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胃肠道术后患者肠道菌群失衡状况及切口感染危险因素

刘楠, 袁海娟, 王伟

(江苏省苏北人民医院胃肠外科, 江苏 扬州 225000)

[摘要] 目的: 分析胃肠道术后患者肠道菌群失衡状况及切口感染的危险因素。方法: 回顾性分析江苏省苏北人民医院2020年2月至2022年2月收治的行胃肠道手术的455例患者, 将术后切口感染的35例患者作为感染组, 无切口感染的420例患者作为无感染组。将术后切口感染患者病原学标本送检, 检测其病原菌及两组肠道菌群分布情况, 并对胃肠道术后患者切口感染危险因素进行单因素、多因素分析。结果: 胃肠道术后患者切口感染发生率为7.69%。感染组患者大肠埃希菌、肠杆菌数量均高于无感染组, 双歧杆菌数量低于无感染组(均 $P<0.05$)。感染组年龄 ≥ 65 岁、急诊手术、手术切口 ≥ 10 cm、III/IV级切口、开腹手术、普通手术室、参观手术人数 >3 、手术时间 >2 h、接台手术的术后肠道感染比例均高于无感染组(均 $P<0.05$)。多因素logistic回归分析显示: 年龄、手术时机、手术切口长度、手术切口等级、手术方式、手术室类型、参观手术人数、接台手术均是胃肠道术后患者肠道感染的独立危险因素(均 $P<0.05$)。结论: 胃肠道术后患者发生感染风险较高, 且可出现肠道菌群失衡, 病原菌以革兰氏阴性菌为主, 危险因素明确, 临床应积极采取措施, 以改善预后。

[关键词] 胃肠道手术; 肠道菌群失衡; 病原菌; 切口感染; 危险因素

Intestinal flora imbalance and risk factors of incision infection in patients after gastrointestinal surgery

LIU Nan, YUAN Haijuan, WANG Wei

(Department of Gastrointestinal Surgery, North Jiangsu People's Hospital, Yangzhou Jiangsu 225000, China)

Abstract **Objective:** To analyze the imbalance of intestinal flora and the risk factors of incision infection in patients after gastrointestinal surgery. **Methods:** A total of 455 patients who underwent gastrointestinal surgery in North Jiangsu People's Hospital from February 2020 to February 2022 were retrospectively analyzed. Thirty-five patients with postoperative incision infection were selected as an infection group, and 420 patients without postoperative incision infection were selected as a non-infection group. The etiological specimens of patients with postoperative incision infection were sent for inspection to detect the distribution of pathogenic bacteria and the distribution of intestinal flora in the 2 groups. The risk factors of incision infection in patients after gastrointestinal surgery were analyzed by univariate and multivariate analysis. **Results:** The incidence of incision infection in patients after gastrointestinal

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通信作者 (Corresponding author): 袁海娟, Email: sbyyyhj@163.com

surgery was 7.69%. The number of *Escherichia coli* and *Enterobacter* in the infection group was higher than that in the non-infection group, and the number of *Bifidobacteria* was lower than that in the non-infection group (all $P < 0.05$). In the infection group, the postoperative intestinal infection proportion after the surgery with age ≥ 65 years old, emergency surgery, surgical incision ≥ 10 cm, grade III/IV incision, open surgery, general operating room, number of visitors to the operation > 3 , operation time > 2 h, the non-first operation, was higher than that in the non-infection group (all $P < 0.05$). Multivariate logistic regression analysis showed age, operation timing, length of incision, grade of incision, operation method, the type of operating room, the number of visitors to the operation, and the non-first operation were the gastrointestinal independent risk factors for intestinal infection in postoperative patients (all $P < 0.05$). **Conclusion:** Patients after gastrointestinal surgery have a high risk of infection, and may have an imbalance of intestinal flora. The pathogenic bacteria are mainly Gram-negative bacteria. The risk factors are clear. Clinical measures should be actively taken to improve the prognosis.

Keywords gastrointestinal surgery; intestinal flora imbalance; pathogenic bacteria; wound infection; risk factors

胃肠道是人体重要的消化器官, 胃肠道手术作为临床常见手术, 其通常涉及开腹手术操作, 易对手术切口造成污染, 切口感染和胃肠道菌群失衡的发生率较高^[1]。患者出现切口感染后, 其临床表现为切口红肿、疼痛、体温升高等, 对患者术后机体康复造成严重影响^[2-3]。近年来抗生素的不合理应用、耐药菌株的产生等增加, 使得患者术后切口感染的控制难度增加^[4]。因此分析胃肠道术后感染的危险因素对采取有效防治措施以降低此风险具有重要意义^[5]。为此, 本研究对收治的行胃肠道手术的患者的肠道菌群和病原菌分布情况进行探究, 且对术后切口感染危险因素进行分析, 现报道如下。

1 对象与方法

1.1 对象

回顾性分析江苏省苏北人民医院2020年2月至2022年2月收治的行胃肠道手术的455例患者。其中男271例, 女184例; 年龄18~82(57.33 \pm 7.52)岁; 胃手术156例, 小肠(包含阑尾炎手术)手术71例, 大肠手术228例。将术后切口感染的35例患者作为感染组, 无切口感染的420例患者作为无感染组。本研究经江苏省苏北人民医院医学伦理委员会批准通过。纳入标准: 均行胃肠道手术; 均签署知情同意书。排除标准: 合并感染性疾病; 合并免疫系统疾病; 既往腹部手术史; 存在手术禁忌证。

1.2 方法

1.2.1 病原菌检测方法

使用无菌棉拭子取患者切口部位分泌物后置

于标本瓶内, 全程严格遵守无菌操作, 最后送至微生物实验室进行培养、分离及检测。采用全自动生物鉴定仪对病原菌进行分析。其中切口感染标准根据《医院感染诊断标准(试行)》^[6]中的相关标准。

1.2.2 胃肠道菌群检测

实用无菌棉拭子取患者术后第1次3~5 g新鲜粪便置于采便盒内待检。取1 g粪便标本, 连续10倍稀释8次, 每次稀释取50 μ L涂抹于培养基内培养, 统计培养皿内菌落数量。以第3次稀释未检出细菌者为阴性。采用革兰氏染色镜检、菌落形态及生化反应判定细菌种类。取菌落数量适中的稀释度, 计算患者在同一稀释度中的平均菌落数, 并计算标本内细菌含量, 计算方法: 每克粪便内细菌数=平均菌落数 \times 稀释倍数 \times 500。

1.3 统计学处理

采用SPSS 22.0统计学软件进行数据分析。计量资料均符合正态分布, 以均数 \pm 标准差($\bar{x}\pm s$)表示, 比较采用 t 检验; 计数资料以例(%)表示, 比较采用 χ^2 检验或Fisher精确检验; 多因素分析采用logistic回归分析, 并建立logistic风险预测模型。 $P < 0.05$ 为差异有统计学意义。

2 结果

2.1 胃肠道术后患者切口感染病原菌分布情况

455例胃肠道术后患者中35例发生切口感染, 占7.69%(35/455); 病原学标本中共分离42株病原菌, 其中革兰氏阴性菌22株、革兰氏阳性菌18株、真菌2株(表1)。

表1 455例胃肠道术后患者切口感染病原菌分布情况
Table 1 Distribution of pathogenic bacteria in 455 patients after gastrointestinal surgery

| 病原菌 | 株数 | 构成比/% |
|---------|----|--------|
| 革兰氏阴性菌 | | |
| 大肠埃希菌 | 12 | 28.57 |
| 铜绿假单胞菌 | 5 | 11.91 |
| 肺炎克雷伯菌 | 2 | 4.76 |
| 鲍曼不动杆菌 | 2 | 4.76 |
| 阴沟肠杆菌 | 1 | 2.38 |
| 革兰氏阳性菌 | | |
| 金黄色葡萄球菌 | 10 | 23.81 |
| 表皮葡萄球菌 | 6 | 14.29 |
| 粪肠球菌 | 2 | 4.76 |
| 真菌 | | |
| 白色念珠菌 | 2 | 4.76 |
| 总计 | 42 | 100.00 |

2.2 胃肠道术后患者肠道菌群分布情况

感染组患者大肠埃希菌、肠杆菌数量均高于无感染组，双歧杆菌数量低于无感染组(均 $P < 0.05$ ，表2)。

2.3 胃肠道术后患者切口感染单因素分析

单因素分析结果示：感染组年龄 ≥ 65 岁、急诊手术、手术切口 ≥ 10 cm、III/IV级切口、开腹手术、普通手术室、参观手术人数 > 3 、手术时间 > 2 h、接台手术的术后肠道感染比例均高于无感染组(均 $P < 0.05$ ，表3)。

2.4 胃肠道术后患者切口感染多因素分析

多因素logistic回归分析结果示：年龄、手术时机、手术切口长度、手术切口等级、手术方式、手术室类型、参观手术人数、接台手术均是胃肠道术后患者肠道感染的独立危险因素(均 $P < 0.05$ ，表4)。

表2 455例胃肠道术后患者肠道菌群分布情况

Table 2 Distribution of intestinal flora in 455 patients after gastrointestinal surgery

| 组别 | <i>n</i> | 大肠埃希菌(湿便)/(lg CFU·g ⁻¹) | 肠杆菌(湿便)/(lg CFU·g ⁻¹) | 双歧杆菌(湿便)/(lg CFU·g ⁻¹) |
|----------|----------|-------------------------------------|-----------------------------------|------------------------------------|
| 无感染组 | 420 | 8.57 ± 0.76 | 8.51 ± 0.84 | 8.91 ± 0.87 |
| 感染组 | 35 | 9.31 ± 0.85 | 9.78 ± 0.91 | 7.76 ± 0.82 |
| <i>t</i> | | 5.483 | 8.538 | 7.545 |
| <i>P</i> | | <0.001 | <0.001 | <0.001 |

表3 455例胃肠道术后患者切口感染的单因素分析

Table 3 Univariate analysis of wound infection in 455 patients with gastrointestinal surgery

| 项目 | 无感染组(<i>n</i> =420) | 感染组(<i>n</i> =35) | χ^2/t | <i>P</i> |
|-------------|----------------------|--------------------|------------|----------|
| 性别/[例(%)] | | | 0.438 | 0.508 |
| 男 | 252 (60.00) | 19 (54.29) | | |
| 女 | 168 (40.00) | 16 (45.71) | | |
| 年龄/[例(%)] | | | 12.564 | <0.001 |
| <65岁 | 271 (64.52) | 12 (34.29) | | |
| ≥ 65 岁 | 149 (35.48) | 23 (65.71) | | |
| 手术部位/[例(%)] | | | 0.942 | 0.332 |
| 胃 | 167 (39.76) | 11 (31.43) | | |
| 肠 | 253 (60.24) | 24 (68.57) | | |

续表3

| 项目 | 无感染组(<i>n</i> =420) | 感染组(<i>n</i> =35) | χ^2/t | <i>P</i> |
|---------------|----------------------|--------------------|------------|----------|
| 手术时机/[例(%)] | | | 6.781 | 0.009 |
| 急诊手术 | 158 (37.62) | 21 (60.00) | | |
| 择期手术 | 262 (62.38) | 14 (40.00) | | |
| 手术切口长度/[例(%)] | | | 36.294 | <0.001 |
| <10 cm | 334 (79.52) | 12 (34.29) | | |
| ≥10 cm | 86 (20.48) | 23 (65.71) | | |
| 切口等级/[例(%)] | | | 42.765 | <0.001 |
| II | 330 (78.57) | 10 (28.57) | | |
| III/IV | 90 (21.43) | 25 (71.43) | | |
| 手术方式/[例(%)] | | | 13.799 | <0.001 |
| 开腹 | 187 (44.52) | 27 (77.14) | | |
| 腹腔镜 | 233 (55.48) | 8 (22.86) | | |
| 手术室类型/[例(%)] | | | 9.924 | 0.002 |
| 普通手术室 | 184 (43.81) | 25 (71.43) | | |
| 层流手术室 | 236 (56.19) | 10 (28.57) | | |
| 参观手术人数/[例(%)] | | | 10.749 | 0.001 |
| ≤3 | 229 (54.52) | 9 (25.71) | | |
| >3 | 191 (45.48) | 26 (74.29) | | |
| 手术时间/[例(%)] | | | 18.314 | <0.001 |
| ≤2 h | 230 (54.76) | 6 (17.14) | | |
| >2 h | 190 (45.24) | 29 (82.86) | | |
| 是否接台手术/[例(%)] | | | 11.084 | 0.001 |
| 是 | 201 (47.86) | 27 (77.14) | | |
| 否 | 219 (52.14) | 8 (22.86) | | |

表4 455例胃肠道术后患者切口感染的多因素分析

Table 4 Multivariate analysis of incision infection in 455 patients after gastrointestinal surgery

| 变量 | β | Wald χ^2 | <i>P</i> | OR | 95%CI |
|--------|---------|---------------|----------|--------|--------------|
| 年龄 | 2.671 | 9.072 | 0.001 | 12.119 | 4.051~32.025 |
| 手术时机 | 2.954 | 12.047 | <0.001 | 15.478 | 4.513~40.012 |
| 手术切口长度 | 3.055 | 13.872 | <0.001 | 17.115 | 4.668~37.175 |
| 手术切口等级 | 2.483 | 7.996 | 0.001 | 9.884 | 3.577~28.512 |
| 手术方式 | 2.773 | 9.268 | <0.001 | 10.005 | 3.811~30.043 |
| 手术室类型 | 2.155 | 6.952 | 0.003 | 9.064 | 2.974~20.175 |
| 参观手术人数 | 2.228 | 7.016 | 0.002 | 8.879 | 2.769~22.015 |
| 手术时间 | 1.224 | 2.157 | 0.072 | 1.054 | 1.024~5.778 |
| 接台手术 | 2.595 | 8.447 | 0.001 | 10.741 | 3.265~18.017 |

3 讨论

手术切口作为医源性感染, 其对患者术后机体恢复造成较大影响^[7]。相关调查^[8]结果显示: 相较于其他手术, 胃肠道手术患者更易发生术后切口感染, 不仅增加了住院时间及医疗费用, 延缓了患者的恢复速度。此次研究观察到455例胃肠道术后患者切口感染率为7.69%, 处于较低水平。其原因主要为: 腹腔镜技术是实施胃肠道术后切口感染的有效保护因素, 本科室应用腹腔镜技术较为成熟, 且术后充分应用快速康复外科理念, 包括尽早拔除胃管及引流管、缩短禁食禁水时间等, 因而可有效降低术后患者切口感染率。本研究观察到: 35例切口感染患者的病原学标本中共分离42株病原菌, 主要为革兰氏阴性菌和革兰氏阳性菌, 其中大肠埃希菌占比最高, 为28.57%, 其次为金黄色葡萄球菌(23.81%)。这表明革兰氏阴性菌及革兰氏阳性菌为胃肠道术后患者发生切口感染的主要菌种, 临床应采取针对性预防措施以尽可能降低感染率。

本研究发现: 感染组患者大肠埃希菌、肠杆菌数量均高于无感染组, 双歧杆菌数量低于无感染组($P < 0.05$)。这表明胃肠道术后患者存在肠道菌群失衡情况。分析原因主要为: 人体肠道内菌群数量众多, 其不仅参与了机体消化、营养物质的分解等^[9], 还促进了免疫系统发育, 并对病原菌的定植产生抑制作用。肠道菌群保持平衡状态有利于机体健康^[10]。而胃肠道手术对患者机体造成较大损耗, 影响患者免疫力, 且由于手术应激的影响等, 易使患者肠道菌群失衡^[11]。本研究观察到年龄、手术时机、手术切口长度等为胃肠道术后患者肠道感染的独立危险因素(均 $P < 0.05$)。分析原因主要为: 1) 年龄。老年患者由于机体各器官功能均已出现衰退, 免疫功能已明显下降, 且术后机体免疫功能难以迅速恢复, 因此发生切口感染的概率更高^[12]。2) 手术时机。急诊手术患者相较于择期手术患者术后切口感染率更高, 一方面由于行急诊手术者常为急重症, 其可伴有腹腔内出血、休克等症状, 因此对手术区域可造成污染; 另一方面急诊手术没有充足的手术准备时间, 特别是预防性使用抗生素及肠道准备^[13-14]。因此临床应在确保患者安全的情况下, 尽可能选择择期手术, 同时做好充分的术前准备工作^[15]。3) 手术切口长度及手术切口等级。III、IV类手术切口患者通常腹部感染情况较重, 患者腹腔内污染物对切口造成污染的概率极高。因此临床对于此类患者应更加重视术

前准备, 做好污染物与切口的有效隔离^[16]。4) 手术方式。实施开腹手术时, 术中操作均接触外界空气, 空气中的污染物、医护人员所携带的污染源等均会使术后切口感染率增高; 而腹腔镜手术操作相对封闭, 对于外界污染物能够起到有效隔离作用, 且腹腔镜手术切口更短, 直接污染切口的概率较低。因此临床在确保手术治疗效果的同时应尽可能应用腹腔镜手术^[17-18]。5) 手术室类型。普通手术室常使用空调实施换气, 其对空气的滤过及净化作用较差, 且气流输送方向无法精确控制; 而层流手术室具有层流超滤装置, 其可有效避免空调换气的缺点, 确保手术室有较高的洁净度^[19]。6) 参观手术人数。临床实习、教学等可使手术室参观人数超出限制, 人员流动增加会使细菌经呼吸进入空气, 增加手术室环境的含金量, 在室内人员走动过程中会增加细菌颗粒落于手术区域内的概率^[20]。7) 接台手术。在进行接台手术时, 手术室内难以彻底消毒, 因此发生切口感染的概率升高。临床需做好手术室无菌环境的相关管理。

综上所述, 年龄、手术时机、手术切口长度、手术切口等级、手术方式、手术室类型、参观手术人数、接台手术均是胃肠道术后患者肠道感染的独立危险因素, 胃肠道术后切口感染患者易发生肠道菌群失衡, 临床应积极采取措施, 以改善预后。本研究不足之处在于研究的时间较短, 选择指标及研究范围也较窄, 对于切口感染和菌群失调之间的关系有待今后进一步研究。

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