·临床研究·

老年无痛胃肠镜检查患者肠道准备失败的影响因素及预测模型构建

杨锦[1],王维[1],张晓燕[2],惠敏[1],李海燕[3*]
(联勤保障部队第九四〇医院:[1]消化内科,[2]内镜中心,[3]输血科,兰州 730050)

【摘 要】 **目的** 探讨老年无痛胃肠镜检查患者肠道准备失败的影响因素并构建风险预测模型。**方法** 回顾性分析2020年6月至2023年9月在联勤保障部队第九四〇医院进行无痛胃肠镜检查的412例老年患者的临床资料,按照2∶1的比例将患者分为测试组(n=275)及验证组(n=137)。根据肠道准备质量,将测试组中患者分为两个亚组,肠道准备成功者纳入成功组(n=178),肠道准备失败者纳入失败组(n=97)。采用SPSS 20.0统计软件进行数据分析。根据数据类型,分别采用t检验或χ^2检验进行组间比较。采用多因素logistic回归模型分析老年无痛胃肠镜检查患者肠道准备失败的影响因素,并以危险因素构建风险预测模型。采用Hosmer-Lemeshow检验验证预测效能。**结果** 成功组与失败组体质量指数、行走情况、便秘、结直肠手术史、首次进行结肠镜检查、服用三环类抗抑郁药、大量腹水、腹部/盆腔手术史、基础病种类资料比较,差异有统计学意义(P<0.05)。多因素logistic回归分析发现,便秘(OR=4.384,95%CI 1.136~16.919)、结直肠手术史(OR=4.043,95%CI 1.392~11.743)、服用三环类抗抑郁药(OR=5.013,95%CI 1.237~20.317)及基础病种类≥2种(OR=4.973,95%CI 1.335~18.526)是老年无痛胃肠镜检查患者肠道准备失败的独立危险因素。以危险因素代入风险预测模型,发现上述因素在老年无痛胃肠镜检查患者肠道准备失败中的预测灵敏度为67.18%、特异度为85.69%,曲线下面积(AUC)为0.739。验证组检验结果发现,灵敏度为66.54%、特异度为82.37%,AUC为0.709。**结论** 便秘、结直肠手术史、服用三环类抗抑郁药及基础病种类≥2种均会对老年胃肠镜检查患者肠道准备质量产生影响,且以上述因素构建的风险预测模型在老年胃肠镜检查患者肠道准备失败中预测效能较佳,临床需根据实际情况提出针对性干预方案,提高肠道准备质量。

【关键词】 老年人;无痛胃肠镜;肠道准备失败;风险预测模型
【中图分类号】 R614;R574 【文献标志码】 A 【DOI】 10.11915/j.issn.1671-5403.2025.05.071

Influencing factors of bowel preparation failure in elderly patients undergoing painless gastroenteroscopy and construction of a predictive model

Yang Jin[1], Wang Wei[1], Zhang Xiaoyan[2], Hui Min[1], Li Haiyan[3*]
([1]Department of Gastroenterolog, [2]Endoscopy Center, [3]Transfusion Department, 940th Hospital of Joint Logistics Support Force of Chinese People's Liberation Army, Lanzhou 730050, China)

【**Abstract**】 **Objective** To investigate the factors influencing bowel preparation failure in elderly patients with painless gastroenteroscopy and establish a risk prediction model. **Methods** A retrospective analysis was made of the clinical data of 412 elderly patients who underwent painless gastrointestinal endoscopy at 940th Hospital of Joint Logistics Support Force of Chinese People's Liberation Army from June 2020 to September 2023. The patients were divided into a test group (n=275) and a validation group (n=137) at a ratio of 2∶1. According to the quality of bowel preparation, the test group were divided into two subgroups: a success group (n=178) and a failure group (n=97). SPSS 20.0 was used for data analysis. According to the data type, t test or χ^2 test was used for data comparison between groups. Multivariate logistic regression analysis was used to analyze the influencing factors of bowel preparation failure, a risk prediction model was established based on the risk factors, and tailored intervention strategies were proposed. Hosmer-Lemeshow test was used to verify the prediction efficiency. **Results** Significant differences were seen between the success group and the failure group in body mass index, walking status, constipation, history of colorectal surgery, first colonoscopy, use of tricyclic antidepressants, massive ascites, history of abdominal/pelvic surgery, and type of underlying diseases (P<0.05). Logistic regression analysis showed that constipation (OR=4.384, 95%CI 1.136-16.919), history of colorectal surgery (OR=4.043, 95%CI 1.392-11.743), and use of tricyclic antidepressants (OR=5.013, 95%CI 1.237-20.317), and underlying diseases ≥2 kinds (OR=4.973, 95%CI 1.335-18.526) were independent risk factor for bowel preparation failure in elderly patients with painless gastroenteroscopy. The risk prediction model incorporating these factors demonstrated a predictive sensitivity of 67.18%, a specificity of 85.69%, and an area under the receiver operating characteristic curve (AUC) of 0.739. The validation test showed a sensitivity of 66.54%, a specificity of 82.37%,

收稿日期: 2024-03-11; **接受日期**: 2024-06-05
基金项目: 甘肃省自然科学基金(21JR1RA183);甘肃省卫生健康委员会资助项目(GSWSKY2021-044)
通信作者: 李海燕, E-mai: 273951194@qq.com

and an AUC of 0.709. **Conclusion** Constipation, history of colorectal surgery, use of tricyclic antidepressants, and underlying disease ≥2 kinds affect the quality of bowel preparation in elderly patients with gastroenteroscopy, and the risk prediction model based on the above factors exhibits a good predictive efficacy for bowel preparation failure in this population. Tailored intervention plans should be proposed according to the actual situations in clinical practice to improve the quality of bowel preparation.

【Key words】 aged; painless gastroenteroscope; bowel preparation failure; risk prediction model

This work was supported by Natural Science Foundation of Gansu Province (21JR1RA183) *and the Project of Health Commission of Gansu Province* (GSWSKY2021-044).

Corresponding author: *Li Haiyan*, *E-mail*: *273951194@qq.com*

近年来,消化道疾病发生率逐年升高,胃肠镜检查为消化道疾病的重要筛查手段,但其为侵入性检查,会增加患者的不适感和疼痛感,而镇痛和镇静可减轻患者的不适感与焦虑感[1,2]。无痛胃肠镜又称麻醉胃肠镜,患者在麻醉状态下进行胃肠镜检查,可有效减少传统胃肠镜检查带来的痛苦,当前已在消化道疾病诊断及治疗中广泛应用[3]。肠道准备质量在胃肠镜诊断准确性及安全性中十分关键,肠道准备失败则会延长胃肠道诊疗的操作时间,增加患者的经济负担和身心痛苦[4,5]。随着年龄的增长,患者普遍存在胃肠道功能减弱、行走功能降低、多基础病等问题,这些均可能会对无痛胃肠镜准备有一定影响[6,7],但影响程度尚有待进一步研究。本研究在以往研究的基础上,着重分析合并用药、胃肠道功能减弱、行走功能降低、多基础病等对老年无痛胃肠镜患者肠道准备失败的影响,旨在为临床提高肠道准备质量提供理论依据。

1 对象与方法

1.1 研究对象

回顾性分析 2020 年 6 月至 2023 年 9 月在解放军联勤保障部队第九四〇医院进行无痛胃肠镜检查的 412 例老年患者的临床资料,按照 2∶1 比例将患者分为测试组(n=275)及验证组(n=137)。根据肠道准备质量,将测试组中患者分为两个亚组,肠道准备成功者纳入成功组(n=178),肠道准备失败者纳入失败组(n=97)。纳入标准:(1)年龄≥60 岁;(2)在本院进行无痛胃肠镜检查;(3)采用聚乙二醇电解质散清肠液(polyethylene glycol electrolytes,PEG)进行肠道清洁。排除标准:(1)严重认知功能障碍及听力障碍;(2)有胃肠镜禁忌证;(3)临床资料不全。

1.2 方法

1.2.1 临床资料收集 包括年龄、性别、体质量指数、文化程度(初中及以下、高中或中专、大专及以上)、饮食习惯(以荤食为主、以素食为主、荤素搭配)、运动习惯(经常运动、偶尔运动、从不运动)、行走情况(行走困难、行走正常)、排便次数、就诊原因(体检、复查、便血、排便频次改变、腹部不适)、便秘、结直肠手术史、使用钙通道阻滞剂、使用阿片类药物、首次进行结肠镜检查、服用阿片类镇痛药、服用三环类抗抑郁药、大量腹水、腹部/盆腔手术史、末次大便浑浊/带渣、高血压及基础病种类。

1.2.2 构建风险预测模型 建立老年无痛胃肠镜检查患者肠道准备失败的 logistic 模型,并将 logistic 回归分析中偏回归系数代入预测模型中,以受试者工作特征曲线(receiver operating characteristic,ROC)下面积(area under the curve,AUC)评估预测效能,AUC≥0.7 则视为预测模型在终点事件中预测效能较佳。

1.3 统计学处理

采用 SPSS 20.0 统计软件进行数据分析。计量资料以均数±标准差($\bar{x}\pm s$)表示,组间比较采用 t 检验。计数资料以例数(百分率)表示,组间比较采用 χ^2 检验。采用多因素 logistic 回归模型分析老年无痛胃肠镜检查患者肠道准备失败的影响因素,以危险因素构建老年无痛胃肠镜检查患者肠道准备失败风险预测模型,采用 AUC 评估危险因素在老年无痛胃肠镜检查患者肠道准备失败中的预测价值。采用 Hosmer-Lemeshow 检验模型预测效能。P<0.05 为差异有统计学意义。

2 结 果

2.1 测试组与验证组基线资料比较

测试组与验证组基线资料比较,差异无统计学意义(P>0.05;表 1)。

2.2 成功组与失败组临床资料比较

成功组与失败组体质量指数、行走情况、便秘、结直肠手术史、首次进行结肠镜检查、服用三环类抗抑郁药、大量腹水、腹部/盆腔手术史、末次大便浑浊/带渣、基础病种类比较,差异有统计学意义(P<0.05;表 2)。

2.3 测试组患者肠道准备失败的危险因素

以老年无痛胃肠镜检查患者肠道准备失败为因变量,以单因素分析中有意义的指标为自变量,进行多因素 logistic 回归分析,发现便秘、结直肠手术史、服用三环类抗抑郁药及基础病种类≥2 种是老年无痛胃肠镜检查患者肠道准备失败的独立危险因素(P<0.05;表 3)。

表1 测试组与验证组基线资料比较

Table 1 Comparison of baseline data between test group and verification group [n(%)]

Item	Test group(n=275)	Verification group(n=137)	χ^2/t	P value
Age			2.059	0.151
≤79 years	135(49.09)	57(41.61)		
>79 years	140(50.91)	80(58.39)		
Gender			0.351	0.554
Male	143(52.00)	67(48.91)		
Female	132(48.00)	70(51.09)		
Body mass index			0.102	0.750
≤24 kg/m^2	125(45.45)	60(43.80)		
>24 kg/m^2	150(54.55)	77(56.20)		
Level of education			0.624	0.732
Junior high school and below	83(30.18)	44(32.12)		
High school or technical secondary school	97(35.27)	51(37.22)		
College and above	95(34.55)	42(30.66)		
Reason for medical treatment			5.559	0.135
Physical examination	79(28.73)	25(18.25)		
Hematochezia	60(21.82)	37(27.00)		
Frequency of defecation changes	58(21.09)	31(22.63)		
Abdominal discomfort	78(28.36)	44(32.12)		

表2 成功组与失败组临床资料比较

Table 2 Comparison of clinical data between successful group and failed group [n(%)]

Item	Failure group(n=97)	Success group(n=178)	χ^2/t	P value
Age			0.024	0.876
≤79 years	47(48.45)	88(49.44)		
>79 years	50(51.55)	90(50.56)		
Gender			0.132	0.716
Male	49(50.52)	94(52.81)		
Female	48(49.48)	84(47.19)		
Body mass index			33.715	<0.001
≤24 kg/m^2	67(69.07)	58(32.58)		
>24 kg/m^2	30(30.93)	120(67.42)		
Degree of education			0.869	0.648
Junior high school and below	31(31.96)	52(29.21)		
High school or technical secondary school	36(37.11)	61(34.27)		
College or above	30(30.93)	65(36.52)		
Eating habit			0.378	0.828
Mainly meat	29(29.90)	49(27.53)		
Mainly vegetarian	35(36.08)	62(34.83)		
Combination of meat and vegetables	33(34.02)	67(37.64)		
Exercise habit			0.320	0.852
Regular exercise	15(15.46)	32(17.98)		
Occasional exercise	41(42.27)	75(42.13)		
Never exercise	41(42.27)	71(39.89)		
Walking condition			34.842	<0.001
Dysphoria	71(73.20)	64(35.96)		
Walking normally	26(26.80)	114(64.04)		
Number of bowel movements			3.230	0.072
≤3 times/week	60(61.86)	90(50.56)		
4-14 times/week	37(38.14)	88(49.44)		
Reason for medical treatment			3.451	0.327
Physical examination	24(24.74)	55(30.90)		
Hematochezia	20(20.62)	40(22.47)		
Frequency of defecation changes	19(19.59)	39(21.91)		
Abdominal discomfort	34(35.05)	44(24.72)		
Constipation	57(58.76)	66(37.08)	11.942	0.001
History of colorectal surgery	71(73.20)	58(32.58)	41.580	<0.001
Use of calcium channel blockers	58(59.79)	85(47.75)	3.647	0.056
Use of opioids	61(62.89)	94(52.81)	2.593	0.107
First colonoscopy	65(67.01)	49(27.53)	40.327	<0.001
Taking opioid analgesics	56(57.73)	88(49.44)	1.731	0.188
Takeing tricyclic antidepressants	59(60.82)	63(35.39)	16.452	<0.001
Massive ascites	72(74.23)	69(38.76)	31.604	<0.001
History of abdominal/pelvic surgery	63(64.95)	78(43.82)	11.218	0.001
Last stool being cloudy/scum	65(67.01)	89(50.00)	4.976	0.026
Hypertension	63(64.95)	99(55.62)	2.258	0.133
Underlying disease			16.633	<0.001
<2 kinds	69(71.13)	81(45.51)		
≥2 kinds	28(28.87)	97(54.49)		

表 3 测试组患者肠道准备失败的危险因素

Table 3 Risk factors for intestinal preparation failure in test group

Factor	β	*SE*	*Wald* χ^2	*OR*	95%*CI*	*P* value
Body mass index	1.377	0.849	2.631	3.963	0.750–20.927	0.106
Walking condition	1.433	0.799	3.217	4.191	0.875–20.066	0.074
Constipation	1.478	0.689	4.602	4.384	1.136–16.919	0.033
History of colorectal surgery	1.397	0.544	6.595	4.043	1.392–11.743	0.011
First colonoscopy	1.299	0.713	3.319	3.666	0.906–14.827	0.069
Taking tricyclic antidepressants	1.612	0.714	5.097	5.013	1.237–20.317	0.024
Massive ascites	1.554	0.826	3.540	4.730	0.937–23.878	0.061
History of abdominal/pelvic surgery	1.413	0.821	2.962	4.108	0.822–20.536	0.086
Last stool being cloudy/scum	1.501	0.897	2.800	4.486	0.773–26.027	0.095
Underlying disease type	1.604	0.671	5.714	4.973	1.335–18.526	0.017

2.4 测试组患者肠道准备失败风险预测模型构建

以便秘、结直肠手术史、服用三环类抗抑郁药、基础病种类≥2 种因素构建老年无痛胃肠镜检查患者肠道准备失败风险预测模型，概率 $P = 1/[1 + e^{(1.478\times便秘+1.397\times结直肠手术史+1.612\times服用三环类抗抑郁药+1.604\times基础病种类)}]$，对危险因素进行 ROC 曲线分析发现，上述因素联合在老年无痛胃肠镜检查患者肠道准备失败中的预测灵敏度为 67.18%、特异度为 85.69%，AUC 为 0.739（图 1）。

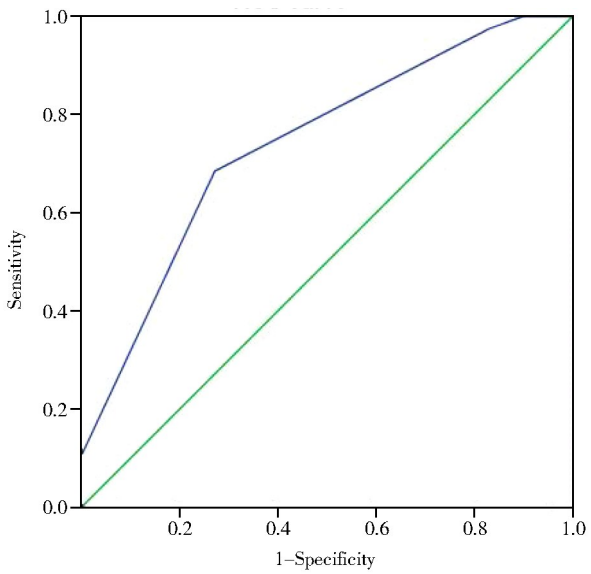

图 1 测试组患者肠道准备失败风险预测 ROC 曲线

Figure 1 ROC curve for predicting the risk of intestinal preparation failure

ROC: receiver operating characteristic.

2.5 患者肠道准备失败风险评分模型的验证

采用 ROC 曲线验证模型预测效果，灵敏度为 66.54%、特异度 82.37%，AUC 为 0.709，Hosmer-Lemeshow χ^2 检验结果显示，$\chi^2 = 4.136$，$P = 0.811$（图 2）。

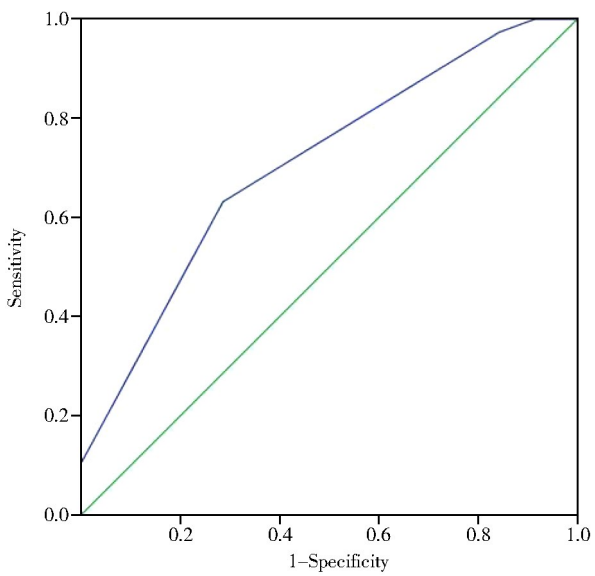

图 2 患者肠道准备失败风险评分模型验证 ROC 曲线

Figure 2 ROC curve for validating risk score model of intestinal preparation failure

ROC: receiver operating characteristic.

3 讨 论

随着国家经济发展及人民物质生活水平的提高，消化性疾病呈逐年升高趋势，胃肠镜为消化道疾病常用检查手段，胃肠镜检查的顺利进行及疾病检出精确性均有赖于肠道准备质量，合格的肠道准备有利于胃肠镜疾病的筛查及临床治疗，为减轻患者不适感，无痛胃肠镜检查已逐渐广泛应用于临床[8,9]，本研究分析影响无痛胃肠镜检查患者肠道准备失败的相关因素，旨在为临床检测及治疗提供依据。

本研究中 logistic 回归分析发现，便秘、结直肠手术史、服用三环类抗抑郁药及基础病种类≥2 种是老年无痛胃肠镜检查患者肠道准备失败的独立危险因素，分析原因如下。便秘患者极易出现排便无力、肠

道排空时间延长等症状,导致肠腔中残留粪便,清洁度不足,从而影响老年患者肠道准备质量[10,11]。有结直肠手术史者肠道解剖学结构会出现改变,还会出现肠道粘连,影响肠道蠕动及排空能力,导致肠腔中滞留内容物,导致肠道准备失败[12,13]。三环类抗抑郁药的服用会影响肠道蠕动功能,延长大便在肠道中停留时间,引起便秘,导致肠道准备失败[14]。王育斌等[15]研究认为环类抗抑郁药的服用不会对患者肠道准备质量产生影响,与本研究结果不同,这可能与研究地域及环类抗抑郁药的服用剂量不同有关。老年患者多合并多种基础病,体质虚弱,导致肠道活动及神经调节均明显减弱,影响胃肠道蠕动功能,进一步导致肠道准备失败[16]。针对有结直肠手术史的患者,可鼓励患者在服药期间增加腹部按摩及步行运动,促进肠道蠕动,实现有效排空肠道内容物,降低肠道失败风险。加强对三环类抗抑郁药服用者的监测,干预措施同便秘者。针对合并多种基础疾病的患者,在检查前可遵医嘱适量服用促进胃肠道蠕动的药物,控制检查前3 d的饮食,尽量清淡饮食,利于清空肠道内容物,提高肠道准备质量。此外,本研究将危险因素代入风险预测模型中发现,便秘、结直肠手术史、服用三环类抗抑郁药、基础病种类≥2种可为老年无痛胃肠镜检查患者肠道准备失败进行风险预测,并为消化道疾病检查及治疗提供依据,Hosmer-Lemeshow χ^2 检验显示,其灵敏度为66.54%、特异度为82.37%,AUC为0.709,提示已建立的预测模型在验证组中亦具有良好的预测效果,故在老年无痛胃肠镜检查患者肠道准备中,可采用上述风险预测模型对肠道准备失败风险进行预测,并积极采取管理措施,提高肠道准备质量。

综上所述,便秘、结直肠手术史、服用三环类抗抑郁药及基础病种类≥2种是老年无痛胃肠镜检查患者肠道准备失败的独立危险因素,且上述因素在老年无痛胃肠镜检查患者肠道失败中具有较高的风险预测价值,可为临床早期有效干预提供依据。

【参考文献】

[1] 史成梅, 周阳, 杨宁, 等. 丙泊酚用于无痛胃肠镜检查对患者术后精神活动的影响[J]. 北京大学学报(医学版), 2023, 55(2): 324-327. DOI: 10.19723/j.issn.1671-167X.2023.02.017.

[2] Song YQ, Mao XL, Zhou XB, *et al*. Use of artificial intelligence to improve the quality control of gastrointestinal endoscopy[J]. Front Med (Lausanne), 2021, (8): 709347. DOI: 10.3389/fmed.2021.709347.

[3] 杨建功, 赵利芳, 孟瑞霞, 等. 甲苯磺酸瑞马唑仑复合瑞芬太尼或阿芬太尼在无痛胃肠镜检查中的应用[J]. 郑州大学学报(医学版), 2023, 58(3): 433-437. DOI: 10.13705/j.issn.1671-6825.2022.11.002.

[4] Liu G, Xiong Y. Analysis of stress response and analgesic effect of remazolam combined with etomidate in painless gastroenteroscopy[J]. Contrast Media Mol Imaging, 2022, 2022: 4863682. DOI: 10.1155/2022/4863682.

[5] 王进, 史传岗. 无痛胃肠镜检查发生肌阵挛危险因素及丙泊酚预处理效果分析[J]. 中南医学科学杂志, 2023, 51(5): 717-719. DOI: 10.15972/j.cnki.43-1509/r.2023.05.023.

[6] 阮玉琴, 唐天奇. 去甲肾上腺素复合丙泊酚和依托咪酯在无痛胃肠镜检查中的应用研究[J]. 浙江医学, 2023, 45(13): 1416-1419. DOI: 10.12056/j.issn.1006-2785.2023.45.13.2022-2279.

[7] 黄昕, 宋比佳, 罗慢, 等. 无痛胃肠镜检查中不良事件及其相关影响因素[J]. 中国医科大学学报, 2022, 51(2): 136-139, 144. DOI: 10.12007/j.issn.0258-4646.2022.02.009.

[8] 孙伟, 吴伟. 门诊老年患者结肠镜检查前肠道准备质量的影响因素分析[J]. 现代医学, 2021, 49(2): 218-222. DOI: 10.3969/j.issn.1671-7562.2021.02.018.

[9] 秦军胜, 石影. 313例住院老年患者肠道准备质量的影响因素研究[J]. 贵州医药, 2023, 47(2): 208-209. DOI: 10.3969/j.issn.1000-744X.2023.02.022.

[10] 封莉, 宋燕明, 张丽, 等. 肝硬化患者肠镜检查前肠道准备质量及其影响因素分析[J]. 北京医学, 2020, 42(10): 1032-1035. DOI: 10.15932/j.0253-9713.2020.10.029.

[11] 梁蓉, 杨支兰, 闫晓晓, 等. 老年患者结肠镜检查前肠道准备现状及其影响因素分析[J]. 中国护理管理, 2019, 19(2): 182-187. DOI: 10.3969/j.issn.1672-1756.2019.02.006.

[12] 梁国栋, 刘广遐, 张婷婷, 等. 老年人肠道准备质量的相关影响因素分析[J]. 实用老年医学, 2017, 31(12): 1148-1150. DOI: 10.3969/j.issn.1003-9198.2017.12.015.

[13] 魏妮娜, 初元, 李洋, 等. 慢性便秘患者结肠镜检查前肠道准备效果及影响因素分析[J]. 同济大学学报(医学版), 2020, 41(4): 502-506. DOI: 10.16118/j.1008-0392.2020.04.018.

[14] 徐苗苗, 付秀荣, 张娜, 等. 老年结肠镜检查患者肠道准备失败风险评分模型的构建及验证[J]. 中华护理杂志, 2022, 57(11): 1337-1344. DOI: 10.3761/j.issn.0254-1769.2022.11.009.

[15] 王育斌, 张长青, 张葵玲, 等. 老年患者结肠镜诊疗相关肠道准备质量的影响因素分析[J]. 第三军医大学学报, 2017, 39(18): 1871-1874. DOI: 10.16016/j.1000-5404.201703053.

[16] 白爱莲, 侯丽英, 张惠玲, 等. 慢性便秘患者结肠镜检查前肠道准备不合格的影响因素及护理对策分析[J]. 中华现代护理杂志, 2022, 28(1): 86-90. DOI: 10.3760/cma.j.cn115682-20210607-02464.

(编辑: 郑真真)