4%, 25.0%, 6.3%. The resistance rates of 32 strains of multi-drug resistant bacteria *Klebsiella pneumoniae* to ceftriaxone, cefuroxime, ampicillin, cefepime, and cefotaxime were 71.9%, 87.5%, 96.9%, 84.4%, and 81.3%, respectively. The sensitivity rates to amikacin, cefotetan, levofloxacin, imipenem, and ciprofloxacin were 59.4%, 68.8%, 81.3%, 75.0%, and 81.3%, respectively. Non-conditional logistic regression analysis showed that blood type A, carbapenem antibacterial drug use, drainage, mechanical ventilation, diabetes, etc. were independent risk factors for multidrug-resistant bacteria *Klebsiella pneumoniae* infection($P<0.05$). **Conclusion:** Multi-drug resistant bacteria *Klebsiella pneumoniae* infection are more common in patients with respiratory tract infections. The drug resistance rate to Cefuroxime and ampicillin are relatively high, and the sensitivity rate to Levofloxacin and ciprofloxacin are relatively high. Blood type A Type, carbapenem antibacterial drug use, drainage, mechanical ventilation, diabetes, etc. are independent risk factors lead to multi-drug resistant bacteria *Klebsiella pneumoniae* infection.

Key words: Respiratory tract infection; Multi-drug resistant bacteria *Klebsiella pneumoniae*; Drug resistance; Risk factors; Blood type

Chinese Library Classification(CLC): R563.1; R969.3 **Document code:** A

Article ID: 1673-6273(2021)11-2280-04

前言

呼吸道感染为各大医院收治的主要疾病之一,除了新冠等

病毒感染外,细菌感染为呼吸道感染的主要病原体^[1,2]。肺炎克雷伯菌属于肠杆菌科、克雷伯菌属的成员,为重要的条件致病菌之一,可致机体发生呼吸道感染,在临床上主要表现为高热、

* 基金项目:国家自然科学基金青年基金项目(81903089);南京医科大学科技发展基金 - 一般项目(NMUB2019165)

作者简介:高琳(1981-),男,本科,主治医师,研究方向:呼吸相关或者重症方向,电话:18951941227, E-mail: GL19810413@163.com

△ 通讯作者:谭焰(1970-),女,主任医师,硕士,研究方向:呼吸与危重医学、重症感染,电话:18951941227, E-mail: tanyan1970@126.com

(收稿日期:2021-01-04 接受日期:2021-01-27)

流涕、腹泻、呼吸困难等^[3-5]。肺炎克雷伯菌易产生超广谱 β 内酰胺酶,是仅次于大肠杆菌的第二大肠杆菌,对碳青霉烯类、青霉素类、广谱头孢菌素类等具有广泛的耐药性^[6,7]。在重症监护病房(Intensive Care Unit, ICU)的患者中,肺炎克雷伯菌污染的人工呼吸是引起肺炎的首要因素,特别是其引起的肺炎患者的死亡率在 50% 以上^[8,9]。随着临床上广谱抗菌药物的不合理使用、激素、免疫抑制剂的大量使用,多重耐药菌肺炎克雷伯菌性肺炎发生率呈逐年上升趋势,如何有效防治该病的发生已成为临床上广泛关注的问题^[10,11]。同时很多呼吸道感染患者存在多器官功能受累、侵入性诊疗操作、机体免疫功能下降等因素,也需要在临床上加强防治^[12,13]。本文探讨与分析了呼吸道感染患者多重耐药菌肺炎克雷伯菌的耐药及危险因素,希望有利于指导临床感染性疾病的预防与治疗。现总结报道如下。

1 资料与方法

1.1 研究对象

选择 2015 年 1 月到 2020 年 2 月本院诊治的呼吸道感染患者 65 例作为研究对象,纳入标准:临床信息资料完整者;住院患者;年龄 18~80 岁;本院伦理委员会批准了此次研究;患者签署了知情同意书;合并重复菌株感染者。排除标准:信息资料不全者。

采用全自动微生物鉴定及药敏分析系统(西门子 WalkAway-96 plus 型)鉴定细菌,药敏纸片为英国 OXOID 公司产品;血琼脂平板、麦康凯琼脂平板购自郑州安图生物工程有限公司产品,药敏纸片为英国 OXOID 公司产品,质控菌株包括肺炎克雷伯杆菌 ATCC700603、大肠埃希菌 ATCC25922、金黄色葡萄球菌 ATCC52923、铜绿假单胞菌 ATCC27853 等药敏试验推荐的抗菌药物包括头孢曲松、头孢呋辛、氨苄西林、头孢吡肟、头孢噻肟、阿米卡星、头孢替坦、左氧氟沙星、亚胺培南、环丙沙星等。

1.2 病原菌分离与耐药分析

取患者的上呼吸道、下呼吸道、血液、尿液、分泌物、灌洗液、脑脊液等样本,采集与送检用全自动细菌鉴定分析系统和药敏分析系统进行细菌鉴定及药敏试验,采用双纸片协同法和双纸片增效法确定菌株。

1.3 资料调查

调查患者的性别、年龄、体重指数、疾病状况、抗菌药物使用、引流、机械通气、入院 24 h 内 APACHE II 评分资料等。

1.4 统计方法

选择 SPSS 25.00,计量数据选择 $\bar{x} \pm s$ 表示(采用 t 检验(正态分布)或秩和检验(非正态分布)进行对比分析),计数数据采用%表示(采用 χ^2 检验),将单因素分析中有显著性差异的变量进行非条件 Logistic 回归分析,检验水准为 $\alpha=0.05$, $P<0.05$ 为差异有统计学意义。

2 结果

2.1 肺炎克雷伯菌检出情况

在呼吸道感染患者 65 例中,分离出多重耐药菌肺炎克雷伯菌 32 株,占比 49.2%。其中男 18 例,女 14 例;年龄最小 19 岁,最大 78 岁,平均年龄 49.28 ± 2.18 岁;平均体重指数 22.48 ± 1.22 kg/m²;合并基础疾病:高血压 4 例,糖尿病 12 例,高脂血症 5 例;血型:A 型 8 例,B 型 12 例,AB 型 4 例,O 型 8 例;引流 12 例,机械通气 8 例,使用碳青霉烯类抗菌药物 12 例,入院 24 h 内 APACHE II 评分 15.33 ± 3.51 分;住院时间 7.66 ± 0.32 d。

2.2 标本来源

在 32 株多重耐药菌肺炎克雷伯菌中,其中下呼吸道、上呼吸道、灌洗液、血液标本分别占 50.0%、9.4%、25.0%、6.3%,是各类送检标本中最主要感染来源,见表 1。

表 1 呼吸道感染患者多重耐药菌肺炎克雷伯菌的标本来源(n=32)

Table 1 Specimen sources of multi-drug resistant bacteria *Klebsiella pneumoniae* in patients with respiratory tract infection (n=32)

Source of specimens	Number of plants	Constituent ratio
Lower respiratory tract	16	50.0 %
Upper respiratory tract	3	9.4 %
Douche	8	25.0 %
Blood	2	6.3 %
Urine	1	3.1 %
Excreta	1	3.1 %
Cerebrospinal fluid	1	3.1 %

2.3 耐药性情况

32 株多重耐药菌肺炎克雷伯菌对头孢曲松、头孢呋辛、氨苄西林、头孢吡肟、头孢噻肟的耐药率分别为 71.9%、87.5%、96.9%、84.4%、81.3%,对阿米卡星、头孢替坦、左氧氟沙星、亚胺培南、环丙沙星的敏感率分别为 59.4%、68.8%、81.3%、75.0%、81.3%,见表 2。

2.4 危险因素分析

在 65 例患者中,以多重耐药菌肺炎克雷伯菌感染作为因

变量(1=是,0=否),以调查资料作为自变量,非条件 Logistic 回归分析显示血型 A 型、碳青霉烯类抗菌药物使用、引流、机械通气、糖尿病等导致多重耐药菌肺炎克雷伯菌感染的独立危险因素($P<0.05$),见表 3。

3 讨论

本研究显示在呼吸道感染患者 65 例中,分离出多重耐药菌肺炎克雷伯菌 32 株,占比 49.2%;下呼吸道、上呼吸道、灌洗

表 2 呼吸道感染患者多重耐药菌肺炎克雷伯菌的耐药性(n=32)

Table 2 The resistance of multidrug resistant bacteria *Klebsiella pneumoniae* in patients with respiratory tract infection (n=32)

Antibacterials	Number of plants	Resistance rate	Sensitivity rate
Ceftriaxone	32	23(71.9 %)	9(28.1 %)
Cefuroxime	32	28(87.5 %)	4(12.5 %)
Ampicillin	32	31(96.9 %)	1(3.1 %)
Cefepime	32	27(84.4 %)	5(15.6 %)
Cefotaxime	32	26(81.3 %)	6(18.8 %)
Amikacin	32	13(40.6 %)	19(59.4 %)
Cefotetan	32	10(31.3 %)	22(68.8 %)
Levofloxacin	32	6(18.8 %)	26(81.3 %)
Imipenem	32	8(25.0 %)	24(75.0 %)
Ciprofloxacin	32	6(18.8 %)	26(81.3 %)

表 3 呼吸道感染患者多重耐药菌肺炎克雷伯菌的危险因素(65)

Table 3 Risk factors of multi-drug resistant bacteria *Klebsiella pneumoniae* in patients with respiratory tract infection (65)

Hazards	β	SE	Wald χ^2	P	OR	95%CI
Blood type A type	1.587	0.503	9.727	0.002	4.728	1.788-12.766
Use of carbapenems	1.239	0.443	7.913	0.005	3.453	1.356-8.813
Drainage	1.206	0.411	8.615	0.003	3.188	1.489-7.479
Mechanical ventilation	1.014	0.382	7.088	0.008	2.758	1.307-5.802
Diabetes	1.088	0.429	6.433	0.011	2.968	1.281-6.884

液、血液标本为送检标本中最主要感染来源。肺炎克雷伯菌为呼吸道感染的主要病原菌之一,也可导致住院或其他免疫功能低下患者发生社区感染或医院感染^[14,15]。其在抗菌药物诱导下可产生超广谱 β 内酰胺酶,经由质粒介导,在细菌之间迅速传播,导致菌株增长与繁殖^[16,17]。肺炎克雷伯菌可以粘附或者以定植形式存在于人体不同组织和系统以及脏器中,在抵抗力差的患者中,肺炎克雷伯菌即可增生繁殖,形成肺炎^[18,20]。

本研究显示 32 株多重耐药菌肺炎克雷伯菌对头孢曲松、头孢呋辛、氨苄西林、头孢吡肟、头孢噻肟的耐药率分别为 71.9 %、87.5 %、96.9 %、84.4 %、81.3 %,对阿米卡星、头孢替坦、左氧氟沙星、亚胺培南、环丙沙星的敏感率分别为 59.4 %、68.8 %、81.3 %、75.0 %、81.3 %。肺炎克雷伯菌对多种抗菌药物具有天然耐药性,其多重耐药菌株逐年增多;特别是多重耐药菌肺炎克雷伯菌对多种抗菌药物耐药^[21,22]。与高丽^[23]的研究类似,该学者分析了他们医院 2012-2017 年肺炎克雷伯菌临床分离株的分布情况及耐药性变迁,送检的 2 674 份微生物标本共检出 205 株肺炎克雷伯菌,感染标本主要来源于痰液(67.32 %);对头孢曲松、美罗培南、氨曲南、庆大霉素、复方新诺明、呋喃妥因等药物的耐药性比较差异均无统计学意义;对哌拉西林、头孢他啶、头孢西丁、哌拉西林/他唑巴坦、阿莫西林/克拉维酸、厄他培南、亚胺培南、替加环素、阿米卡星、左氧氟沙星等药物的耐药性比较差异均有统计学意义。当前也有研究表明肺炎克雷伯菌对氨苄西林、头孢噻肟、氨苄西林舒巴坦、头孢呋辛、头孢曲松的耐药率比较高,对左氧氟沙星、哌拉西林他唑巴坦、环丙

沙星、亚胺培南、美洛培南比较敏感^[24,25]。由此可见,肺炎克雷伯菌感染在呼吸道感染中的多重耐药问题比较严重,在临床上要慎重选用耐药率比较高的抗菌药物。同时肺炎克雷伯菌感染肺炎患者的临床表现不典型,增加了治疗、诊断的难度,随着抗菌药物使用的增多,加速了细菌耐药性的产生^[26,27]。

本研究非条件 Logistic 回归分析显示血型 A 型、碳青霉烯类抗菌药物使用、引流、机械通气、糖尿病等导致多重耐药菌肺炎克雷伯菌感染的独立危险因素,与陈蕾^[28]的研究类似,该学者研究了重症监护室内医院获得性耐碳青霉烯类肺炎克雷伯菌肺炎的危险因素分析,Logistic 回归分析筛选患者发生获得性耐碳青霉烯类肺炎克雷伯菌可能的危险因素,结果显示感染前入住 ICU 时间 ≥ 7 d、糖尿病、急性生理与慢性健康评分(APACHE II) >18 分、使用碳青霉烯类抗菌药物、机械通气和引流为患者医院获得性耐碳青霉烯类肺炎克雷伯菌肺部感染的危险因素。从机制上分析,引流、机械通气破坏了正常机体的自然保护屏障,特别是机械通气可导致气道粘膜损伤,气道正常的生理通气压力及生理血流动力学发生改变,增加了肺炎发生的机会^[29-30]。肺炎克雷伯菌引起的呼吸道感染与糖尿病相关,糖尿病破坏了菌群间的制约关系,使人体微生态平衡被破坏,有利于多重耐药菌肺炎克雷伯菌的生成^[31,32]。肺炎克雷伯菌体内具有很大的变异潜能,在长期应用抗菌药物的前提下,肺炎克雷伯菌长期处于被抗菌药物包围的环境中,可导致耐药性增加^[33-35]。本研究创新性的结果显示 A 型血的相对危险度为 4.728,表明 A 型血中分离出多重耐药菌肺炎克雷伯菌风险性

很高,这为后期研究多重耐药菌肺炎克雷伯菌感染在呼吸道感染的独立危险因素提供的新的思路和预防策略。但是本研究样本量少,来源单一,结果也存在一定的偏倚,后期需要联合多家医院,扩大样本量进行进一步的验证。

总之,多重耐药菌肺炎克雷伯菌感染在呼吸道感染患者中比较常见,对头孢唑林、氨基苄西林的耐药率比较高,对左氧氟沙星、环丙沙星的敏感率比较高,血型 A 型、碳青霉烯类抗菌药物使用、引流、机械通气、糖尿病等为导致多重耐药菌肺炎克雷伯菌感染的独立危险因素。

参考文献(References)

- [1] Volozhantsev NV, Shpirt AM, Kislichkina AA, et al. Structure and gene cluster of the capsular polysaccharide of multidrug resistant carbapenemase OXA-48-producing *Klebsiella pneumoniae* strain KPB536 of the genetic line ST147 [J]. *Res Microbiol*, 2020, 171(2): 74-79
- [2] Wu D, Huang X, Jia C, et al. Clinical Manifestation, Distribution, and Drug Resistance of Pathogens Among Abdominal Solid Organ Transplant Recipients With *Klebsiella pneumoniae* Infections [J]. *Transplant Proc*, 2020, 52(1): 289-294
- [3] Khairy RMM, Mahmoud MS, Shady RR, et al. Multidrug-resistant *Klebsiella pneumoniae* in hospital-acquired infections: Concomitant analysis of antimicrobial resistant strains[J]. *Int J Clin Pract*, 2020, 74(4): e13463
- [4] Fauvet T, Tarantola A, Colot J, et al. Mucoviscous characteristics of *Klebsiella pneumoniae* strains: A factor of clinical severity? [J]. *Med Mal Infect*, 2020, 50(6): 500-506
- [5] Gaibani P, Re MC, Campoli C, et al. Bloodstream infection caused by KPC-producing *Klebsiella pneumoniae* resistant to ceftazidime/avibactam: epidemiology and genomic characterization [J]. *Clin Microbiol Infect*, 2020, 26(4): 516-519
- [6] Ghaith DM, Zafer MM, Said HM, et al. Genetic diversity of carbapenem-resistant *Klebsiella pneumoniae* causing neonatal sepsis in intensive care unit, Cairo, Egypt [J]. *Eur J Clin Microbiol Infect Dis*, 2020, 39(3): 583-591
- [7] Agyeman AA, Bergen PJ, Rao GG, et al. A systematic review and meta-analysis of treatment outcomes following antibiotic therapy among patients with carbapenem-resistant *Klebsiella pneumoniae* infections [J]. *Int J Antimicrob Agents*, 2020, 55(1): e105833
- [8] Bao W, Wei R, Liu X, et al. Regulation of Pyruvate Formate Lyase-Deficient *Klebsiella pneumoniae* for Efficient 1,3-Propanediol Bioproduction [J]. *Curr Microbiol*, 2020, 77(1): 55-61
- [9] Borjan J, Meyer KA, Shields RK, et al. Activity of ceftazidime-avibactam alone and in combination with polymyxin B against carbapenem-resistant *Klebsiella pneumoniae* in a tandem in vitro time-kill/in vivo *Galleria mellonella* survival model analysis [J]. *PLoS Pathog*, 2020, 55(1): e105852
- [10] Chao X, Xie L, Wang H, et al. *Klebsiella pneumoniae* presents antimicrobial drug resistance for β -lactam through the ESBL/PBP signaling pathway [J]. *Int J Environ Res Public Health*, 2020, 19(4): 2449-2456
- [11] Cheng J, Zhang J, Han B, et al. *Klebsiella pneumoniae* isolated from bovine mastitis is cytopathogenic for bovine mammary epithelial cells [J]. *J Dairy Sci*, 2020, 103(4): 3493-3504
- [12] Chua MD. *Klebsiella pneumoniae* Redistributes Katanin Severing Proteins and Alters Astral Microtubules during Mitosis [J]. *Nat Microbiol*, 2020, 303(7): 1859-1864
- [13] Chung DR. Hypervirulent *Klebsiella pneumoniae*: Liver Abscess Isolates versus Intestinal Flora [J]. *mBio*, 2020, 35(2): e28
- [14] Effah CY, Sun T, Liu S, et al. *Klebsiella pneumoniae*: an increasing threat to public health [J]. *Nat Rev Microbiol*, 2020, 19(1): e1
- [15] Hao Z, Duan J, Liu L, et al. Prevalence of Community-Acquired, Hypervirulent *Klebsiella pneumoniae* Isolates in Wenzhou, China [J]. *Microb Drug Resist*, 2020, 26(1): 21-27
- [16] Hasani A, Soltani E, Ahangharzadeh Rezaee M, et al. Detection and characterization of NDM-1-producing *Klebsiella pneumoniae* in Iran: an incursion crisis [J]. *Infect Dis (Lond)*, 2020, 52(4): 291-293
- [17] Huang M, He P, Munir S, et al. Ecology and etiology of bacterial top rot in maize caused by *Klebsiella pneumoniae* KpC4 [J]. *Microb Pathog*, 2020, 139(15): e103906
- [18] Mesbah Zekar F, Granier SA, Touati A, et al. Occurrence of Third-Generation Cephalosporins-Resistant *Klebsiella pneumoniae* in Fresh Fruits and Vegetables Purchased at Markets in Algeria [J]. *mBio*, 2020, 26(4): 353-359
- [19] Nishida S, Ono Y. Genomic analysis of a pan-resistant *Klebsiella pneumoniae* sequence type 11 identified in Japan in 2016 [J]. *Int J Antimicrob Agents*, 2020, 55(4): e105854
- [20] Ojdana D, Kochanowicz J, Sacha P, et al. Infection caused by *Klebsiella pneumoniae* ST11 in a patient after craniectomy [J]. *Folia Microbiol (Praha)*, 2020, 65(1): 205-209
- [21] Paczosa MK, Silver RJ, McCabe AL, et al. Transposon Mutagenesis Screen of *Klebsiella pneumoniae* Identifies Multiple Genes Important for Resisting Antimicrobial Activities of Neutrophils in Mice [J]. *Anat Rec (Hoboken)*, 2020, 88(4): 221-229
- [22] Piccirilli A, Perilli M, Piccirilli V, et al. Molecular characterization of carbapenem-resistant *Klebsiella pneumoniae* ST14 and ST512 causing bloodstream infections in ICU and surgery wards of a tertiary university hospital of Verona (northern Italy): co-production of KPC-3, OXA-48, and CTX-M-15 β -lactamases [J]. *J Korean Med Sci*, 2020, 96(3): e114968
- [23] 高丽,杨丹丹,樊红丽,等.2012-2017 年某院肺炎克雷伯菌检出情况及耐药性分析 [J]. *海南医学*, 2019, 30(6): 52-56
- [24] Rajaure M, Wall E, Johnson J, et al. Novel Cassette Assay To Quantify the Outer Membrane Permeability of Five β -Lactams Simultaneously in Carbapenem-Resistant *Klebsiella pneumoniae* and *Enterobacter cloacae* [J]. *mBio*, 2020, 11(1): 78-89
- [25] Shi Y, Chen Y, Yang Z, et al. Characterization and genome sequencing of a novel T7-like lytic phage, kpssk3, infecting carbapenem-resistant *Klebsiella pneumoniae* [J]. *Arch Virol*, 2020, 165(1): 97-104
- [26] Squires KM, Nguyen MH, Shields RK, et al. Sequence type-258 carbapenem-resistant *Klebsiella pneumoniae* isolates in which ceftazidime-avibactam resistance emerged are not hypermutators [J]. *Diagn Microbiol Infect Dis*, 2020, 96(3): e114954
- [27] Stohr J, Verweij JJ, Buiting AGM, et al. Within-patient plasmid dynamics in *Klebsiella pneumoniae* during an outbreak of a carbapenemase-producing *Klebsiella pneumoniae* [J]. *PLoS One*, 2020, 15(5): e0233313

- sentinel lymph node mapping in early-stage cervical cancer [J]. *Gynecol Oncol*, 2020, 156(1): 93-99
- [14] 曾江忠, 蔡小核, 朱非白, 等. HPV 感染高危女性宫颈癌认知程度影响因素及预防性 HPV 疫苗接种效果调查分析 [J]. *中国中西医结合皮肤性病杂志*, 2018, 17(4): 313-316
- [15] 董宏英, 赵玉芬. 300 例妇女宫颈癌认知情况及影响因素分析[J]. *中国医师杂志*, 2017, 19(12): 1874-1876
- [16] 彭鹏, 鲍萍萍, 王春芳, 等. 上海市女性居民宫颈癌筛查知识和行为现状调查[J]. *环境与职业医学*, 2014, 31(5): 342-346
- [17] Rashid S, Labani S, Das BC. Knowledge, Awareness and Attitude on HPV, HPV Vaccine and Cervical Cancer among the College Students in India[J]. *PLoS One*, 2016, 11(11): e0166713
- [18] Williams MS, Kenu E, Adanu A, et al. Awareness and Beliefs About Cervical Cancer, the HPV Vaccine, and Cervical Cancer Screening Among Ghanaian Women with Diverse Education Levels [J]. *J Cancer Educ*, 2019, 34(5): 897-903
- [19] 阎彤菲, 林昕, 李榕. 女大学生宫颈癌防治及 HPV 疫苗认知现状调查[J]. *职业与健康*, 2020, 36(10): 1399-1401
- [20] Musa J, Achenbach CJ, O'Dwyer LC, et al. Effect of cervical cancer education and provider recommendation for screening on screening rates: A systematic review and meta-analysis [J]. *PLoS One*, 2017, 12(9): e0183924
- [21] Saei Ghare Naz M, Kariman N, Ebadi A, et al. Educational Interventions for Cervical Cancer Screening Behavior of Women: A Systematic Review[J]. *Asian Pac J Cancer Prev*, 2018, 19(4): 875-884
- [22] Patel H, Sherman SM, Tincello D, et al. Awareness of and attitudes towards cervical cancer prevention among migrant Eastern European women in England[J]. *J Med Screen*, 2020, 27(1): 40-47
- [23] Bhatta MP, Johnson DC, Lama M, et al. Cervical Cancer and Human Papillomavirus Vaccine Awareness Among Married Bhutanese Refugee and Nepali Women in Eastern Nepal [J]. *J Community Health*, 2020, 45(3): 516-525
- [24] 冯明明, 周林, 张洁, 等. 宫颈癌术后复发的危险因素及 SCC-Ag、HR-HPV 对复发的预测价值分析 [J]. *现代生物医学进展*, 2020, 20(8): 1583-1587
- [25] 刘锦丹, 张莹莹. 豫东农村地区妇女宫颈癌筛查及知信行现状[J]. *护理研究*, 2019, 33(5): 839-842
- [26] Devarapalli P, Labani S, Nagarjuna N, et al. Barriers affecting uptake of cervical cancer screening in low and middle income countries: A systematic review[J]. *Indian J Cancer*, 2018, 55(4): 318-326
- [27] Hweissa NA, Su TT. Awareness of cervical cancer and socio-demographic variations among women in Libya: An exploratory study in Az-Zawiya city[J]. *Eur J Cancer Care (Engl)*, 2018, 27(1): 10
- [28] Majidi A, Majidi S, Salimzadeh S, et al. Cancer Screening Awareness and Practice in a Middle Income Country; A Systematic Review from Iran[J]. *Asian Pac J Cancer Prev*, 2017, 18(12): 3187-3194
- [29] Choi YJ, Lee HY, An S, et al. Predictors of Cervical Cancer Screening Awareness and Literacy Among Korean-American Women [J]. *J Racial Ethn Health Disparities*, 2020, 7(1): 1-9
- [30] 李沁梅, 刘晴, 柏扬, 等. 湖北省五峰地区汉族和土家族农村妇女宫颈癌认知及筛查态度分析 [J]. *中国健康教育*, 2019, 35(8): 722-726

(上接第 2283 页)

- [28] 陈蕾, 田俊华, 贾磊, 等. 重症监护室内医院获得性耐碳青霉烯类肺炎克雷伯菌肺炎的危险因素分析[J]. *国际流行病学传染病学杂志*, 2020, 47(3): 231-234
- [29] Storey D, McNally A, Strand M, et al. Klebsiella pneumoniae type VI secretion system-mediated microbial competition is PhoPQ controlled and reactive oxygen species dependent [J]. *PLoS Pathogens*, 2020, 16(3): e1007969
- [30] Tekeli A, Dolapci İ, Evren E, et al. Characterization of Klebsiella pneumoniae Coproducing KPC and NDM-1 Carbapenemases from Turkey[J]. *Microb Drug Resist*, 2020, 26(2): 118-125
- [31] Thattaruthody F, Hesse S. Phage Resistance in Multidrug-Resistant Klebsiella pneumoniae ST258 Evolves via Diverse Mutations That Culminate in Impaired Adsorption[J]. *Ocul Immunol Inflamm*, 2020, 11(1): 224-229
- [32] Yang X, Dong N, Chan EW, et al. Carbapenem Resistance-Encoding and Virulence-Encoding Conjugative Plasmids in Klebsiella pneumoniae[J]. *Trends Microbiol*, 2021, 29(1): 65-83
- [33] Zhang P, Shi Q, Hu H, et al. Emergence of ceftazidime/avibactam resistance in carbapenem-resistant Klebsiella pneumoniae in China[J]. *Clin Microbiol Infect*, 2020, 26(1): 124-127
- [34] Mobasser G, Thong KL, Rajasekaram G, et al. Molecular characterization of extended-spectrum β -lactamase-producing Klebsiella pneumoniae from a Malaysian hospital [J]. *Braz J Microbiol*, 2020, 51(1): 189-195
- [35] Naha S, Sands K, Mukherjee S, et al. KPC-2-producing Klebsiella pneumoniae ST147 in a neonatal unit: Clonal isolates with differences in colistin susceptibility attributed to AcrAB-TolC pump[J]. *Int J Antimicrob Agents*, 2020, 55(3): e105903