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• 临床研究 •

# 脊柱损伤患者术后切口感染病原学特征、红细胞免疫指标及降钙素原水平分析\*

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**【摘要】** **目的** 研究脊柱损伤患者术后切口感染病原菌分布特征、红细胞免疫指标及降钙素原水平变化,并探讨其临床意义。**方法** 选取在本院接受手术治疗的脊柱损伤患者 200 例,其中术后切口感染患者 80 例为观察组,术后切口未感染患者 120 例为对照组。利用全自动微生物鉴定系统对观察组患者送检标本进行菌株鉴定;检测两组患者免疫黏附促进因子(FEER)、红细胞-C3b受体(RBC-C3bR)、降钙素原(PCT)、肿瘤坏死因子- $\alpha$ (TNF- $\alpha$ )及干扰素- $\gamma$ (INF- $\gamma$ )水平,并做协同肿瘤红细胞花环(ATER)和直向肿瘤红细胞花环(DTER)试验,进行比较分析。**结果** 80 例脊柱损伤术后感染患者送检标本共检出病原菌 89 株,其中革兰阴性菌 63 株(占 70.79%),以大肠埃希菌(21 株,23.59%)及铜绿假单胞杆菌(20 株,22.48%)为主;革兰阳性菌 26 株(占 29.21%),以金黄色葡萄球菌(12 株,13.48%)为主。观察组患者红细胞免疫指标 FEER、ATER、DTER 及 RBC-C3bR 均显著低于对照组患者( $t$  值分别为 9.093、12.842、20.293、19.849,均  $P < 0.05$ );血清炎症因子 PCT、TNF- $\alpha$  及 INF- $\gamma$  水平均显著高于对照组患者( $t$  值分别为 43.980、34.495、11.731,均  $P < 0.05$ )。**结论** 脊柱损伤患者术后切口感染致病菌以革兰阴性菌为主。术后切口感染可导致患者免疫功能降低、炎性损伤加重,因此应加强对上述指标的监测及干预。

**【关键词】** 脊柱损伤;感染;病原菌;免疫功能;炎症因子

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## Analysis of pathogen characteristics, immune indicators, and procalcitonin levels in patients with a postoperative surgical site infection after a spinal injury

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**【Abstract】** **Objectives** To study the distribution of pathogenic bacteria, erythrocyte immune indicators, and procalcitonin levels in patients with a postoperative surgical site infection after a spinal injury and to explore their clinical significance. **Methods** Subjects were 200 patients with spinal injuries. Eighty patients with a surgical site infection served as the observation group, and 120 patients without a surgical site infection served as the control group. The bacterial strains were identified by an automated microbial identification system. FEER and RBC-C3bR and levels of PCT, TNF- $\alpha$ , and INF- $\gamma$  were measured. The associated tumor erythrocyte rosette rate (ATER) and direct tumor erythrocyte rosette rate (DTER) were determined. The changes in the above indicators in the two groups were compared and analyzed. **Results**

A total of 89 strains of pathogenic bacteria were detected in 80 patients with an infection after surgery for spinal injury. Of the 89 strains, 63 (70.79%) were strains of Gram-negative bacteria, which were mainly *Escherichia coli* (21 strains, 23.59%) and *Pseudomonas aeruginosa* (20 strains, 22.48%). Of the total strains, 26 (29.21%) were strains of Gram-positive bacteria, which were mainly *Staphylococcus aureus* (12 strains, 13.48%). In the observation group, FEER was  $45.12 \pm 4.67\%$ , ATER was  $50.38 \pm 5.04\%$ , DTER was  $24.36 \pm 2.61\%$ , and RBC-C3bR was  $12.51 \pm 1.27\%$ . In the control group, FEER was  $51.75 \pm 5.29\%$ , ATER was  $61.15 \pm 6.27\%$ , DTER was  $33.64 \pm 3.49\%$ , and RBC-C3bR was  $17.16 \pm 1.82\%$ . The serum levels of PCT, TNF- $\alpha$ , and INF- $\gamma$  in the observation group were  $45.12 \pm 4.67$  ng/mL,  $50.38 \pm 5.04$  ng/mL and  $12.51 \pm 1.27$  ng/L respectively. The serum levels of PCT, TNF- $\alpha$ , and INF- $\gamma$  in the control group were  $2.16 \pm 0.23$  ng/mL,  $1.76 \pm 0.19$  ng/mL, and  $78.46 \pm 7.96$  ng/mL, respectively. FEER, ATER, DTER, and RBC-C3bR were significantly lower in patients in the observation group than in the control group ( $t$  values: 9.093, 12.842, 20.293, and 19.849, respectively,  $P < 0.05$ ). The levels of PCT, TNF- $\alpha$ , and INF- $\gamma$  in serum were significantly

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higher than those in the control group ( $t$  values: 43.980, 34.495, and 11.731, respectively,  $P < 0.05$ ). **Conclusion** Pathogens causing a surgical site infection after a spinal injury were mainly Gram-negative bacteria. Postoperative wound infection can lead to a decline in immune function and aggravate inflammatory injury. Monitoring of the aforementioned indicators needs to be enhanced along with interventions to address them.

**【Key words】** Spinal injury; infection; pathogens; immune function; inflammatory factors

近年来交通事故及高空作业事故逐渐增多,因此而导致的脊柱损伤性疾病病例亦随之增加。目前脊柱损伤性疾病的临床治疗以外科手术为主<sup>[1-6]</sup>,但实施难度较高,而且存在术后易发生切口感染等风险。因此检测分析感染病原菌种类及患者相关免疫指标,对该类疾病的治疗具有参考意义。本研究拟对该院2016年5月至2018年5月收治的脊柱损伤患者术后切口感染病原菌的分布特征、红细胞免疫指标及炎症因子水平等的资料进行整理分析,以期为临床治疗提供指导。

## 对象与方法

### 1 病例

2016年5月至2018年5月在本院行脊柱外科手术的脊柱损伤患者200例。其中术后发生切口感染的80例患者设为观察组,男42例,女38例;年龄39~62岁,平均年龄(53.7±6.8)岁;颈椎手术35例,胸椎手术18例,腰骶椎手术27例。术后未出现切口感染的120例患者设为对照组,男71例,女49例;年龄37~61岁,平均年龄(53.2±6.4)岁;颈椎手术51例,胸椎手术25例,腰骶椎手术44例。两组患者一般资料具有可比性( $P > 0.05$ )。

纳入标准:①符合脊柱外科手术治疗指证;②年龄18~70周岁;③临床资料完整;④既往无脊柱外科手术史。排除标准:①临床资料缺失或失访者;②合并感染性疾病者;③存在脊柱感染病史者;④合并凝血功能异常者。院伦理委员会批准本研究,所有患者均签署知情同意书。

### 2 方法

**2.1 病原菌检测** 严格按无菌操作规范采集观察组患者切口感染部位的脓液或分泌物,采用全自动微生物鉴定系统(Thermo)进行病原菌的检测。

**2.2 红细胞免疫水平检测** 抽取患者静脉血2 ml,利用郭峰等<sup>[7]</sup>的方法进行免疫黏附促进因子(FEER)和红细胞-C3b受体(RBC-C3bR)水平检测,并做协同肿瘤红细胞花环(ATER)和直向肿瘤红细胞花环(DTER)试验。

**2.3 炎症因子水平检测** 抽取患者静脉血5 ml,分离血清,采用酶联免疫吸附法(ELISA)检测炎症因子降钙素原(PCT)、肿瘤坏死因子- $\alpha$ (TNF- $\alpha$ )及干扰素-

$\gamma$ (INF- $\gamma$ )水平。试剂盒购于上海钰博生物科技公司,按说明书方法操作。

**2.4 统计学分析** 采用SPSS 17.0软件处理数据。计数资料以“n”和“%”表示,进行 $\chi^2$ 检验;计量资料以 $\bar{x} \pm s$ 表示,进行 $t$ 检验。 $P < 0.05$ 表示差异有统计学意义。

## 结果

### 1 病原菌分布情况

80例脊柱损伤术后感染患者送检标本共检出病原菌89株,其中革兰阴性菌63株(占70.79%),以大肠埃希菌(21株,23.59%)及铜绿假单胞杆菌(20株,22.48%)为主;革兰阳性菌26株(占29.21%),以金黄色葡萄球菌(12株,13.48%)为主(表1)。

表1 病原菌分布及构成比(%)  
Table 1 Distribution and proportion of pathogenic bacteria(%)

病原菌 Pathogen	株数 No.	构成比(%) Constituent ratio
革兰阴性菌	63	70.79
大肠埃希菌	21	23.59
铜绿假单胞杆菌	20	22.48
阴沟肠杆菌	12	13.48
肺炎克雷伯菌	5	5.63
产气肠杆菌	3	3.37
其他	2	2.24
革兰阳性菌	26	29.21
金黄色葡萄球菌	12	13.48
表皮葡萄球菌	7	7.88
溶血葡萄球菌	3	3.37
凝固酶阴性葡萄球菌	2	2.24
屎肠球菌	2	2.24
合计 Total	89	100.00

### 2 红细胞免疫水平

观察组患者红细胞免疫指标FEER、ATER、DTER及RBC-C3bR分别为(45.12±4.67)%、(50.38±5.04)%、(24.36±2.61)%和(12.51±1.27)%,对照组分别为(51.75±5.29)%、(61.15±6.27)%、(33.64±3.49)%和(17.16±1.82)%,差异均有统计学意义( $t$ 值分别为9.093,12.842,20.293,19.849,均 $P < 0.05$ )。

### 3 炎症因子水平

ELISA方法检测观察组患者血清中炎症因子PCT、TNF- $\alpha$ 及INF- $\gamma$ 分别为(45.12±4.67)ng/mL、(50.38±5.04)ng/mL和(12.51±1.27)ng/L,对照

组分别为(2.16±0.23) ng/mL、(1.76±0.19) ng/mL和(78.46±7.96) ng/mL,差异均有统计学意义( $t$ 值分别为43.980,34.495,11.731,均 $P<0.05$ )。

## 讨 论

本组80例脊柱损伤性疾病术后感染患者送检标本共检出病原菌89株,主要为革兰阴性菌(63株),以大肠埃希菌(21株)及铜绿假单胞杆菌(20株)多见;革兰阳性菌26株,以金黄色葡萄球菌(12株)多见。表明导致脊柱损伤性疾病患者术后切口感染的病原菌以革兰阴性菌为主,与文献[8-9]的报道相似。脊柱损伤性疾病常发生于工矿、交通事故、自然灾害及高空作业时,伤情严重复杂,多发伤、复合伤较多,并发症多,合并脊髓损伤的患者预后差,严重者可导致终生残废,甚至危及生命<sup>[10-12]</sup>。脊柱为人体的中轴骨骼,是身体的支柱,具有支持躯干、减震、保护内脏、脊髓和进行运动的功能。如果患者颈部脊椎损伤,可能导致四肢瘫痪;如果腰椎损伤,可能面临下肢瘫痪。目前临床常用治疗手段为外科手术,但术后切口易发生感染,可直接导致患者面临巨大的生命危险,增加诊疗的难度及患者经济负担。因此,减少患者术后切口感染对改善患者预后具有重要意义。

切口感染是脊柱术后较为严重的临床并发症之一,可造成患者局部软组织坏死,切口愈合效率降低,免疫功能减退,严重影响患者术后恢复。红细胞免疫是机体的一种防御机制,红细胞除本身具有许多与免疫相关的物质外,还与其它免疫活性细胞有着密切的联系<sup>[13]</sup>。本次研究发现,观察组患者红细胞免疫指标FEER、ATER、DTER及RBC-C3bR百分率均显著低于对照组患者( $P<0.05$ ),血清中炎症因子PCT、TNF- $\alpha$ 及INF- $\gamma$ 水显著高于对照组患者( $P<0.05$ )。表明术后切口感染可导致脊柱损伤性疾病患者免疫功能紊乱,炎性应激反应水平升高。切口处感染的发生与机体的免疫功能状态密切相关,FEER、ATER、DTER及RBC-C3bR为红细胞免疫研究中较为常见的指标,其水平变化具有较高的临床意义<sup>[14]</sup>。PCT、TNF- $\alpha$ 及INF- $\gamma$ 为机体常见炎症因子,其水平变化可反应患者炎症应激损伤程度<sup>[15]</sup>。自由基代谢失衡导致的红细胞免疫黏附降低是红细胞免疫功能下降的重要因素之一,因此推测其作用机制可能与炎症反应导致的氧化-抗氧化水平失衡有关。在脊柱损伤性疾病患者的临床治疗中应重视对术后红细胞免疫及炎症应激反应程度的监测并采取相应的医护措施。

综上所述,脊柱损伤患者术后切口感染致病菌分布广泛,主要致病菌为革兰阴性菌。术后感染可导致患者免疫功能降低、炎性损伤加重。因此,对于早期感

染者应及时进行病原菌的检查,以指导临床合理应用抗菌药物,改善患者预后。

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