DOI:10.13350/j.cjpb.230514

·临床研究·

妊娠合并细菌性阴道病感染特征及妊娠结局分析

齐亮*,唐晓磊,赵锡桐
(中国医科大学附属盛京医院,辽宁沈阳 110004)

【摘要】 **目的** 分析孕28周后孕晚期妊娠合并细菌性阴道病的发病率、感染特点及对妊娠结局的影响。 **方法** 选取2020年1月1日～2022年7月31日,孕28周后孕晚期于本院进行妊娠期细菌性阴道病筛查的孕产妇1 566例为研究对象。采集患者阴道分泌物进行检测,使用Amsel临床诊断方法进行临床判断。同时观察分泌物中乳酸杆菌、阴道加德纳菌、其他细菌等密集度,并使用酶联免疫吸附测定法测定阴道分泌物中白细胞介素-8(IL-8)水平。征求315例妊娠合并细菌性阴道病孕产妇本人意愿,同意接受治疗者纳入治疗组(n=150),拒绝者纳入未治疗组(n=165)。选取同期健康孕产妇300例为健康对照组,比较不同分组间孕产妇的妊娠结局。 **结果** 315例孕妇合并细菌性阴道病,发病率为20.11%,霉菌性阴道炎发病率(14.43%)、滴虫性阴道炎发病率(0.51%)显著低于细菌性阴道病发病率。不同孕周细菌性阴道病的发病率不同,孕28～33^{+6}周孕妇发病率为11.01%(49/446),孕34～39^{+6}周孕妇发病率为25.65%(238/928),孕40～42周孕妇发病率为14.58%(28/192)。细菌性阴道病阳性组孕妇乳杆菌密集度主要集中于0～Ⅰ级(99.37%),阴道加德纳菌密集度主要集中于Ⅲ～Ⅳ级(80.95%),其他细菌密集度主要集中于Ⅰ～Ⅱ级(50.16%)。健康对照组孕妇乳杆菌密集度主要集中于Ⅱ～Ⅲ级(93.33%),阴道加德纳菌密集度主要集中于0～Ⅰ级(82.67%),其他细菌密集度主要集中于0～Ⅰ级(71.33%)。阳性组孕妇乳杆菌密集度0级占比高于对照组,Ⅱ级、Ⅲ级占比低于对照组,阴道加德纳菌密集度Ⅱ级、Ⅲ级、Ⅳ级占比高于对照组,其他细菌密集度0级占比低于对照组,Ⅰ级、Ⅱ级、Ⅲ级、Ⅳ级占比高于对照组,差异有统计学意义(均$P<0.05$)。阳性组孕妇的IL-8水平显著高于阴性组孕妇。阳性组孕产妇早产率、胎膜早破发生率、产褥感染发生率、新生儿窒息发生率、新生儿黄疸发生率、新生儿感染发生率均高于健康组,差异有统计学意义($P<0.05$)。治疗组孕产妇的早产率、胎膜早破发生率、产褥感染发生率、新生儿窒息发生率、新生儿黄疸发生率、新生儿感染发生率分别为4.67%、12.00%、4.00%、0.67%、7.33%和2.67%,显著低于未治疗组,差异有统计学意义($P<0.05$)。 **结论** 孕28周后孕晚期妊娠合并细菌性阴道病的发病率高于其他类型阴道炎,阳性组孕产妇的优势菌为阴道加德纳菌,乳酸杆菌缺失,菌群多样性增加。妊娠合并细菌性阴道病对妊娠结局影响显著,积极治疗可减少不良妊娠结局发生。

【关键词】 妊娠;细菌性阴道病;妊娠结局
【中图分类号】 R378 【文献标识码】 A 【文章编号】 1673-5234(2023)05-0566-04

[*Journal of Pathogen Biology*. 2023 May;18(5):566-569,574.]

Clinical analysis of pregnancy complicated with bacterial vaginosis infection and the influence of pregnancy outcome

QI Liang, TANG Xiaolei, ZHAO Xitong (*Shengjing Hospital of China Medical University, Shenyang* 110004, *China*)*

【Abstract】 **Objective** To analyze the incidence rate and infection characteristics of bacterial vaginosis in the third trimester of pregnancy after 28 weeks of pregnancy and its influence on the pregnancy outcome. **Methods** From January 1, 2020 to July 31, 2022, 1 566 pregnant women who were screened for bacterial vaginosis during pregnancy at our hospital in the third trimester after 28 weeks of pregnancy were selected as the study subjects. The vaginal secretions from patients were collected to detected, and the clinical judgment were judged by Amsel clinical diagnosis method. At the same time, lactobacillus, Gardner vaginalis and the density of other bacteria in vaginal secretions were observe. The level of interleukin-8 (IL-8) in vaginal secretions were determined by enzyme-linked immunosorbent assay. The wishes of 315 pregnant women with bacterial vaginosis during pregnancy were solicited. Those who agreed to receive treatment were included in the treatment group ($n=150$), and those who refused to receive treatment were included in the non-treatment group ($n=165$). At the same time, 300 healthy pregnant women in the same period were selected as the healthy control group, and the pregnancy outcomes of pregnant women in different groups were compared. **Results** 315 pregnant women complicated with bacterial vaginosis, the incidence rate was 20.11%. The incidence rate of fungal vaginitis (14.43%) and the incidence rate of trichomonal vaginitis (0.51%) were significantly lower than the incidence rate of

* 【通讯作者(简介)】 齐亮(1980-),女,辽宁锦州人,本科,护师。主要从事产科疾病防治与护理工作。E-mail:qlmeilin@163.com

bacterial vaginosis. The incidence rate of bacterial vaginosis varies in different gestational weeks. The incidence rate of pregnant women at 28-33^{+6} weeks is 11.01% (49/446), the incidence rate of pregnant women at 34-39^{+6} weeks is 25.65% (238/928), and the incidence rate of pregnant women at 40-42 weeks is 14.58% (28/192). The concentration of lactobacilli in pregnant women with positive bacterial vaginosis was mainly concentrated in grades 0 to I (99.37%), the concentration of Gardner's bacteria in vagina was mainly concentrated in grades III to IV (80.95%), and the concentration of other bacteria was mainly concentrated in grades I to II (50.16%). The concentration of lactobacilli in pregnant women in the health control group was mainly concentrated in grade II to III (93.33%), the concentration of Gardner's bacteria in the vagina of pregnant women in the health control group was mainly concentrated in grade 0 to I (82.67%), and the concentration of other bacteria in pregnant women in the health control group was mainly concentrated in grade 0 to I (71.33%). The proportion of lactobacilli density of grade 0 in the positive group was higher than that in the control group, the proportion of grade II and grade III was lower than that in the control group, the proportion of gardnerella vaginalis density of grade II, grade III and grade IV was higher than that in the control group, the proportion of other bacteria density of grade 0 was lower than that in the control group, the proportion of grade I, grade II, grade III and grade IV was higher than that in the control group, and the difference was statistically significant ($P<0.05$). The level of IL-8 in the positive pregnant women was significantly higher than that in the negative pregnant women. The difference is statistically significant. The premature delivery rate, premature rupture of membranes rate, puerperal infection rate, neonatal asphyxia rate, neonatal jaundice rate and neonatal infection rate of the pregnant women in the positive group was significantly higher than the healthy group, and the difference was statistically significant ($P<0.05$). The pregnancy outcomes of pregnant women in the treatment group were 4.67%, 12.00%, 4.00%, 0.67%, 7.33% and 2.67%, which were significantly lower than those in the untreated group ($P<0.05$). **Conclusion** After 28 weeks of pregnancy, the incidence rate of bacterial vaginosis in the third trimester of pregnancy was higher than that of other types of vaginitis. The dominant bacteria of pregnant women in the positive group was Gardner vaginalis. Lactobacillus was absent, and the diversity of flora increased. Pregnancy complicated with bacterial vaginosis has a significant impact on pregnancy outcomes, and treatment can effectively improve the incidence of adverse pregnancy outcomes.

【Key words】 pregnancy; bacterial vaginosis; pregnancy outcome

细菌性阴道病(bacterial vaginosis,BV)是阴道菌群失调(abnormal vaginal flora,AVF)临床常见表现之一,不同人种间发病率不同,约为7%～30%[1-2]。细菌性阴道病主要由于阴道内阴道加德纳菌及厌氧菌过度生长,乳酸杆菌及兼性厌氧菌减少,从而导致阴道菌群失调的无阴道黏膜炎症性表现[3]。妊娠期女性受到体内雌孕激素水平变化,容易导致阴道菌群失衡,增加细菌性阴道病的发病率[4]。相关研究发现,我国妊娠期女性合并细菌性阴道病的发病率为10%～50%,国外妊娠期女性合并细菌性阴道病的发病率为10%～30%[5]。细菌性阴道病可以通过阴道内相关病原体上行感染引发多种疾病,导致不良妊娠结局发生,例如早产、流产、产褥感染、新生儿感染等[6-7]。本次研究选取于本院进行妊娠期细菌性阴道病筛查的孕产妇1 566例为研究对象,分析孕28周后孕晚期妊娠合并细菌性阴道病的发病率、感染特点及对妊娠结局影响,结果报道如下。

材料与方法

1 研究对象

选取2020年1月1日～2022年7月31日,孕28周后孕晚期于中国医科大学附属盛京医院进行妊娠期细菌性阴道病筛查的孕产妇1 566例为研究对象。年龄24～39(27.84±6.19)岁,分娩孕周28～42(35.64±1.66)周。纳入标准:①临床资料完整,自愿参与本次研究者;②孕周28～42周;③单胎妊娠;④妊娠结局明确者。排除标准:孕周<28周或>42周者;多胎妊娠;合并妊娠期其他疾病,如妊娠期高血压、糖尿病、心脏病等;检查前7 d内有阴道用药史者。

2 病例诊断标准

符合美国CDC发布的《性传播感染治疗指南(2021)》诊断标准[8],通常使用Amsel临床诊断方法进行临床判断,临床通常满足以下三项诊断标准,线索细胞阳性是必备条件:①阴道分泌物呈均质、稀薄、灰白色状,粘附于阴道壁;②阴道分泌物于显微镜下可观察到的线索细胞(clue cell)占鳞状上皮细胞百分比>20%,则判定线索细胞检测结果阳性;③pH>4.5;④阴道分泌物加入10% KOH液,产生类烂鱼肉腥臭味,则判定胺臭味试验结果阳性。

3 分泌物采集与检测

嘱患者采用仰卧截石位,对患者外阴、阴道黏膜及宫颈进行检查,使用一次性无菌棉拭子采集患者阴道后穹隆处分泌物,观察分泌物性状后置于无菌试管中及时送检。通过光学显微镜观察涂片染色标本,干燥

后于10×100倍油镜下观察，乳酸杆菌、阴道加德纳菌、其他细菌等密集度。

4 阴道分泌物中白细胞介素-8(IL-8)水平检测

采用检查试剂盒(厦门慧嘉生物科技)通过酶联免疫吸附测定法(enzyme linked immunosorbent assay, ELISA)检测所有患者阴道分泌物中IL-8水平，操作过程严格依据试剂盒操作说明书进行操作。

5 分组方法

征求315例妊娠合并细菌性阴道病孕产妇本人意愿，将同意接受治疗者纳入治疗组($n=150$)，将拒绝接受治疗者纳入未治疗组($n=165$)。同时选取同期健康孕产妇300例为健康对照组。治疗组孕产妇给予甲硝唑(江西川奇药业有限公司，国药准字H19983066)400 mg，采用阴道上药方式，每日一次，一周为一个治疗疗程，连续用药2～4周后复查。

6 统计分析

应用SPSS 25.0统计学软件对本次研究中细菌性阴道病孕妇感染特点、阴道分泌物IL-8水平、不同分组孕产妇妊娠结局数据进行分析，计数资料采用例(%)表示，组间比较采用χ^2检验，计量资料采用$\bar{x}\pm s$表示，组间比较采用独立样本t检验，$P<0.05$为差异有统计学意义。

结 果

1 孕晚期妊娠合并细菌性阴道病的发病率

本次研究中1 566例孕晚期孕妇中，315例孕妇合并细菌性阴道病，发病率为20.11%。226例孕妇合并霉菌性阴道炎，发病率为14.43%。8例孕妇合并滴虫性阴道炎，发病率为0.51%。孕晚期妊娠合并细菌性阴道病的发病率高于其他类型阴道炎，且不同孕周发病率不同。孕28～33^{+6}周孕妇共计446例，其中49例合并细菌性阴道病，发病率为11.01%。孕34～39^{+6}周孕妇共计928例，其中238例合并细菌性阴道病，发病率为25.65%。孕40～42周孕妇共计192例，其中28例合并细菌性阴道病，发病率为14.58%。

2 细菌性阴道病孕妇感染特点

细菌性阴道病阳性组孕妇乳杆菌密集度主要集中于0～Ⅰ级(99.37%)，健康对照组孕妇乳杆菌密集度主要集中于Ⅱ～Ⅲ级(93.33%)。阳性组孕妇乳杆菌密集度0级占比高于对照组，Ⅱ级、Ⅲ级占比低于对照组，差异有统计学意义($P<0.05$)。细菌性阴道病阳性组孕妇阴道加德纳菌密集度主要集中于Ⅲ～Ⅳ级(80.95%)，健康对照组孕妇阴道加德纳菌密集度主要集中于0～Ⅰ级(82.67%)。阳性组孕妇阴道加德纳菌密集度Ⅱ级、Ⅲ级、Ⅳ级占比高于对照组，差异有统计学意义($P<0.05$)。细菌性阴道病阳性组孕妇其他细菌密集度主要集中于Ⅰ～Ⅱ级(50.16%)，健康对照组孕妇其他细菌密集度主要集中于0～Ⅰ级(71.33%)。阳性组孕妇其他细菌密集度0级占比低于对照组，Ⅰ级、Ⅱ级、Ⅲ级、Ⅳ级占比高于对照组，差异有统计学意义($P<0.05$)(表1)。

表1 细菌性阴道病孕妇感染特点
Table 1 Infection characteristics of pregnant women with bacterial vaginosis

阴道菌群感染情况 Infection of vaginal flora		阳性组($n=315$) Positive group		对照组($n=300$) Control group	
		例数 No.	百分比(%) Percentage	例数 No.	百分比(%) Percentage
乳杆菌密集度	0级	143	45.40	1	0.33
	Ⅰ级	170	53.97	8	2.67
	Ⅱ级	1	0.32	82	27.33
	Ⅲ级	1	0.32	198	66.00
	Ⅳ级	0	0.00	11	3.67
阴道加德纳菌密集度	0	0	0.00	92	30.67
	Ⅰ级	22	6.98	156	52.00
	Ⅱ级	38	12.06	32	10.67
	Ⅲ级	105	33.33	11	3.67
	Ⅳ级	150	47.62	9	3.00
其他细菌密集度	0	57	18.10	168	56.00
	Ⅰ级	86	27.30	46	15.33
	Ⅱ级	72	22.86	49	16.33
	Ⅲ级	54	17.14	32	10.67
	Ⅳ级	46	14.60	5	1.67

3 不同分组孕产妇阴道分泌物IL-8水平比较

细菌性阴道病阳性孕妇孕妇的IL-8水平为(2.74±0.23)×10^6/ng/L，阴性组为(1.52±0.14)×10^6/ng/L，差异有统计学意义($P<0.05$)。

4 不同分组孕产妇妊娠结局比较

4.1 阳性组与健康组妊娠结局比较 妊娠合并细菌性阴道病阳性组孕产妇的早产率、胎膜早破发生率、产褥感染发生率、新生儿窒息发生率、新生儿黄疸发生率、新生儿感染发生率分别为7.62%、16.51%、6.03%、1.27%、10.79%和6.98%。健康对照组孕产妇的早产率、胎膜早破发生率、产褥感染发生率、新生儿窒息发生率、新生儿黄疸发生率、新生儿感染发生率分别为2.67%、7.33%、2.00%、0.33%、3.67%和0.67%。两组孕产妇不良妊娠发生率差异有统计学意义(均$P<0.05$)(表2)。

4.2 细菌性阴道病治疗患者和未治疗患者妊娠结局比较 对比细菌性阴道病治疗患者和未治疗患者妊娠结局，结果显示，两组孕产妇的早产率、胎膜早破发生率、产褥感染发生率、新生儿窒息发生率、新生儿黄疸发生率、新生儿感染发生率，未治疗组显著高于治疗组，差异有统计学意义(均$P<0.05$)(表3)。

表2 细菌性阴道病阳性组与健康组妊娠结局比较
Table 2 Comparison of pregnancy outcome between bacterial vaginosis positive group and healthy group

妊娠结局 Pregnancy outcome	阳性组(n=315) Positive group		对照组(n=300) Control group		P
	例数 No.	百分比(%) Percentage	例数 No.	百分比(%) Percentage	
早产	24	7.62	8	2.67	0.000
胎膜早破	52	16.51	22	7.33	0.000
产褥感染	19	6.03	6	2.00	0.000
新生儿窒息	4	1.27	1	0.33	0.000
新生儿黄疸	34	10.79	11	3.67	0.000
新生儿感染	22	6.98	2	0.67	0.000

表3 细菌性阴道病治疗患者和未治疗患者妊娠结局比较
Table 3 Comparison of pregnancy outcomes between patients with bacterial vaginosis treated and untreated

妊娠结局 Pregnancy outcome	治疗组(n=150) Treated group		未治疗组(n=165) Untreated group		P
	例数 No.	百分比(%) Percentage	例数 No.	百分比(%) Percentage	
早产	7	4.67	17	10.30	0.000
胎膜早破	18	12.00	34	20.61	0.006
产褥感染	6	4.00	13	7.88	0.002
新生儿窒息	1	0.67	3	1.82	0.000
新生儿黄疸	11	7.33	23	13.94	0.002
新生儿感染	4	2.67	18	10.91	0.000

讨 论

妊娠期女性由于体内雌孕激素水平升高，阴道分泌物增加，阴道黏膜充血，阴道上皮细胞糖原聚集，机体抵抗力下降，为细菌繁殖提供有利条件[9]。妊娠合并细菌性阴道病可导致多种不良妊娠结局发生，例如习惯性流产、胎膜早破、早产等，因此，针对妊娠期女性的早期筛查与及时治疗，可以有效预防不良妊娠结局的发生。

本次研究中，共计315例孕妇合并细菌性阴道病，发病率为20.11%，发病率高于霉菌性阴道炎与滴虫性阴道炎。不同孕周细菌性阴道病发病率不同，孕34～39^{+6}周孕妇发病率(25.65%)高于孕28～33^{+6}周孕妇(11.01%)、孕40～42周孕妇(14.58%)。江飞云等[10]关于细菌性阴道病与自发性早产的相关性分析发现，细菌性阴道病阳性率为20.7%。生育期女性患细菌性阴道病几率高于其他女性，临床表现主要为阴道瘙痒、灼热感，分泌物带鱼腥味，乳酸杆菌数量减少。妊娠期女性阴道皱襞增加、通透性增强，容易遭受病原菌入侵，为致病菌繁殖提供有利条件，更易患细菌性阴道病。

本次对315例细菌性阴道病阳性患者与300例健康对照组患者的阴道分泌物进行分析，阳性组患者阴道加德纳菌密集度主要集中于Ⅲ～Ⅳ级，为优势菌群。阳性组孕妇乳杆菌密集度0级占比高于对照组，Ⅱ级、Ⅲ级占比低于对照组，其他细菌密集度0级占比低于对照组，Ⅰ级、Ⅱ级、Ⅲ级、Ⅳ级占比高于对照组。与张华杰等[11]研究结果一致。女性阴道内的乳酸杆菌可将上皮细胞产生的糖原转化为乳酸，保持阴道处于酸性环境。细菌性阴道炎患者阴道内内乳酸杆菌显著减少，阴道加德纳菌、消化链球菌及某些厌氧菌等病原菌大量繁殖，阴道内正常菌群失衡。

本次研究中对细菌性阴道病阳性孕妇与细菌性阴道病阴性孕妇的阴道分泌物IL-8水平进行比较，阳性组孕妇的IL-8水平显著高于阴性组孕妇，对比差异具有统计学意义。孔丽君等[12]关于妊娠期细菌性阴道病与围产结局的关系研究结果与本次研究一致，阳性孕妇的阴道分泌物中的IL-8水平显著升高。针对IL-6、IL-8等水平对阴道屏障功能的影响及细菌性阴道病发病机制，Doerflinger等[13]及国内学者均进行了研究，但细菌性阴道病的发病机制目前尚未明了。

对比妊娠合并细菌性阴道病阳性组孕产妇与健康对照组孕产妇的早产率、胎膜早破发生率、产褥感染发生率、新生儿窒息发生率、新生儿黄疸发生率、新生儿感染发生率，健康组发生率显著低于阳性组。对比细菌性阴道病治疗患者和未治疗患者妊娠结局，未治疗患者不良妊娠发生率显著高于治疗组。王西叶等[14]研究结果发现，细菌性阴道病组治疗患者胎膜早破、新生儿高胆红素血症的发生率较未治疗患者降低，细菌性阴道病组治疗患者的分娩孕周和新生儿体重较未治疗患者升高。妊娠合并细菌性阴道病患者阴道内存在大量致病菌，通过分解蛋白酶稀释宫颈黏液，引发宫内感染，引起胎儿早产、宫内窒息、胎儿畸形等不良妊娠结局。

【参考文献】

[1] Svare JA, Schmidt H, Hansen BB, et al. Bacterial vaginosis in a cohort of Danish pregnant women: prevalence and relationship with preterm delivery, low birthweight and perinatal infections [J]. BJOG, 2019, 113(2): 1419-1426.

[2] Kero K, Rautava J, Syrjanen K, et al. Association of asymptomatic bacterial vaginosis with persistence of female genital human papilloma-virus infection[J]. Eur J Clin Microbiol Infect Dis, 2017, 36(11): 2215-2219.

[3] Mastromarino P, Vitali B, Mosca L. Bacterial vaginosis: a review on clinical trials with probiotics[J]. New Microbiol, 2018, 36(3): 229-238.

[4] 张帝开，梁茂莲. 妊娠早期阴道微生态改变的影响因素与阴道炎症[J]. 实用妇产科杂志，2018，34(10)：723-725.

[5] Ibrahim SM, Bukar M, Galadima GB, et al. Prevalence of bacterial vaginosis in pregnant women in Maiduguri, North-Eastern Nigeria [J]. Niger J Clin Pract, 2014, 17(2): 154-158.

[6] Nelson DB, Hanlon A, Nachamkin I, et al. Early pregnancy changes in bacterial vaginosis-associated bacteria and preterm delivery[J]. Paediatr Perinat Epidemiol, 2017, 28(2): 88-96.

(下转574页)

菌药物的耐药率显著高于exoS基因。鞠晓红等[19]研究显示老年组ecoS+/ecoU+阳性率、exoS和ecoU的总阳性率均高于非老年组，ecoS+/ecoU+组对亚胺培南和左氧氟沙星耐药率明显高于其他基因型。周蓓蓓等[9]研究中对T3SS和T6SS中的毒力基因进行了检测，并对每个基因型铜绿假单胞菌的耐药程度进行对比，结果显示痰液和血液来源铜绿假单胞菌T3SS毒力基因ecoU携带率和对亚胺培南的耐药率存在明显差异。目前铜绿假单胞菌的耐药机制尚不完全清楚，它对多种抗生素天然耐药，且易形成生物膜使得临床治疗棘手。在本次研究中发现exoS和exoU阳性率在多耐药菌和非多耐药菌存在差异，提示在临床治疗时检出铜绿假单胞菌携带ecoS和ecoU基因时，该菌株对亚胺培南、氟喹诺酮类耐受性较强。

【参考文献】

[1] Kumarage J, Khonyongwa K, Khan A, et al. Transmission ofmulti-drug resistant *Pseudomonas aeruginosa* between twoflexible ureteroscopes and an outbreak of urinary tract infection: the fragility of endoscope decontamination [J]. JHospInfect, 2019, 102(1): 89-94.

[2] Catho G, Martischang R, Boroli F, et al. Outbreak of *Pseudomonas aeruginosa* producing VIM carbapenemase in an intensive care unit and its termination by implementation of waterless patient care[J]. Crit Care, 2021, 25(1): 301.

[3] Campana EH, Xavier DE, Petrolini FV, et al. Carbapenem-resistant and cephalosporin - susceptible: A worrisome phenotype among *Pseudomonas aeruginosa* clinical isolates in Brazil[J]. Braz J Infect Dis, 2017, 21(1): 57-62.

[4] World Health Organization. WHO publishes list of bacteria for which new antibiotics are urgently needed [EB/OL]. (2017-02-17).

[5] 国家卫生健康委合理用药专家委员会. 2019年全国细菌耐药监测报告[J]. 中国合理用药探索, 2021, 18(3): 1-11.

[6] 胡付品, 郭燕, 朱德妹, 等. 2021年CHINET中国细菌耐药监测[J]. 中国感染与化疗杂志, 2022, 22(5): 521-530.

[7] Teiji S, Masaru S, Kiyoshi M, et al. Association between *Pseudomonas aeruginosa* type Ⅲ secretion, antibiotic resistance, and clinical outcome: a review [J]. Critical Care, 2014, 18(6): 668-678.

[8] Sawa T, Hamaoka S, Kinoshita M, et al. *Pseudomonas aeruginosa* type III secretory toxin exoU and its predicted homologies[J]. Toxins, 2016, 8(11): 307.

[9] 周蓓蓓, 王凌波, 张秀彩, 等. 铜绿假单胞菌T3SS和T6SS的基因分布特性及与耐药的相关性[J]. 温州医科大学学报, 2022, 52(12): 981-986.

[10] 蒋月婷, 欧阳浩新, 吴爱武, 等. 多重耐药铜绿假单胞菌毒力基因与耐药的相关性[J]. 热带医学杂志, 2016, 16(5): 604-607.

[11] Allsopp LP, Wood TE, Howard SA, et al. RsmA and AmrZ orchestrate the assembly of all three type VI secretion systems in *Pseudomonas aeruginosa* [J]. Proc Natl Acad Sci USA, 2017(114): 7707-7712.

[12] Cho HH, Kwon KC, Kim S, et al. Correlation between virulence genotype and fluoroquinolone resistance in Carbapenem Resistant *Pseudomonas aeruginosa*[J]. Ann Lab Med, 2014, 34(4): 286-292.

[13] 朱健铭, 翁幸鑒, 姜如金, 等. 铜绿假单胞菌临床分离株毒力基因分子流行病学研究[J]. 中国卫生检验杂志, 2021, 31(19): 2315-2320.

[14] Pachori P, Gothalwal R, Gandhi P. Emergence of antibiotic resistance *Pseudomonas aeruginosa* in intensive care unit: a critical review[J]. Genes & diseases, 2019, 6(2): 109-119.

[15] Siriyong T, Murray RM, Bidgood LE, et al. Dual β-Lactam combination therapy for multi-drug resistant *Pseudomonas aeruginosa* infection: Enhanced efficacy *in vivo* and comparison with monotherapies of penicillin-binding protein inhibition[J]. Sci Rep, 2019, 9(1): 9098-9110.

[16] Logan LK, Gandra S, Mandal S, et al. Multidrug- and carbapenemresistant *Pseudomonas aeruginosa* in children, United States, 1999-2012[J]. J Pediatric Infect Dis Soc, 2017, 6(4): 352-359.

[17] Huang T, Zeng M, Fu H, et al. A novel antibiotic combination of linezolid and polymyxin B octapeptide PBOP against clinical *Pseudomonas aeruginosa* strains [J]. Ann Clin Microbiol Antimicrob, 2022, 21(1): 1-11.

[18] 方雪瑶, 胡龙华, 杭亚平, 等. 铜绿假单胞菌Ⅲ型分泌系统相关毒力基因在抗菌药物中表达差异的研究[J]. 中国抗生素杂志, 2019, 44(12): 1390-1393.

[19] 鞠晓红, 李瑶, 王月华, 等. 铜绿假单胞菌毒力基因exoS、exoU临床分布及耐药性研究[J]. 中国医院药学杂志, 2017, 37(1): 48-51.

【收稿日期】 2022-11-12 **【修回日期】** 2023-02-05

(上接569页)

[7] Bothuyne-Queste E, Hannebicque-Montaigne K, Canis F, et al. Is the bacterial vaginosis risk factor of prematurity? Study of a cohort of 1336 patients in the hospital of Arras[J]. J Gynecol Obstet Biol Reprod(Paris), 2017, 41(3): 262-270.

[8] United States Centers for Disease Control and Prevention. Sexually Transmitted Diseases Treatment Guideline[S]. MMWR, 2021, 70(4): 65-70.

[9] Africa CW, Nel J, Stemmet M. Anaerobes and bacterial vaginosis in pregnancy: virulence factors contributing to vaginal colonisation [J]. Int Environ Res Public Health, 2017, 11(7): 6979-7000.

[10] 江飞云. 细菌性阴道病与自发性早产的相关性分析[D]. 皖南医学院, 2021.

[11] 张华杰, 丁淼, 何宏舸. 细菌性阴道病菌群特点及感染因素分析[J]. 中国病原生物学杂志, 2022, 17(8): 968-971.

[12] 孔丽君, 张莉, 李光辉. 妊娠期细菌性阴道病与围产结局的关系[J]. 新乡医学院学报, 2015, 32(3): 262-264.

[13] Doerflinger SY, Throop AL, Herbst-Kralovetz MM. Bacteria in the vaginal microbiome alter the innate immune response and barrier properties of the human vaginal epithelia in a species-specific manner[J]. J Infect Dis, 2014, 209(12): 1989-1999.

[14] 王西叶, 蒋益炯, 金晶, 等. 孕28周后妊娠合并细菌性阴道病发病分析及对妊娠结局的影响[J]. 中华医院感染学杂志, 2017, 27(14): 3277-3280.

【收稿日期】 2022-12-08 **【修回日期】** 2023-02-20