



腹部手术患者慢性术后疼痛发生的神经心理危险因素分析*

黄艳军¹, 于卫民², 宁杰^{1△}, 王淑媛¹, 李晓焕¹, 孙利朋³

1. 郑州工业应用技术学院 外科学教研室(郑州 451100); 2. 郑州大学第一附属医院 胸外科(郑州 450052);
3. 郑州工业应用技术学院 妇产科学教研室(郑州 451100)

【摘要】目的 分析腹部手术患者慢性术后疼痛(chronic postoperative pain, CPSP)的发生情况及神经心理危险因素。**方法** 选取2023年1月—2025年1月本院行腹部手术的102例患者为研究对象,收集患者一般人口学资料及手术相关资料;术后3个月通过门诊随访或电话随访,采用疼痛数字评分法(numerical rating scale, NRS)评估CPSP发生情况,同时采用简易精神状态检查表(Mini-Mental State Examination, MMSE)、焦虑自评量表(Self-Rating Anxiety Scale, SAS)、抑郁自评量表(Self-Rating Depression Scale, SDS)及疼痛灾难化量表(Pain Catastrophizing Scale, PCS)评估患者神经心理状态。采用单因素和多因素logistic回归分析筛选CPSP的独立影响因素。**结果** 102例患者中,术后3个月CPSP发生率为31.37%(32例)。CPSP组和非CPSP组在年龄、手术时长、术后住院天数、SDS、PCS方面差异有统计学意义($P < 0.05$);多因素logistic回归分析显示年龄[比值比(odds ratio, OR)=1.336, 95%置信区间(confidence interval, CI): 1.046 ~ 1.710]、术后住院天数(OR=0.495, 95%CI: 0.296 ~ 0.829)及PCS(OR=2.437, 95%CI: 1.137 ~ 5.224)为腹部手术患者术后3个月发生CPSP的独立影像因素($P < 0.05$)。**结论** 年龄和PCS是腹部手术患者发生CPSP的危险因素,术后住院天数是保护因素。临床应针对高风险人群实施术前筛查、心理干预及疼痛管理,以降低CPSP发生率。

【关键词】 腹部手术 慢性术后疼痛 流行病学特征 神经心理因素

Neuropsychological Risk Factors for Chronic Postoperative Pain Following Abdominal Surgery

Huang Yanjun¹, Yu Weimin², Ning Jie^{1△}, Wang Shuyuan¹, Li Xiaohuan¹, Sun Lipeng³. 1. Department of Surgery, Zhengzhou University of Industrial Technology, Zhengzhou 451100, China; 2. Department of Thoracic Surgery, The First Affiliated Hospital of Zhengzhou University, Zhengzhou 450052, China; 3. Department of Obstetrics and Gynecology, Zhengzhou University of Industrial Technology, Zhengzhou 451100, China

△ Corresponding author

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[Abstract] Objective To analyze the incidence of chronic postoperative pain (CPSP) after patients have undergone abdominal surgery and identify the neuropsychological risk factors involved. **Methods** A total of 102 patients who underwent abdominal surgery at our hospital between January 2023 and January 2025 were enrolled. The general demographic and surgery-related data were collected. Three months after surgery, follow-up assessments were conducted via outpatient visits or telephone interviews. The occurrence of CPSP was assessed using the Numerical Rating Scale (NRS). Neuropsychological status was evaluated using the Mini-Mental State Examination (MMSE), the Self-Rating Anxiety Scale (SAS), the Self-Rating Depression Scale (SDS), and the Pain Catastrophizing Scale (PCS). Univariate and multivariate logistic regression analyses were performed to identify independent influencing factors associated with CPSP. **Results** Among the 102 patients, the incidence of CPSP at 3 months post-surgery was 31.37% (32 cases). Significant differences were observed between the CPSP and non-CPSP groups with respect to age, duration of surgery, postoperative length-of-stay in the hospital, SDS scores, and PCS scores ($P < 0.05$). Multivariate logistic regression analysis revealed that age (odds ratio [OR] = 1.336, 95% CI: 1.046-1.710), postoperative length-of-stay (OR = 0.495, 95% CI: 0.296-0.829), and PCS score (OR = 2.437, 95% CI: 1.137-5.224) were independent influencing factors associated with the development of CPSP at 3 months after abdominal surgery ($P < 0.05$). **Conclusion** Age and PCS are risk factors for CPSP in patients undergoing abdominal surgery, while the length of postoperative length-of-stay is a protective factor. Targeted strategies, including preoperative screening, psychological interventions, and optimized pain management for high-risk patients are recommended to reduce the incidence of CPSP.

[Key words] Abdominal surgery Chronic postoperative pain Epidemiologic characteristics
Neuropsychological factors

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△ 通信作者

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大型腹部手术涵盖多种外科手术式,且患者群体存在高度异质性,因此术后疼痛程度与镇痛需求差异显著,镇痛策略需综合考量患者个体因素及手术特点^[1]。术后疼痛是组织损伤引发的一种生理性保护反应,通常随手术部位的愈合而逐渐消退^[2]。然而,部分患者的疼痛可能在术后长期持续存在。慢性术后疼痛(chronic postoperative pain, CPSP)定义为术后持续至少3至6个月的疼痛,其报告发生率介于10%至50%之间,正日益被视为常规手术后常见的后遗症^[3]。术后疼痛程度及其带来的困扰,与并发症发生率的上升、功能恢复的延迟以及生活质量的下降密切相关^[4]。CPSP不仅引起患者躯体不适,还可能诱发焦虑、抑郁等心理问题,降低睡眠质量及日常生活能力,甚至导致长期劳动力丧失、难以回归社会,从而给患者家庭及社会医疗资源带来沉重负担^[4]。

CPSP的发生具有广泛的手术类型关联性,几乎所有类型的外科手术均存在诱发CPSP的可能。在各类外科手术相关的CPSP研究领域中,截肢手术、开颅手术、胸部手术、乳腺切除手术、腹股沟疝手术、剖宫产手术、胆囊切除术及膝关节置换手术,是目前学界关注度最高、数据积累最为丰富的CPSP相关手术类型^[5]。研究表明,慢性疼痛的病因基于生物-心理-社会模型,因此身体、心理及社会因素均与CPSP的发展有关^[6]。术前疼痛、术后重度急性疼痛、麻醉方式及手术方式等生物学因素已得到广泛研究,而对疼痛认知、情绪状态、睡眠质量等神经心理因素的系统分析仍相对较少^[7]。近年来,疼痛心理学研究提示,个体对疼痛的负性认知及情绪障碍可通过调节中枢神经系统的痛觉调制通路,加重疼痛感知并延长疼痛持续时间^[8]。基于此,本研究通过分析CPSP的发生情况,重点探讨神经心理因素对CPSP发生的影响,旨在为临床制定生理-心理一体化的干预策略提供实证依据。

1 资料与方法

1.1 样本量计算

本研究为前瞻性观察性研究,主要结局指标为术后3个月CPSP发生率。参考国内外文献报道,腹部手术后CPSP发生率约为10%~50%,取预期发生率为30%。设定容许误差为8%,置信水平为95%,采用单样本率估算公式,计算得样本量为126例。考虑20%的失访、排除及拒绝参与率,需纳入158例。本研究采用随机抽样方法,从509例初步评估患者中随机抽取190例,经筛选、排除及失访后,最终纳入102例分析。主要分析的事后效能计算显示,在双侧 $\alpha=0.05$ 水平下,检验效能超过80%,当前样本量仍可满足主要研究目的。

1.2 研究对象

本研究经郑州大学第一附属医院医学伦理委员会审核批准(伦理批号:2025-ky-0311)。选取2023年1月—2025年1月于本院行腹部手术的患者102例。纳入标准:①>18岁;②择期腹部手术(包括胃肠手术、肝胆手术、胰腺手术、妇科腹部手术等);③病例资料完整;④意识清楚,能完成神经心理量表评估;④自愿参与本研究并签署知情同意书。排除标准:①术前存在慢性疼痛史或神经病理性疼痛;②存在严重精神疾病(精神分裂症、双相障碍、分裂情感性障碍、精神发育迟滞、急性应激障碍伴严重功能缺损等)及认知障碍;③合并严重器官功能衰竭(终末期心、肝、肾、呼吸功能衰竭)、恶性肿瘤晚期、严重凝血功能障碍、自身免疫性疾病活动期等可能影响术后恢复及疼痛评估的重大躯体疾病;④术后出现严重并发症(吻合口瘘、感染);⑤随访期间失访(如电话无法联系、拒绝继续参与);⑥妊娠期或哺乳期女性。

CPSP诊断标准参照国际疼痛研究协会(IASP)针对《国际疾病分类》第11版(ICD-11)^[9]提出的修订意见进行界定,具体标准如下:疼痛需与手术直接相关且疼痛部位局限于手术区域及其邻近部位,疼痛数字评分法(numerical rating scale, NRS)评分 ≥ 1 分;疼痛持续时间需满足组织损伤已完全愈合(术后时间满3个月)后仍持续存在;排除由其他明确病因所致的疼痛;排除术前已存在的慢性疼痛状态。研究对象纳入流程见图1。

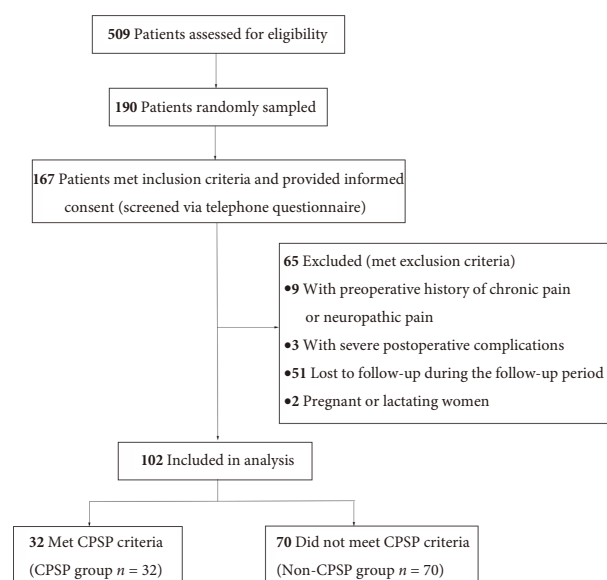


图1 研究对象纳入流程图

Fig 1 Flowchart of participant enrollment

1.3 资料收集

分别于术前1 d、术后3个月及术后6个月进行资料收集。术前1 d收集一般人口学资料及手术相关资料,完成

神经心理量表评估;术后3个月通过门诊随访或电话随访,评估CPSP发生情况及疼痛特征并完成神经心理量表评估;术后6个月通过门诊随访或电话随访,评估CPSP发生情况。调查员均为外科主治医师或护理师,经统一培训掌握量表使用方法及访谈技巧;量表填写时,调查员现场指导,确保患者理解条目含义;资料收集后,由2名研究员独立核对数据,发现缺失或矛盾时及时联系患者补充确认。本研究术后6个月CPSP仅23例,为减少统计效能不足及偏倚风险,并基于IASP《国际疾病分类》第11版(ICD-11)将术后3个月定为结局指标(术后3个月作为界定急性疼痛向慢性疼痛转化的核心节点,为CPSP诊断及同类研究的国际通用时点,以此为结局指标可保证研究的规范性与可比性,且该时点也是临床识别CPSP高危人群、实施早期干预的关键窗口期,研究结论更具临床实践价值)。

一般人口学资料问卷:自行设计,包括年龄、性别、体质质量指数(body mass index, BMI)、文化程度、职业、既往手术史、糖尿病史、冠心病史、高血压史、吸烟史、饮酒史、居住地。

手术相关资料:从电子病历系统提取,包括手术类型、手术方式、手术时长、切口部位术中出血量、术后切口感染、术后住院天数等。

1.4 疼痛评估及神经心理量表评估

1.4.1 数字评分法

NRS^[10]用于评估疼痛程度,量表范围0~10分,0分代表无痛,10分代表最剧烈疼痛;NRS<4分为轻度疼痛,NRS≥4分为中重度疼痛^[4]。同时记录疼痛部位(切口周围/腹部其他部位/牵涉痛)、疼痛性质(钝痛/胀痛/刺痛/烧灼感)。

1.4.2 简易精神状态检查表

采用简易精神状态检查表(Mini-Mental State Examination, MMSE)^[11]评估患者的整体认知功能,该量表共30个条目,总分0~30分,分值越低,认知能力越差。

1.4.3 心理情绪状态评估

焦虑自评量表(Self-Rating Anxiety Scale, SAS)及抑郁自评量表(Self-Rating Depression Scale, SDS)为自我评价量表^[12]。SAS共20个条目,采用1~4级评分,满分100分,<50分为正常,≥50分为焦虑。SDS共20个条目,1~4级评分,<53分为正常,≥53分为抑郁。

1.4.4 疼痛灾难化量表^[13]

采用疼痛灾难化量表(Pain Catastrophizing Scale, PCS)对疼痛的消极认知及情感应对策略进行评估。该量表共13个条目,0~4级评分,总分0~52分,≥30分为存在明显疼痛灾难化。

1.5 统计学方法

采用SPSS 25.0软件进行数据分析。符合正态分布的计量资料以 $\bar{x} \pm s$ 表示,组间比较采用独立样本 t 检验;计数资料以频数(百分比)表示,组间比较采用 χ^2 检验或校正 χ^2 检验,组内不同时间点比较采用校正配对 χ^2 检验(校正McNemar检验)。将年龄采用哑变量编码替代原单一赋值方式,构建哑变量:40~59岁哑变量(赋值:40~59岁=1,非40~59岁=0);≥60岁哑变量(赋值:≥60岁=1,非≥60岁=0);设定18~39岁为参照组。采用逐步logistic回归法分析所有变量,计算比值比(odds ratio, OR)及95%置信区间(confidence interval, CI)。P<0.05为差异有统计学意义。

2 结果

2.1 患者基本资料

研究共纳入102例患者,男58例(56.86%),女44例(43.14%);年龄22~73岁,平均(48.6±12.3)岁,其中18~39岁29例(28.43%),40~59岁21例(20.59%),≥60岁52例(50.96%);平均BMI(23.2±3.1) kg/m²;文化程度小学及以下27例(26.47%),初中26例(25.49%),高中19例(18.63%),大专及以上30例(29.41%);职业中体力劳动者41例(40.20%),脑力劳动者38例(37.25%);有既往手术史20例(19.61%);有糖尿病史12例(11.76%);有冠心病史10例(9.80%);有高血压史20例(19.61%);有吸烟史25例(24.51%);有饮酒史28例(27.45%);居住地在城市50例(49.02%),农村52例(50.98%)。手术类型以胃肠手术最多(45例,44.12%),其次为肝胆手术(32例,31.37%)、妇科腹部手术(20例,19.61%)、胰腺手术(5例,4.90%);手术方式中腹腔镜手术63例(61.76%),开腹手术39例(38.24%);平均手术时长(145.6±42.8) min;切口部位在上腹部37例(36.27%),下腹部44例(43.14%),多部位联合21例(20.59%);平均术中出血量(128.3±85.5) mL;术后切口感染6例(5.88%);平均术后住院天数(7.8±3.2) d。

2.2 腹部手术患者CPSP发生率

术后3个月随访时,102例患者中32例发生CPSP,发生率为31.37%;术后6个月随访时,23例仍存在CPSP,发生率降至22.55%,与术后3个月比较差异有统计学意义(P<0.05)。

2.3 腹部手术患者CPSP疼痛特征

术后3个月的32例CPSP患者中疼痛部位在切口周围有25例(78.13%),腹部其他部位(如脐周、下腹部)有4例(12.50%),牵涉痛(如腰背部、肩部)有3例(9.38%)。疼痛性质为钝痛15例(46.88%),胀痛11例(34.38%),刺痛4例(12.50%),烧灼感2例(6.25%)。采用NRS评分法对疼痛

程度进行评估,其中轻度疼痛25例(78.12%),中重度疼痛7例(21.88%)。

2.4 腹部手术患者术后3个月发生CPSP的单因素分析

将患者分为CPSP组($n=32$)和非CPSP组($n=70$),结果显示(表1), CPSP组和非CPSP组在年龄、手术时长、术后

住院天数、SDS、PCS方面差异有统计学意义($P<0.05$)。

2.5 腹部手术患者术后3个月发生CPSP的logistic回归分析

将差异有统计学意义的因素纳入二元logistic回归分析(赋值情况见表2),结果显示(表3), ≥ 60 岁[比值比(odds ratio, OR)=1.336, 95%CI: 1.046 ~ 1.710]、术后住院

表1 腹部手术患者术后3个月发生CPSP的单因素分析

Table 1 Univariate analysis of CPSP occurrence in patients who have undergone abdominal surgery three months after the operation

Index	CPSP group ($n=32$)	Non-CPSP group ($n=70$)	t/χ^2	P
Sex/case (%)			0.120	0.729
Male	19 (59.38)	39 (55.71)		
Female	13 (40.62)	31 (44.29)		
Age/case (%)			6.162	0.046
18-39 yr.	4 (12.50)	25 (35.71)		
40-59 yr.	7 (21.87)	14 (20.00)		
≥ 60 yr.	21 (65.63)	31 (44.29)		
BMI/(kg/m ²)	22.97 $\pm$ 2.71	23.64 $\pm$ 2.59	-1.195	0.235
Education level/case (%)			0.192	0.979
Primary school or below	8 (25.00)	19 (27.14)		
Junior high school	9 (28.13)	17 (24.29)		
Senior high school	6 (18.75)	13 (18.57)		
College degree or above	9 (28.13)	21 (30.00)		
Occupation/case (%)			2.234	0.327
Manual labor	12 (37.50)	29 (41.43)		
Mental labor	15 (46.87)	23 (32.86)		
Unemployed	5 (15.63)	18 (25.71)		
Past surgical history/case (%)	9 (28.13)	11 (15.71)	2.146	0.143
History of diabetes/case (%)	3 (9.38)	9 (12.86)	0.031	0.861 ^a
History of coronary heart disease/case (%)	3 (9.38)	7 (10.00)	0.068	0.795 ^a
History of hypertension/case (%)	6 (18.75)	14 (20.00)	0.022	0.883
Smoking history/case (%)	7 (21.87)	18 (25.71)	0.175	0.676
Alcohol history/case (%)	10 (31.25)	18 (25.71)	0.338	0.561
Residence/case (%)			0.518	0.472
Urban	14 (43.75)	36 (51.43)		
Rural	18 (56.25)	34 (48.57)		
Surgical approach/case (%)			1.315	0.252
Laparoscopic surgery	13 (40.62)	37 (52.86)		
Open surgery	19 (59.38)	33 (47.14)		
Type of surgery/case (%)			0.062	0.996 ^a
Gastrointestinal surgery	14 (43.75)	31 (44.29)		
Hepatobiliary surgery	10 (31.25)	22 (31.43)		
Pancreatic surgery	6 (18.75)	14 (20.00)		
Gynecological abdominal surgery	2 (6.25)	3 (4.28)		
Operative time/min	166.15 $\pm$ 50.32	143.47 $\pm$ 48.26	2.173	0.032
Incision site/case (%)			0.910	0.634
Upper abdomen	10 (31.25)	27 (38.57)		
Lower abdomen	16 (50.00)	28 (40.00)		
Combined multiple sites	6 (18.75)	15 (21.43)		
Estimated blood loss/mL	140.87 $\pm$ 88.12	122.83 $\pm$ 85.65	0.978	0.330
Postoperative incision infection/case (%)	4 (12.50)	2 (2.86)	2.152	0.142 ^a
Postoperative hospital stay/d	7.34 $\pm$ 2.91	9.15 $\pm$ 3.66	-2.462	0.016
MMSE/score	27.94 $\pm$ 1.56	28.24 $\pm$ 1.42	-0.960	0.339
SAS ≥ 50 /case (%)	5 (15.63)	9 (12.86)	0.004	0.947 ^a
SDS ≥ 53 /case (%)	9 (28.13)	6 (8.57)	5.226	0.022 ^a
PCS ≥ 30 /case (%)	13 (40.63)	6 (8.57)	14.886	< 0.001

CPSP: chronic post-surgical pain; BMI: body mass index; MMSE: Mini-Mental State Examination; SAS: Self-Rating Anxiety Scale; SDS: Self-Rating Depression Scale; PCS: Pain Catastrophizing Scale. ^a Adjusted chi-square test.

表 2 影响因素赋值情况
Table 2 Value assignment for the influencing factors

Variable	Assignment	
Dependent variable	Occurrence of CPSP	Yes = 1, No = 0
Independent variables	Age	18-39 yr.: 18-39 yr. = 1, 40-59 yr. = 0, ≥ 60 yr. = 0; 40-59 yr.: 18-39 yr. = 0, 40-59 yr. = 1, ≥ 60 yr. = 0; ≥ 60 yr.: 18-39 yr. = 0, 40-59 yr. = 0, ≥ 60 yr. = 1
	Operative time	Original value
	Postoperative hospital stay	Original value
	SDS	SDS ≥ 53 = 1, SDS < 53 = 0
	PCS	PCS ≥ 30 = 1, PCS < 30 = 0

CPSP: chronic post-surgical pain; SDS: Self-Rating Depression Scale; PCS: Pain Catastrophizing Scale.

表 3 影响CPSP发生的logistic回归分析 (n=102)
Table 3 Logistic regression analysis of factors influencing the occurrence of CPSP (n = 102)

Variable	Univariate logistic regression analysis			Multivariate logistic regression analysis		
	OR	95% CI	P	OR	95% CI	P
Aged 40-59 yr.	1.579	0.847-2.945	0.151	—	—	—
Aged ≥60 yr.	1.382	1.067-1.790	0.014	1.336	1.046-1.710	0.020
Operative time	1.347	0.784-2.314	0.280	—	—	—
Postoperative hospital stay	0.476	0.289-0.783	0.003	0.495	0.296-0.829	0.008
SDS ≥ 53	2.068	0.815-5.247	0.126	—	—	—
PCS ≥ 30	2.305	1.107-4.798	0.026	2.437	1.137-5.224	0.022

CPSP: chronic post-surgical pain; SDS: Self-Rating Depression Scale; PCS: Pain Catastrophizing Scale; OR: odds ratio.

天数(OR=0.495, 95%CI: 0.296 ~ 0.829)及PCS(OR=2.437, 95%CI: 1.137 ~ 5.224)为腹部手术患者术后3个月发生CPSP的独立影响因素($P<0.05$)。

3 讨论

IASP将慢性疼痛界定为一种疼痛类型,其持续时间超过3个月,且已超出正常组织损伤后的生理愈合周期^[14]。本研究显示,腹部手术患者术后3个月CPSP发生率为31.37%,术后6个月降至22.55%,呈下降趋势。这可能表明,腹部手术患者术后3个月是CPSP发生的关键窗口期,此阶段慢性疼痛高发,可能会延缓胃肠功能恢复、降低活动能力,甚至引发焦虑、抑郁及睡眠障碍,导致疼痛及康复延迟,严重影响预后。因此,本研究聚焦该窗口期,旨在分析CPSP的发生情况及神经心理危险因素,为制定个性化干预方案提供依据。

术后3个月CPSP患者78.13%的疼痛集中于切口周围,12.50%位于腹部其他部位,9.38%表现为牵涉痛。切口周围疼痛与神经断端异常再生及瘢痕机械压迫相关^[15]。牵涉痛可能与内脏-躯体神经反射有关,例如肝胆手术刺激膈肌牵涉至肩部^[16]。本研究中,46.88%的患者为钝痛,34.38%为胀痛,78.12%为轻度疼痛。钝痛多源于瘢痕慢性炎症,胀痛可能与腹腔粘连或循环障碍相关,轻度疼痛

高占比可能与术后常规镇痛及患者耐受性提升有关。临床干预应针对不同疼痛类型施策,如切口周围疼痛可考虑神经阻滞或瘢痕松解,牵涉痛需排查潜在刺激因素,钝痛、胀痛则可分别辅以抗炎、改善局部循环治疗^[17]。

多因素logistic回归分析显示,年龄和PCS是CPSP的独立危险因素,术后住院天数为保护因素。老年患者(≥60岁)外周神经髓鞘合成能力下降,手术创伤导致的神经损伤后再生修复延迟,易形成神经病理性疼痛^[18];其次,老年患者中枢神经系统功能衰退,前额叶皮层对疼痛信号的调节能力减弱,更易出现中枢敏化^[19];此外,老年患者常合并高血压、糖尿病等基础疾病,可能加重神经微循环障碍,进一步增加疼痛慢性化风险。疼痛灾难化作为唯一的独立神经心理危险因素,凸显了负面认知模式在CPSP发生中的关键作用^[20]。疼痛灾难化是个体对疼痛的过度担忧、威胁放大及无助感的综合认知状态。在认知层面,PCS评分高的患者易将术后切口疼痛解读为“组织愈合不良”“病情加重”等负面信号,这种认知偏差会放大疼痛感知,即使轻度疼痛也被赋予强烈的负面情绪色彩,形成疼痛、担忧、疼痛加剧的恶性循环^[21];在行为层面,灾难化思维会促使患者采取回避行为,如拒绝下床活动、减少日常活动,导致术后腹腔粘连、神经压迫风险增加,进一步加重疼痛^[22];最后,在神经生理层面,功能影像学研究

证实,疼痛灾难化患者的前扣带回皮质、岛叶等疼痛相关脑区激活增强,而前额叶皮质的疼痛调节功能减弱,这种脑区功能失衡直接降低疼痛阈值,促进中枢敏化形成^[23]。基于此,临床干预需分层施策:对PCS评分高的疼痛灾难化患者,术后早期需加强疼痛认知教育,引导其正确看待疼痛信号,鼓励适度活动以减少神经粘连风险^[8]。此外,单因素分析中CPSP组抑郁评分(SDS ≥ 53)比例明显高于非CPSP组,但多因素logistic回归中SDS未进入最终模型。其原因可能包括:抑郁与疼痛灾难化存在共线性,当PCS纳入模型后SDS的独立效应被削弱;样本量有限,统计效能不足;抑郁也可能通过影响疼痛灾难化等中介路径间接增加CPSP风险。尽管如此,仍提示应关注围术期抑郁状态,未来需扩大样本量或采用中介分析进一步验证。

术后住院天数延长是CPSP的影响因素,这与住院期间的规范疼痛管理密切相关:医院对腹部手术患者术后常规采用多模式镇痛,并由护士定期评估疼痛、调整镇痛方案^[24];同时,住院期间的早期康复指导可减少腹腔粘连、神经压迫风险,降低疼痛慢性化概率。相反,住院天数短的患者可能因出院后镇痛不规律、康复锻炼不足,增加CPSP发生风险。

综上,本研究证实,腹部手术患者术后3个月CPSP发生率较高,且年龄、住院天数、疼痛灾难化是其独立影响因素。临床需重视高风险人群的术前筛查与干预,通过生理及心理协同管理,减少CPSP对患者生活质量的影响。同时,本研究也存在局限性,比如为单中心研究,样本量较小,可能存在选择偏倚,结果外推性需多中心大样本研究验证。此外,同一疾病不同手术方式,不同部位切口的疼痛表现可能不同,但单一疾病样本量不足,可能导致统计效能不足及偏倚风险,无法进行分层分析。未来研究可扩大样本量,并纳入切口愈合状态、瘢痕体质、炎症因子等更多客观指标,采用组合分层分析等精细统计方法,提升研究结论的可靠性与临床转化价值。

* * *

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