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• 临床研究 •

# 胎膜早破合并宫内感染病原菌分布特点及危险因素分析

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**【摘要】** **目的** 探讨胎膜早破孕妇合并宫内感染的病原菌分布特征及其相关危险因素,为临床预防及治疗提供科学依据。**方法** 选取本院接诊的63例胎膜早破合并宫内感染患者及同期63例胎膜早破未合并宫内感染患者为本次研究对象。采集宫内感染患者羊水标本,进行细菌培养和药敏试验,分析病原菌种类及耐药情况。同时,采用 Logistic 回归分析法评估相关危险因素,以期临床防治工作提供参考。**结果** 63例宫内感染患者中共分离出72株病原菌。其中,55例患者检出1株病原菌,7例检出2株,1例检出3株。病原菌中,革兰阴性菌占55.56%,主要为大肠埃希菌(23.61%),其次是肺炎克雷伯菌(9.72%)和阴道加德纳菌(6.94%)。革兰阳性菌占31.94%,以无乳链球菌(19.44%)为主。真菌占12.5%,主要是白色假丝酵母菌(8.33%)。大肠埃希菌对氨苄西林的耐药率最高为88.24%,对头孢呋辛的耐药率为58.82%,对头孢他啶、美罗培南、亚胺培南、莫西沙星的耐药率较低,分别为17.65%、11.76%、5.88%、17.65%,未检出对阿米卡星的耐药株。无乳链球菌对克林霉素的耐药率最高为78.57%,对红霉素、四环素的耐药率分别为71.43%、64.29%,对氯霉素的耐药率较低为7.14%,未检出对青霉素G、氨苄西林、万古霉素的耐药株。单因素分析表明,两组患者在破膜孕周、破膜后待产时间、阴道检查次数及瘢痕子宫方面存在显著差异( $P < 0.05$ ),而年龄、体重指数和分娩史差异无统计学意义( $P > 0.05$ )。进一步的二元 Logistic 回归分析显示,破膜孕周 $< 33$ 周、破膜后待产时间 $\geq 2$  d、破膜后行阴道检查次数 $\geq 4$ 次、瘢痕子宫均为宫内感染发生的独立危险因素( $P < 0.05$ )。感染组患者中,产褥感染、胎盘早剥、胎儿呼吸窘迫、新生儿窒息、新生儿感染和缺氧性脑病的发生率分别为28.57%、14.29%、12.7%、17.46%、23.81%和20.63%。对照组中,产褥感染、胎盘早剥、胎儿呼吸窘迫、新生儿窒息、新生儿感染和缺氧性脑病的发生率分别为6.35%、4.76%、3.17%、6.35%、7.94%和17.46%。两组患者在产褥感染、胎儿呼吸窘迫和新生儿感染的发生率差异有统计学意义( $P < 0.05$ )。**结论** 胎膜早破合并宫内感染患者病原菌主要为大肠埃希菌和无乳链球菌,对临床常用抗菌药物耐药情况具有一定差异性,临床需谨慎选择抗菌药物。破膜孕周、破膜后待产时间、阴道检查次数等因素可能与宫内感染的发生风险相关,需在临床实践中加以关注和控制。感染组患者更易发生不良妊娠结局,针对这类患者早期诊断和及时干预至关重要。

**【关键词】** 胎膜早破;宫内感染;病原菌;危险因素;妊娠结局

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## Analysis of the distribution characteristics of pathogenic bacteria and risk factors in premature rupture of fetal membranes complicated with intrauterine infection

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**【Abstract】** **Objective** To explore the distribution characteristics of pathogenic bacteria and related risk factors in pregnant women with premature rupture of fetal membranes complicated with intrauterine infection, so as to provide scientific basis for clinical prevention and treatment. **Methods** 63 patients with premature rupture of fetal membranes complicated with intrauterine infection and 63 patients with premature rupture of fetal membranes without intrauterine infection admitted to our hospital during the same period were selected as the research objects of this study. Amniotic fluid specimens from patients with intrauterine infection were collected for bacterial culture and drug sensitivity test to analyze the types of pathogenic bacteria and drug resistance. At the same time, Logistic regression analysis was used to evaluate relevant risk factors in order to provide a reference for clinical prevention and treatment. **Results** A total of 72 strains of pathogenic bacteria were isolated from 63 patients with intrauterine infection. Among them, 55 patients were detected with 1 strain of pathogenic bacteria, 7 patients were detected with 2 strains, and 1 patient was detected with 3 strains. Among the pathogenic bacteria, Gram-negative bacteria accounted for 55.56%, mainly *Escherichia coli* (23.61%), followed by *Klebsiella pneumoniae* (9.72%) and *Gardnerella vaginalis* (6.94%). Gram-positive bacteria

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accounted for 31.94%, mainly *Streptococcus agalactiae* (19.44%). Fungi accounted for 12.5%, mainly *Candida albicans* (8.33%). The resistance rate of *Escherichia coli* to ampicillin was the highest at 88.24%. The resistance rate to cefuroxime was 58.82%. The resistance rates to ceftazidime, meropenem, imipenem, and moxifloxacin were relatively low, which were 17.65%, 11.76%, 5.88%, and 17.65% respectively. No resistant strains to amikacin were detected. The resistance rate of *Streptococcus agalactiae* to clindamycin was the highest at 78.57%. The resistance rates to erythromycin and tetracycline were 71.43% and 64.29% respectively. The resistance rate to chloramphenicol was relatively low at 7.14%. No resistant strains to penicillin G, ampicillin, and vancomycin were detected. Univariate analysis showed that there were significant differences between the two groups of patients in terms of gestational weeks of membrane rupture, waiting time after membrane rupture, frequency of vaginal examinations, and scarred uterus ( $P < 0.05$ ), while there were no significant differences in age, body mass index, and delivery history ( $P > 0.05$ ). Further binary Logistic regression analysis showed that gestational weeks of membrane rupture  $< 33$  weeks, waiting time after membrane rupture  $\geq 2$  days, frequency of vaginal examinations after membrane rupture  $\geq 4$  times, and scarred uterus were all independent risk factors for intrauterine infection ( $P < 0.05$ ). Among the infected group, the incidences of puerperal infection, placental abruption, fetal respiratory distress, neonatal asphyxia, neonatal infection, and hypoxic encephalopathy were 28.57%, 14.29%, 12.7%, 17.46%, 23.81%, and 20.63%, respectively. In the control group, the incidences of puerperal infection, placental abruption, fetal respiratory distress, neonatal asphyxia, neonatal infection, and hypoxic encephalopathy were 6.35%, 4.76%, 3.17%, 6.35%, 7.94%, and 17.46%, respectively. There were significant differences in the incidences of puerperal infection, fetal respiratory distress, and neonatal infection between the two groups of patients ( $P < 0.05$ ).

**Conclusion** In patients with premature rupture of fetal membranes complicated with intrauterine infection, the pathogenic bacteria were mainly *Escherichia coli* and *Streptococcus agalactiae*. There were certain differences in the drug resistance to commonly used antibacterial drugs in clinical practice, so antibacterial drugs need to be carefully selected clinically. Factors such as gestational weeks of membrane rupture, waiting time after membrane rupture, and frequency of vaginal examinations may be related to the risk of intrauterine infection and need to be paid attention to and controlled in clinical practice. Infected patients were more likely to have adverse pregnancy outcomes. Early diagnosis and timely intervention for such patients were extremely important.

**【Keywords】** Premature rupture of membranes; Intrauterine infection; Pathogenic bacteria; Risk factors; Pregnancy outcome

胎膜早破 (Premature rupture of membrane, PROM), 可以进一步分为足月胎膜早破和未足月胎膜早破两种类型<sup>[1]</sup>。它属于围产期常见并发症之一, 具有较高的发生率。胎膜早破的诱发因素多种多样, 其中包括细菌感染、病毒感染等, 这些因素可能导致胎膜的强度减弱, 从而在分娩前发生破裂, 给孕妇和胎儿带来一定的风险和挑战<sup>[2]</sup>。根据流行病学调查研究结果显示, 胎膜早破的发生率大约为 6%~12%, 数据显示这一比例呈现出逐年上升的趋势, 引起了医学界的广泛关注和担忧<sup>[3]</sup>。胎膜早破患者由于其胎膜屏障消失, 使得阴道内病原微生物更容易上行至子宫内部, 进而导致患者出现宫内感染的情况<sup>[4-5]</sup>。宫内感染不仅会对母体造成严重的健康问题, 还可能对胎儿产生不利影响, 如新生儿感染、新生儿窒息等并发症<sup>[6,7]</sup>。因此, 对于胎膜早破的患者, 临床上应采取一系列预防和治疗措施, 以减少感染的风险, 确保母婴安全。

本研究通过回顾性分析本院接诊的 63 例胎膜早破合并宫内感染患者临床资料, 探讨胎膜早破合并宫内感染的病原菌分布特征及其相关危险因素, 结果报告如下。

## 对象与方法

### 1 研究对象

选取山东聊城第二人民医院产科接诊的 63 例胎膜早破合并宫内感染患者为本次研究对象。纳入标准: ①胎膜早破符合胎膜早破的诊断与处理指南(2015年版)相关诊断标准<sup>[8]</sup>; ②经综合检测确诊为宫内感染, 羊水培养结果为阳性<sup>[9]</sup>; ③年龄  $\geq 22$  岁; ④孕周  $\geq 28$  周; ⑤单胎妊娠; ⑥胎位正常; ⑦临床资料完整; ⑧破膜后进行母胎监测, 实施治疗方案。排除标准: ①合并其他部分感染者; ②合并妊娠高血压、妊娠糖尿病、妊娠期甲状腺疾病等孕期并发症; ③合并恶性肿瘤者; ④合并既往早产史者; ⑤合并凝血功能障碍者; ⑥外伤导致胎膜早破者; ⑦合并饮酒、吸烟、长期服药等不良史者; ⑧合并免疫系统疾病者。同时选取 63 例同期胎膜早破未并发宫内感染患者为对照组。

### 2 资料收集

通过本院电子病历系统及问卷调查收集患者临床资料, 包括年龄、体重指数、分娩史、破膜孕周、破膜后待产时间、破膜后行阴道检查次数、是否为瘢痕子宫及妊娠结局(包括产褥感染、胎盘早剥、胎儿呼吸窘迫、新

生儿窒息、新生儿感染、缺氧性脑病)等。

### 3 病原菌鉴定及药敏试验

对出现羊水浑浊的患者,采用无菌方法采集羊水标本。剖宫产术中发生羊水浑浊者,即在切开患者羊膜腔后且患儿娩出前,采用无菌注射器收集患者2~5 mL羊水标本。针对检查过程中发现羊水浑浊者,采用无菌手套进入宫口后,采用无菌注射器收集患者2~5 mL羊水标本。羊水标本贴好标签后,及时送检。将羊水标本接种于血培养仪中进行孵育,对发出阳性警报的羊水标本进行涂片和革兰染色。根据染色结果,将标本分别接种于巧克力培养基和血平板上,于37℃环境中,进行有氧后厌氧培养48 h。培养菌株进行分离、纯化后,采用微生物全自动鉴定及药敏分析仪(VITEK 2 Compact,法国梅里埃)进行菌种鉴定及药敏试验。

### 4 统计分析

采用SPSS 26.0对本次研究数据进行统计分析,组间对比采用卡方检验,对比感染组与对照组患者临床资料及妊娠结局,分析胎膜早破合并宫内感染患者危险因素, $P < 0.05$ 为差异有统计学意义。

## 结 果

### 1 病原菌分布特点

63例宫内感染患者羊水标本,共培养分离出72株病原菌,其中55例检出1株病原菌,7例检出2株病原菌,1例检出3株病原菌。革兰阴性菌占比55.56%(40/72),包括大肠埃希菌17株(23.61%,17/72),肺炎克雷伯菌7株(9.72%,7/72),阴道加德纳菌5株(6.94%,5/72),铜绿假单胞菌3株(4.17%,3/72),阴沟肠杆菌3株(4.17%,3/72),奇异变形杆菌2株(2.78%,2/72),粘质沙雷菌2株(2.78%,2/72),弗劳地柠檬酸杆菌1株(1.39%,1/72)。革兰阳性菌占比31.94%(23/72),包括无乳链球菌14株(19.44%,14/72),粪肠球菌5株(6.94%,5/72),金黄色葡萄球菌2株(2.78%,2/72),表皮葡萄球菌2株(2.78%,2/72)。真菌占比12.5%(9/72),包括白色假丝酵母菌6株(8.33%,6/72),近平滑假丝酵母菌2株(2.78%,2/72),热带假丝酵母菌1株(1.39%,1/72)。

### 2 主要病原菌耐药性分析

**2.1 大肠埃希菌耐药性分析** 药敏结果显示,大肠埃希菌对抗菌药物的耐药性主要体现在氨苄西林、头孢吡辛上,对氨苄西林的耐药率最高为88.24%(15/17),对头孢吡辛的耐药率为58.82%(10/17),远高于其他抗菌药物。对氨苄西林/舒巴坦、庆大霉素、左氧氟沙星、头孢他啶、美罗培南、亚胺培南、莫西沙星的耐药率分别为23.53%(4/17)、41.18%(7/17)、47.06%

(8/17)、17.65%(3/17)、11.76%(2/17)、5.88%(1/17)、17.65%(3/17),未检出对阿米卡星的耐药株。

**2.2 无乳链球菌耐药性分析** 药敏结果显示,无乳链球菌对抗菌药物的耐药性主要体现在红霉素、克林霉素、四环素的上,其中对克林霉素的耐药率最高为78.57%(11/14),对红霉素、四环素的耐药率分别为71.43%(10/14)、64.29%(9/14)%,显著高于其他抗菌药物。对左氧氟沙星、莫西沙星、氯霉素的耐药率较低,分别为21.43%(3/14)、14.29%(2/14)、7.14%(1/14),未检出对青霉素G、氨苄西林、万古霉素的耐药株。

### 3 胎膜早破合并宫内感染危险因素分析

**3.1 胎膜早破合并宫内感染单因素分析** 对比两组患者临床资料,单因素分析显示:两组患者破膜孕周、破膜后待产时间、破膜后行阴道检查次数、是否为瘢痕子宫差异有统计学意义( $P < 0.05$ ),两组患者年龄、体重指数、分娩史差异无统计学意义( $P > 0.05$ )(表1)。

**3.2 胎膜早破合并宫内感染多因素分析** 将具有统计学意义的单因素进一步进行二元Logistic回归分析显示,破膜孕周 $< 33$ 周、破膜后待产时间 $\geq 2$  d、破膜后行阴道检查次数 $\geq 4$ 次、瘢痕子宫,是胎膜早破合并宫内感染的独立危险因素( $P < 0.05$ )(表2)。

表1 胎膜早破合并宫内感染单因素分析  
Table 1 Univariate analysis of premature rupture of membranes complicated with intrauterine infection.

相关因素 Relevant factors	感染组 (n=63) Infection group	对照组 (n=63) Control group	$\chi^2$	P	
年龄(岁)	$< 30$	36	39	0.296	0.586
	$\geq 30$	27	24		
体重指数(kg/m <sup>2</sup> )	$< 24$	44	47	0.356	0.551
	$\geq 24$	19	16		
分娩史	初产妇	45	38	1.730	0.188
	经产妇	18	25		
破膜孕周(周)	$< 33$	32	12	13.969	0.000
	$\geq 33$	31	51		
破膜后待产时间(d)	$< 2$	44	60	14.098	0.000
	$\geq 2$	19	3		
破膜后行阴道检查次数	$< 4$	46	57	6.436	0.011
	$\geq 4$	17	6		
瘢痕子宫	否	43	59	13.176	0.000
	是	20	4		

表2 胎膜早破合并宫内感染多因素分析  
Table 2 Multivariate analysis of premature rupture of membranes complicated with intrauterine infection.

相关因素 Relevant factors	$\beta$	SE2	Wald $\chi^2$ 值	P	OR	OR95%CI2
破膜孕周	-1.302	0.469	7.700	0.006	0.272	(0.108~0.682)
破膜后待产时间	2.537	0.702	13.077	0.000	12.641	(3.196~49.996)
破膜后行阴道检查次数	1.209	0.590	4.194	0.041	3.349	(1.053~10.648)
瘢痕子宫	1.894	0.637	8.840	0.003	6.646	(1.907~23.163)

#### 4 妊娠结局对比分析

感染组患者中,18例发生产褥感染(28.57%,18/63),9例发生胎盘早剥(14.29%,9/63),8例发生胎儿呼吸窘迫(12.7%,8/63),11例发生新生儿窒息(17.46%,11/63),15例发生新生儿感染(23.81%,15/63),13例发生缺氧性脑病(20.63%,13/63)。对照组患者中,4例发生产褥感染(6.35%,4/63),3例发生胎盘早剥(4.76%,3/63),2例发生胎儿呼吸窘迫(3.17%,2/63),4例发生新生儿窒息(6.35%,4/63),5例发生新生儿感染(7.94%,5/63),11例发生缺氧性脑病(17.46%,11/63)。两组患者,产褥感染、胎儿呼吸窘迫、新生儿感染发生率对比差异具有统计学意义( $P < 0.05$ )。见表3。

表3 两组患者妊娠结局对比分析  
Table 3 Comparative analysis of pregnancy outcomes between the two groups of patients

妊娠结局 Pregnancy outcome	感染组 (n=63) Infection group		对照组 (n=63) Control group		$\chi^2$	P
	病例数 No.	构成比 Proportion (%)	病例数 No.	构成比 Proportion (%)		
产褥感染	18	28.57	4	6.35	10.794	0.001
胎盘早剥	9	14.29	3	4.76	3.316	0.069
胎儿呼吸窘迫	8	12.70	2	3.17	3.910	0.048
新生儿窒息	11	17.46	4	6.35	3.708	0.054
新生儿感染	15	23.81	5	7.94	5.943	0.015
缺氧性脑病	13	20.63	11	17.46	0.206	0.650

#### 讨论

宫内感染主要是由于病原体侵入孕妇羊膜腔,导致胎膜、羊水以及胎盘发生感染,进而引发一系列的感染问题<sup>[10-11]</sup>。感染路径的多样性提示在临床实践中需提高警惕,对孕期妇女进行细致的监测与管理。胎膜、羊水和胎盘作为胎儿生长发育的重要环境,一旦发生感染,会对胎儿的健康造成严重影响<sup>[12]</sup>。因此,预防和及时治疗宫内感染对于保障母婴健康至关重要。

本次研究中,63例宫内感染患者羊水标本中共分离出72株病原菌。革兰阴性菌占55.56%,主要为大肠埃希菌,其次是肺炎克雷伯菌和阴道加德纳菌。革兰阳性菌占31.94%,以无乳链球菌为主。真菌占12.5%,主要是白色假丝酵母菌。药敏结果显示,大肠埃希菌对氨苄西林的耐药率最高,对头孢他啶、美罗培南、亚胺培南、莫西沙星的耐药率较低,未检出对阿米卡星的耐药株。无乳链球菌对克林霉素的耐药率最高为78.57%,对氯霉素的耐药率较低,未检出对青霉素G、氨苄西林、万古霉素的耐药株。无乳链球菌是妇产科临床中常见的条件致病菌之一。这类细菌通常在孕

妇的生殖道以及肛门周围的区域进行定植,是孕妇围术期感染的重要病原菌,容易引发多种不良的妊娠结局,包括但不限于早产、宫内感染、产后发热等严重问题<sup>[13]</sup>。无乳链球菌引发的宫内感染不仅对胎儿构成威胁,而且可能导致新生儿吸入性肺炎等并发症,使得婴儿出生后的治疗和护理更加复杂。

研究表明,宫内感染可增加早产、难产等风险,严重时甚至导致母婴死亡<sup>[14]</sup>。本次研究单因素分析表明,两组患者在破膜孕周、破膜后待产时间、阴道检查次数及瘢痕子宫方面存在显著差异( $P < 0.05$ ),而年龄、体重指数和分娩史无显著差异( $P > 0.05$ )。进一步的二元 Logistic 回归分析显示,破膜孕周 $< 33$ 周、破膜后待产时间 $\geq 2$  d、破膜后行阴道检查次数 $\geq 4$ 次、瘢痕子宫均为宫内感染发生的独立危险因素( $P < 0.05$ )。怀孕周数 $< 33$ 周的情况下,胎儿尚未完全发育成熟。如果在这个阶段过早地终止妊娠,产妇将面临多种并发症的风险。在破膜至分娩期间需要多次进行阴道镜检查,以密切监测孕妇和胎儿的体征,确保母婴的安全。然而,随着外界侵入性操作次数的增加以及时间的延长,病原菌上行引发感染的风险也会相应增加,从而导致宫内感染的发生率较高<sup>[15]</sup>。另一方面,瘢痕子宫的孕妇发生胎膜早破时,病菌更容易沿着瘢痕处进入宫腔,使得她们更容易发生宫内感染<sup>[16]</sup>。因此,在处理这类孕妇时,医生需要格外小心,以避免感染的发生,确保母婴的安全。因此,加强孕期管理,提高孕妇自身免疫能力,做好个人卫生,是降低宫内感染发生的关键。此外,对已感染孕妇进行及时有效的治疗,也是减少并发症、改善妊娠结局的重要措施。

本次研究中,感染组患者在产褥感染、胎儿呼吸窘迫和新生儿感染的发生率上均显著高于对照组患者( $P < 0.05$ )。与吴丽侠等<sup>[17]</sup>研究结果相近。由于宫内感染的患者在早期阶段往往没有明显的临床症状,这使得疾病的诊断变得相当困难,随着一系列炎症因子的释放,以及基底膜破坏因子的活跃,病情持续恶化<sup>[18]</sup>。这种情况不仅对患者自身健康构成威胁,还可能对妊娠结局产生严重影响。不良妊娠结局不仅会增加家庭的心理和经济负担,还可能引发社会公共卫生问题。因此,强化孕期监护,提升宫内感染的预防意识,对于改善母婴健康、降低不良妊娠结局至关重要。

综上所述,临床医生在针对胎膜早破患者的孕期管理中应重视宫内感染的预防与早期诊断,以及对病原菌耐药性的监测。通过精细化管理和及时干预,有望显著降低母婴并发症的发生率,为改善妊娠结局提供有力保障。

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