

·临床研究·

妇科与普外科女性患者术后寒战发生率比较及相关因素

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摘要:【目的】比较接受妇科手术与普外科手术女性患者术后寒战的发生率,并分析术后寒战的围术期相关因素。【方法】本研究回顾性纳入2022年1月1日至2024年3月15日接受妇科或普外科手术的患者共12 186例,其中10 884例女性患者作为主要分析人群,并以麻醉后恢复室记录的术后寒战为主要结局。在女性患者中采用1:1最邻近匹配法进行倾向性评分匹配,卡钳值设为0.02(倾向性评分原始尺度),并对美国麻醉医师协会(ASA)分级进行精确匹配。匹配后采用McNemar检验比较两组术后寒战发生率;采用以匹配对为分层变量的条件Logistic回归,分析手术类型及围术期因素与术后寒战的关联。【结果】倾向性评分匹配前,普外科组与妇科组女性患者术后寒战发生率分别为2.98%(28/940)和4.94%(491/9 944),差异有统计学意义($P=0.007$)。匹配后共获得881对患者,所有协变量的绝对标准化差异(SMD)均 <0.10 。普外科组与妇科组术后寒战发生率分别为3.06%(27/881)和4.99%(44/881);无连续性校正的McNemar检验结果为 $P=0.044$,精确McNemar检验结果为 $P=0.057$ 。单因素条件Logistic回归显示,与普外科手术相比,妇科手术患者术后寒战发生的比值较高[比值比(OR)=1.63,95%置信区间(CI):1.01~2.63, $P=0.046$];但进一步的多因素分析显示,妇科手术与术后寒战的关联无统计学意义[调整后比值比(aOR)=1.62,95%CI:0.78~3.37, $P=0.197$]。手术时间每延长30 min,术后寒战发生的比值增加32%(aOR=1.32,95%CI:1.07~1.62, $P=0.009$)。术中最低体温每升高1℃,术后寒战发生的比值呈降低趋势,但该关联未达到统计学意义(aOR=0.32,95%CI:0.10~1.02, $P=0.053$)。【结论】倾向性评分匹配后,妇科组女性患者术后寒战发生率高于普外科组,但该关联在精确检验及多因素调整后均未达到统计学意义。手术时间延长与术后寒战发生的比值升高相关;术中最低体温升高可能与术后寒战发生的比值降低有关。

关键词: 术后寒战; 妇科手术; 普外科手术; 倾向性评分匹配; 手术时间

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Comparison of Postoperative Shivering Incidence and Associated Factors
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Abstract: 【Objective】To compare the incidence of postoperative shivering between female patients undergoing gynecological and general surgery and to examine perioperative factors associated with postoperative shivering. 【Methods】This retrospective study included 12 186 patients who underwent gynecological or general surgery between January 1, 2022, and March 15, 2024, of whom 10 884 female patients constituted the primary analysis population. Among the

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female patients, 1:1 nearest-neighbor propensity score matching was performed using a caliper of 0.02 on the raw propensity score scale, with exact matching on American Society of Anesthesiologists (ASA) physical status. After matching, the incidence of postoperative shivering was compared using the McNemar test. Conditional logistic regression stratified by matched pair was used to assess the associations of surgical categories and perioperative factors with postoperative shivering.【Results】Before propensity score matching, the incidences of postoperative shivering were 2.98% (28/940) in the general surgery group and 4.94% (491/9 944) in the gynecological surgery group ($P=0.007$). After matching, 881 matched pairs were obtained, and the absolute standardized mean differences (SMDs) for all covariates were <0.10 . The incidences of postoperative shivering were 3.06% (27/881) in the general surgery group and 4.99% (44/881) in the gynecological surgery group. The McNemar test without continuity correction yielded $P=0.044$, whereas the exact McNemar test showed a P value of 0.057. Unifactorial conditional logistic regression showed that gynecological surgery was associated with higher odds of postoperative shivering than general surgery [odds ratio (OR)=1.63, 95% confidence interval (CI): 1.01–2.63, $P=0.046$]. However, the association was not statistically significant in the multifactorial conditional logistic regression [adjusted odds ratio (aOR)=1.62, 95%CI: 0.78–3.37, $P=0.197$]. Each 30-min increase in the duration of surgery was associated with 32% higher odds of postoperative shivering (aOR=1.32, 95%CI: 1.07–1.62, $P=0.009$). Each 1 °C increase in the minimum intraoperative body temperature was associated with lower odds of postoperative shivering, although the association did not reach statistical significance (aOR=0.32, 95%CI: 0.10–1.02, $P=0.053$).【Conclusion】After propensity score matching, the incidence of postoperative shivering was higher among female patients undergoing gynecological surgery than among those undergoing general surgery; however, neither the exact comparison nor the adjusted association reached statistical significance. A longer duration of surgery was associated with higher odds of postoperative shivering, whereas a higher minimum intraoperative body temperature may be associated with lower odds.

Key words: postoperative shivering; gynecological surgery; general surgery; propensity score matching; duration of surgery

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术后寒战(postoperative shivering, POS)是麻醉恢复期常见的并发症之一,主要表现为非自主性、节律性骨骼肌收缩。非心脏手术患者术后麻醉苏醒期的寒战发生率通常为20%~45%;不同研究报道的POS发生率差异较大,可能与研究人群、麻醉方式、手术类型、围术期体温管理措施及寒战评价标准不同有关^[1-2]。全身麻醉药物可抑制中枢体温调节功能,降低血管收缩和寒战反应阈值,并通过外周血管扩张引起机体热量由核心向外周重新分布;同时,较低的手术室温度、手术区域暴露、液体输入及冲洗液冲洗、体腔开放和蒸发散热等因素均可增加围术期热量丢失^[3-5]。麻醉苏醒本身还涉及睡眠-觉醒相关中枢神经网络的调控,腹侧被盖区(ventral tegmental area, VTA)被认为参与吸入麻醉苏醒过程^[6],但此类觉醒环路与术后寒战之间的直接关系尚不明确。与此同时,POS并非完全由低体温引起,部分核心体温正常的患者也可发生寒战,提示疼痛、手术应激、外周血管收缩以及麻醉和镇

痛药物等非体温因素也可能参与其发生^[1, 7]。POS可增加机体氧耗和二氧化碳生成,促进儿茶酚胺释放并加重心肺负荷;严重寒战还可能干扰心电图、无创血压和脉搏血氧饱和度等监测,影响麻醉恢复质量^[1]。既往研究表明,POS与年龄、体质量、围术期体温、手术及麻醉时间、急诊手术、手术类型和围术期用药等多种因素有关^[2, 8-9]。即使术后核心体温处在正常范围,较低的外周温度和较长的手术时间仍可能与POS有关^[7]。因此,POS是患者特征、手术因素、麻醉管理及体温变化共同作用的围术期并发症。不同专科患者的基础状况、手术方式及围术期管理存在差异,直接比较其POS发生率可能受到性别、年龄、手术时间和体温等混杂因素的影响。妇科手术患者均为女性,且此类手术较多涉及腹腔镜或盆腔操作;部分手术需采用截石位或头低足高位,并使用冲洗液。因此,妇科手术在手术方式、体位、麻醉时间、液体管理及术后疼痛等方面可能与普外科手术存在差异。此外,在相同手术类型中,

女性患者发生术后寒战和恶心呕吐的概率均高于男性^[10]。既往有关妇科手术后寒战的研究主要关注麻醉药物、镇痛方案以及主动保温或预保温措施等干预因素^[11-13],直接比较妇科与普外科女性患者POS发生率的证据仍较有限。由于普外科与妇科患者的性别构成和基线特征明显不同,未经调整的组间比较难以准确反映手术类型与POS之间的关联。本研究基于单中心回顾性临床资料,以女性患者为主要分析人群,采用倾向性评分匹配法提高妇科手术组与普外科手术组在基线特征方面的可比性,比较两组POS发生率,并进一步分析POS的围术期相关因素,以评价控制混杂因素后手术类型与POS之间的关联,为不同手术专科患者的围术期体温管理和寒战预防提供参考。

1 材料与方法

1.1 研究对象和资料

本研究回顾性收集2022年1月1日至2024年3月15日在中山大学附属第一医院接受气管插管全身麻醉的妇科和普外科手术患者资料,初步检索病例12 839例。本研究经中山大学附属第一医院临床科研和实验动物伦理委员会批准,并获准免除患者知情同意,伦理批件号:伦审临[2024]320号。

纳入标准:①接受妇科、胃肠外科、肝外科或胆胰外科择期手术,采用气管插管全身麻醉,且术后转入麻醉后恢复室(post-anesthesia care unit, PACU);②年龄 ≥ 18 岁。排除标准:①既往有精神或心理疾病病史的患者;②术前纽约心脏病协会(New York Heart Association, NYHA)心功能分级 $\geq$ Ⅲ级;③美国麻醉医师协会(American Society of Anesthesiologists, ASA)分级 $\geq$ Ⅳ级;④主要结局指标缺失,或其他研究变量缺失比例 $> 20\%$ 。

1.2 观察指标和统计分析

1.2.1 观察指标 收集患者的一般资料、术前临床资料、围术期资料及术后结局指标。一般资料和术前临床资料包括年龄、性别、体质量、体质量指数(body mass index, BMI)、肥胖、吸烟或饮酒史、脑卒中史、冠心病、糖尿病、高血压、其他合并症、ASA分级,以及术前血糖、血红蛋白、丙氨酸氨基转移酶、天冬氨酸氨基转移酶和血肌酐水平。围术期资料包括手术时间、术中最低体温、术中平均体温、术中液体总入量、胶体液入量、七氟烷、氟比洛芬酯、止

呕药及血管活性药物的使用情况,以及留置尿管情况等。

主要观察指标为术后寒战。术后寒战定义为患者在PACU留观期间出现不自主、重复性骨骼肌收缩。麻醉后恢复室医护人员根据常规观察记录术后寒战是否发生,并将其作为二分类变量进行分析。

1.2.2 统计学分析 采用R软件4.5.2版(R Foundation for Statistical Computing, Vienna, Austria)进行数据整理、统计学分析及绘图,使用PowerPoint辅助绘图。匹配前连续变量采用Anderson-Darling检验并结合Q-Q图评价其分布特征,采用基于中位数的Levene检验(Brown-Forsythe检验)评价方差齐性。考虑到大样本条件下正态性检验对轻微分布偏离较为敏感,数据分布根据检验统计量、Q-Q图及分布形态综合判断。主体分布近似对称的连续变量以均数 $\pm$ 标准差表示,考虑组间样本量差异及部分变量方差不齐,采用Welch t 检验进行组间比较;明显偏态分布的连续变量以中位数 M ($P_{25} \sim P_{75}$)表示,采用Mann-Whitney U 检验进行组间比较。分类变量以例数(百分比)表示,组间比较采用Pearson χ^2 检验;理论频数不满足要求时采用Fisher确切概率法。

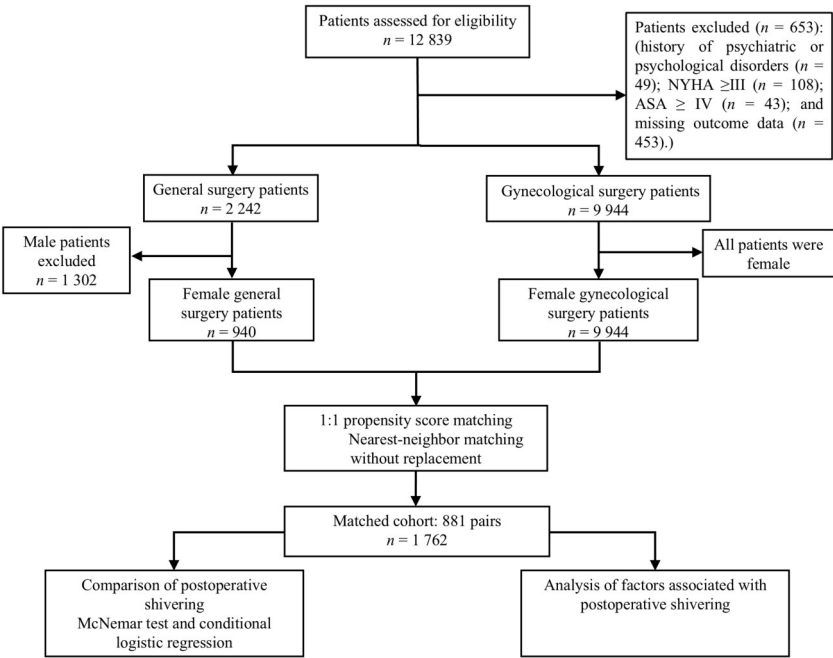
鉴于妇科手术组均为女性,为降低性别构成差异造成的混杂,在女性患者中采用1:1最邻近匹配法进行倾向性评分匹配(propensity score matching, PSM),不放回,卡钳值设为0.02(倾向性评分原始尺度),并对ASA分级进行精确匹配;在卡钳范围内,以年龄和BMI的Mahalanobis距离优化配对。倾向性评分模型纳入年龄、BMI、吸烟或饮酒史、脑卒中史、冠心病、糖尿病、高血压、其他合并症、ASA分级、术前血糖、血红蛋白、丙氨酸氨基转移酶、天冬氨酸氨基转移酶和血肌酐,并纳入年龄和BMI的二次项。采用绝对标准化差异(standardized mean difference, SMD)评价匹配效果,以 $SMD < 0.10$ 表示协变量平衡良好。匹配后采用McNemar检验比较两组术后寒战发生率,并采用以匹配对为分层变量的条件logistic回归,分析手术类型及围术期因素与术后寒战的关联,结果以比值比(odds ratio, OR)及其95%置信区间(confidence interval, CI)表示。多因素模型纳入主要暴露因素及单因素分析中 $P < 0.10$ 的变量。模型拟合后检查其收敛情况及参数估计的稳定性;分别在模型中加入连续变量的二次

项,并采用似然比检验评价logit线性假设;采用方差膨胀因子评价变量间的多重共线性;通过逐一剔除结局不一致的匹配对进行影响分析。所有检验均为双侧检验,以 $P<0.05$ 为差异有统计学意义。检验统计量及 P 值保留3位小数。

2 结果

2.1 研究对象及全部纳入患者特征

按照纳入和排除标准筛选病例,最终纳入患者12 186例。其中,普外科手术患者2 242例,妇科手术患者9 944例(图1)。



n: number of patients; NYHA: New York Heart Association; ASA: American Society of Anesthesiologists.

图1 研究对象筛选及倾向性评分匹配流程图

Fig. 1 Flowchart of patient selection and propensity score matching

在全部纳入患者中,普外科组男性1 302例(58.1%)、女性940例(41.9%),妇科组患者均为女性。两组在年龄、性别构成、BMI、部分合并症、ASA分级及术前实验室指标等方面存在不同程度的基线差异,多个变量的SMD超过0.10。普外科组与妇

科组术后寒战发生率分别为4.33%和4.94%,差异无统计学意义($P=0.223$)。以普外科组为参照,妇科组术后寒战的粗OR为1.15(95%CI: 0.92~1.44;表1)。

表1 妇科与普外科全部纳入患者的基线特征及术后寒战发生率

Table 1 Baseline characteristics and incidence of postoperative shivering among all included patients undergoing gynecological or general surgery [n, ($\bar{x} \pm s$), n(%)]

Variables	General surgery	Gynecological surgery	$t/\chi^2/Z$	P	SMD
Total	2 242	9 944			
Age/year	54 ± 14	43 ± 12	$t=-36.448$	<0.001	0.882
Sex			$\chi^2=6\,465.604$	<0.001	1.664
Male	1 302 (58.1)	0 (0.0)			
Female	940 (41.9)	9 944 (100.0)			
Body weight/kg	61.9 ± 11.3	57.1 ± 9.1	$t=-18.681$	<0.001	0.465

续表

Variables	General surgery	Gynecological surgery	$t/\chi^2/Z$	P	SMD
BMI/($\text{kg} \cdot \text{m}^{-2}$)	22.9 ± 3.4	22.8 ± 3.5	$t=-2.164$	0.031	0.050
Obesity	155 (6.9)	729 (7.3)	$\chi^2=0.474$	0.491	0.016
Smoking or alcohol history	468 (20.9)	58 (0.6)	$\chi^2=1\ 823.805$	<0.001	0.694
History of stroke	45 (2.0)	53 (0.5)	$\chi^2=49.838$	<0.001	0.132
Coronary heart disease	117 (5.2)	97 (1.0)	$\chi^2=190.916$	<0.001	0.247
Diabetes mellitus	290 (12.9)	375 (3.8)	$\chi^2=297.779$	<0.001	0.336
Hypertension	469 (20.9)	1,014 (10.2)	$\chi^2=196.761$	<0.001	0.299
Other comorbidities	23 (1.0)	253 (2.5)	$\chi^2=19.054$	<0.001	0.115
ASA physical status			$\chi^2=1319.494$	<0.001	0.781
I	73 (3.3)	1 245 (12.5)			
II	1 300 (58.0)	7 771 (78.1)			
III	869 (38.8)	928 (9.3)			
Glucose/($\text{mmol} \cdot \text{L}^{-1}$)	4.8 (4.4, 5.4)	4.6 (4.3, 5.2)	$Z=-9.638$	<0.001	0.195
ALT/($\text{U} \cdot \text{L}^{-1}$)	23.0 (15.0, 38.0)	14.0 (10.0, 19.0)	$Z=-33.854$	<0.001	0.529
AST/($\text{U} \cdot \text{L}^{-1}$)	25.0 (20.0, 35.0)	19.0 (16.0, 23.0)	$Z=-31.596$	<0.001	0.506
Cr/($\mu\text{mol} \cdot \text{L}^{-1}$)	72.0 (60.0, 84.0)	58.0 (52.0, 65.0)	$Z=-37.837$	<0.001	0.445
Hb/($\text{g} \cdot \text{L}^{-1}$)	130 ± 18	118 ± 18	$t=-28.687$	<0.001	0.674
Postoperative shivering	97 (4.33)	491 (4.94)	$\chi^2=1.488$	0.223	—

Data are presented as mean ± standard deviation, median (interquartile range, IQR), or n (%). Group comparisons used the Welch t test, Mann-Whitney U test, Pearson χ^2 test, or Fisher exact test, as appropriate. General surgery was the reference for the crude OR of postoperative shivering (OR=1.15, 95%CI: 0.92–1.44; $P=0.223$). The signs of the t and Z statistics represent gynecological surgery minus general surgery. BMI: body mass index; ASA: American Society of Anesthesiologists; ALT: alanine aminotransferase; AST: aspartate aminotransferase; Hb: hemoglobin; Cr: creatinine; SMD: standardized mean difference; OR: odds ratio; CI: confidence interval.

2.2 女性患者倾向性评分匹配结果

鉴于两组研究对象的性别构成差异明显,进一步将研究对象限制为女性患者。匹配前,普外科组女性患者 940 例,妇科组女性患者 9 944 例。采用 1:1 倾向性评分匹配后,共获得 881 对患者,两组各 881 例。匹配前,两组在年龄、体质量、BMI、脑卒中

史、冠心病、糖尿病、高血压、ASA 分级、血红蛋白、丙氨酸氨基转移酶和天冬氨酸氨基转移酶等变量上存在一定程度的不平衡。匹配后,所有基线变量的 SMD 均 <0.10,提示两组基线协变量平衡良好(表 2;图 2)。

表 2 女性患者倾向性评分匹配前后基线特征

Table 2 Baseline characteristics of female patients before and after propensity score matching

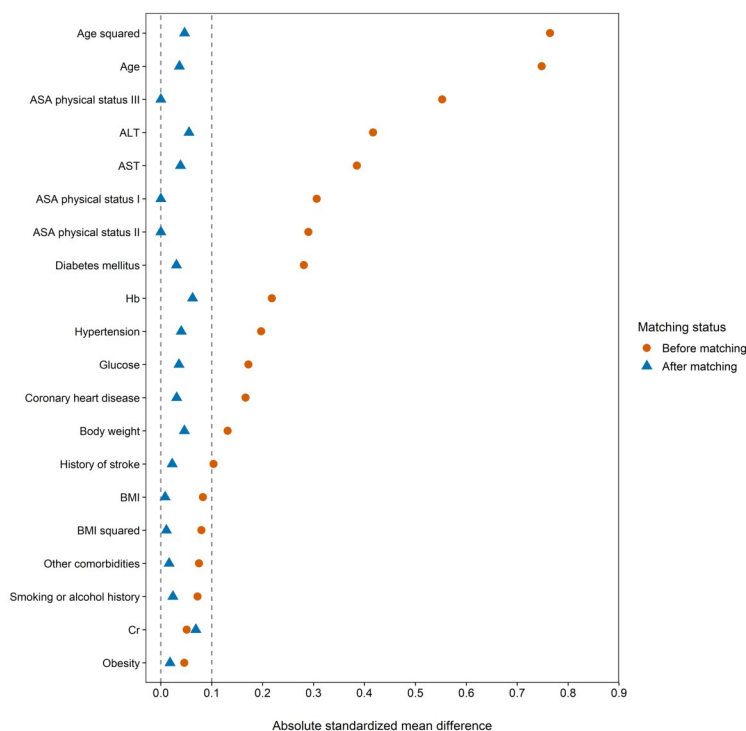
$[(\bar{x} \pm s), n(\%)]$

Before propensity score matching			
Variables	General surgery($n=940$)	Gynecological surgery($n=9\ 944$)	SMD
Age/year	53 ± 14	43 ± 12	0.748
Body weight/kg	55.9 ± 9.1	57.1 ± 9.1	0.131
BMI/($\text{kg} \cdot \text{m}^{-2}$)	22.5 ± 3.4	22.8 ± 3.5	0.083

续表

Before propensity score matching			
Obesity	58 (6.2)	729 (7.3)	0.046
Smoking or alcohol history	12 (1.3)	58 (0.6)	0.072
History of stroke	15 (1.6)	53 (0.5)	0.104
Coronary heart disease	32 (3.4)	97 (1.0)	0.167
Diabetes mellitus	104 (11.1)	375 (3.8)	0.281
Hypertension	159 (16.9)	1 014 (10.2)	0.197
Other comorbidities	14 (1.5)	253 (2.5)	0.075
ASA physical status			0.604
I	39 (4.1)	1 245 (12.5)	
II	613 (65.2)	7 771 (78.1)	
III	288 (30.6)	928 (9.3)	
Glucose/(mmol·L ⁻¹)	4.8 (4.4, 5.4)	4.6 (4.3, 5.2)	0.172
Hb/(g·L ⁻¹)	122 ± 15	118 ± 18	0.218
ALT/(U·L ⁻¹)	17.0 (12.0, 30.0)	14.0 (10.0, 19.0)	0.417
AST/(U·L ⁻¹)	22.0 (18.0, 30.0)	19.0 (16.0, 23.0)	0.385
Cr/(μmol·L ⁻¹)	60.0 (53.0, 66.0)	58.0 (52.0, 65.0)	0.051
After propensity score matching			
Variables	General surgery(n=881)	Gynecological surgery(n=881)	SMD
Age/year	52 ± 14	53 ± 15	0.034
Body weight/kg	56.2 ± 8.9	55.7 ± 9.0	0.047
BMI/(kg·m ⁻²)	22.6 ± 3.3	22.5 ± 3.3	0.009
Obesity	55 (6.2)	51 (5.8)	0.019
Smoking or alcohol history	9 (1.0)	7 (0.8)	0.024
History of stroke	14 (1.6)	12 (1.4)	0.019
Coronary heart disease	26 (3.0)	30 (3.4)	0.026
Diabetes mellitus	93 (10.6)	100 (11.4)	0.025
Hypertension	151 (17.1)	139 (15.8)	0.037
Other comorbidities	13 (1.5)	15 (1.7)	0.018
ASA physical status			0.000
I	39 (4.4)	39 (4.4)	
II	595 (67.5)	595 (67.5)	
III	247 (28.0)	247 (28.0)	
Glucose/(mmol·L ⁻¹)	4.8 (4.4, 5.4)	4.8 (4.4, 5.4)	0.032
Hb/(g·L ⁻¹)	122 ± 15	123 ± 16	0.067
ALT/(U·L ⁻¹)	16.0 (12.0, 26.0)	16.0 (12.0, 24.0)	0.079
AST/(U·L ⁻¹)	21.0 (18.0, 28.0)	21.0 (17.0, 27.0)	0.069
Cr/(μmol·L ⁻¹)	60.0 (53.0, 66.0)	59.0 (53.0, 67.0)	0.045

Data are presented as mean ± standard deviation, median (interquartile range, IQR), or *n* (%). An absolute SMD < 0.10 indicated adequate balance. PSM used 1:1 nearest-neighbor matching without replacement (raw-scale caliper, 0.02), with exact matching on ASA physical status. BMI: body mass index; ASA: American Society of Anesthesiologists; ALT: alanine aminotransferase; AST: aspartate aminotransferase; Hb: hemoglobin; Cr: creatinine; SMD: standardized mean difference; PSM: propensity score matching.



Points represent absolute SMDs before and after PSM; dashed lines indicate 0 and the 0.10 balance threshold. Body weight and obesity were additional balance variables; age-squared and BMI-squared terms were included in the propensity score model. SMD: standardized mean difference; PSM: propensity score matching; ASA: American Society of Anesthesiologists; ALT: alanine aminotransferase; AST: aspartate aminotransferase; Hb: hemoglobin; BMI: body mass index; Cr: creatinine.

图2 倾向性评分匹配前后协变量平衡图

Fig. 2 Love plot of covariate balance before and after propensity score matching

2.3 匹配前后术后寒战发生情况

在匹配前的女性患者中,普外科组发生术后寒战28例(2.98%),妇科组发生491例(4.94%),两组差异有统计学意义($P=0.007$)。倾向性评分匹配后,普外科组发生术后寒战27例(3.06%),妇科组发生44例(4.99%),两组发生率的绝对差为1.93个百分点。无连续性校正的McNemar检验显示两组差异有统计学意义($P=0.044$),而精确McNemar检验结果未达到统计学意义($P=0.057$)。以匹配对为分层变量的单因素条件logistic回归显示,与普外科手术相比,妇科手术患者的术后寒战发生的比值较高($OR=1.63$, 95%CI: 1.01 ~ 2.63, $P=0.046$;表3)。

2.4 匹配后术后寒战相关因素分析

单因素条件Logistic回归分析显示,妇科手术、术中最低体温、术中平均体温、术中液体总入量、胶体液入量、手术时间、术中使用氟比洛芬酯及留置尿管与术后寒战有关;术中使用多巴胺与术后寒战的关联接近统计学意义($P=0.054$;表4)。将主要暴露因素及单因素分析中 $P<0.10$ 的候选变量纳入

多因素条件Logistic回归。考虑变量间的共线性、部分变量暴露例数较少以及结局不一致匹配对数量有限,术中平均体温与最低体温、胶体液入量与液体总入量未同时纳入模型;术中多巴胺因暴露例数较少,也未纳入最终模型。将留置尿管加入模型后,模型拟合未显著改善(似然比检验 $P=0.884$),故未将其纳入最终模型。多因素条件Logistic回归显示,手术时间与术后寒战有关:手术时间每延长30 min,术后寒战发生的比值为原来的1.32倍[调整后比值比(adjusted odds ratio, aOR)=1.32, 95%CI: 1.07 ~ 1.62, $P=0.009$]。术中最低体温每升高1℃,术后寒战发生的比值呈降低趋势,但该关联未达到统计学意义(aOR=0.32, 95%CI: 0.10 ~ 1.02, $P=0.053$)。调整术中氟比洛芬酯的使用、术中最低体温、液体总入量和手术时间后,妇科手术与术后寒战的关联不再具有统计学意义(aOR=1.62, 95%CI: 0.78 ~ 3.37, $P=0.197$)。术中使用氟比洛芬酯和液体总入量在多因素模型中差异无统计学意义(均 $P>0.05$;表4)。

表 3 女性患者倾向性评分匹配前后术后寒战发生率比较		
Table 3 Comparison of the incidence of postoperative shivering before and after propensity score matching in female patients [n/N(%)]		
Outcomes	Before matching	After matching
General surgery	28/940 (2.98)	27/881 (3.06)
Gynecological surgery	491/9 944 (4.94)	44/881 (4.99)
Absolute incidence difference/percentage points	1.96	1.93
Test statistic	$\chi^2=7.257$	McNemar $\chi^2=4.070$
<i>P</i>	0.007	0.044
OR (95%CI)	—	1.63 (1.01–2.63)

The absolute incidence difference was calculated as gynecological minus general surgery. *P* values were obtained using the Pearson χ^2 test before matching and the asymptotic McNemar test without continuity correction after matching (exact McNemar $P=0.057$). The OR was estimated using conditional logistic regression stratified by matched pair (general surgery reference; $P=0.046$). OR: odds ratio; CI: confidence interval. *n*: number of patients with postoperative shivering; *N*: total number of patients.

最后,我们检查了条件 Logistic 回归模型的收敛情况,模型正常收敛,未出现拟合警告。术中最低体温、液体总入量及手术时间二次项的似然比检验均无统计学意义(均 $P>0.05$),未发现明显的非线性关系。各变量的方差膨胀因子为 1.10~2.65,未发现明显多重共线性。影响分析显示,手术时间的效应方向及统计学结论较为稳定,而术中最低体温和氟比洛芬酯的效应估计对个别匹配对较为敏感。

表 4 匹配后女性患者术后寒战相关因素的单因素和多因素条件 Logistic 回归分析				
Table 4 Unifactorial and multifactorial conditional Logistic regression analyses of factors associated with postoperative shivering in matched female patients				
Variables	Unifactorial analysis		Multifactorial analysis	
	OR (95% CI)	<i>P</i>	Adjusted OR (95% CI)	<i>P</i>
Gynecological <i>vs.</i> general surgery	1.63 (1.01–2.63)	0.046	1.62 (0.78–3.37)	0.197
Intraoperative flurbiprofen axetil (yes <i>vs.</i> no)	0.46 (0.22–0.94)	0.032	0.45 (0.17–1.20)	0.111
Intraoperative dopamine (yes <i>vs.</i> no)	4.50 (0.97–20.83)	0.054	—	—
Minimum body temperature/per 1 °C increase	0.25 (0.11–0.56)	<0.001	0.32 (0.10–1.02)	0.053
Mean body temperature/per 1 °C increase	0.25 (0.11–0.60)	0.002	—	—
Total fluid intake/per 500 mL increase	1.23 (1.05–1.44)	0.009	0.93 (0.69–1.26)	0.642
Colloid volume/per 500 mL increase	1.42 (1.01–2.01)	0.045	—	—
Duration of surgery/per 30 min increase	1.31 (1.15–1.50)	<0.001	1.32 (1.07–1.62)	0.009
Urinary catheterization (yes <i>vs.</i> no)	3.43 (1.48–7.96)	0.004	—	—

Conditional logistic regression was stratified by matched pair. The final multifactorial model included gynecological surgery, intraoperative flurbiprofen axetil, minimum body temperature, total fluid intake, and duration of surgery. Effect units were 1 °C for temperatures, 500 mL for fluid variables, and 30 min for surgery duration. OR: odds ratio; CI: confidence interval.

3 讨论

3.1 主要发现

本研究采用倾向性评分匹配比较妇科与普外

科女性患者术后寒战的发生情况。匹配后,妇科组术后寒战发生率高于普外科组,无连续性校正的 McNemar 检验及单因素条件 Logistic 回归均提示差异有统计学意义。然而,精确 McNemar 检验结果未

达到统计学意义,且进一步调整围术期因素后,妇科手术与术后寒战的关联亦无统计学意义。因此,本研究提示妇科手术患者术后寒战发生率可能较高,但尚不足以认为妇科手术本身是术后寒战的独立危险因素。既往研究表明,术后寒战是由患者自身因素、麻醉方式、手术时间、体温变化、疼痛刺激及围术期用药等多种因素共同影响的临床结局^[3,7,13-14],提示仅依据手术类型判断寒战风险可能存在局限。妇科手术在手术体位、手术区域暴露、冲洗液使用及麻醉镇痛管理等方面具有一定特点,但这些因素在不同术式和医疗机构之间可能存在较大差异。本研究中妇科手术的效应在多因素调整后减弱,提示匹配后观察到的组间差异可能部分由围术期因素解释。

3.2 手术时间与术中体温

本研究发现,手术时间延长与术后寒战发生的比值升高相关,且影响分析中该关联的方向及统计学结论较为稳定,提示手术时间可能是较为稳定的围术期相关因素。该结果与既往研究结论一致:较长的手术或麻醉时间是围术期低体温及术后寒战的重要相关因素^[14]。手术时间延长可增加患者暴露于较低手术室温度的时间,延长麻醉药物对体温调节反应的抑制,并可能伴随更大的手术区域暴露和更多的液体输入,从而增加热量丢失及术中低体温的可能性。有研究提示,低体温持续时间超过120 min可能与包括严重寒战、切口感染和苏醒延迟在内的术后并发症风险增加有关^[15-17]。患者进入PACU后,机体为恢复核心体温可触发骨骼肌不自主收缩,从而出现寒战^[2]。这一机制也与本研究的另一项发现相符,即术中最低体温升高时,术后寒战发生的比值呈降低趋势。全身麻醉可降低血管收缩和寒战阈值,并使核心热量向外周重新分布;当核心体温下降至寒战阈值以下时,可诱发不自主骨骼肌活动^[3,14-15]。此外,有研究表明,即使术后核心体温处于正常范围,较低的外周温度仍可能是寒战的独立危险因素^[7]。因此,加强术中体温监测并减少低温暴露可能更具临床意义,但由于本研究中该关联未达到统计学意义且置信区间较宽,该结果仅可视为有待进一步验证的关联信号,提示需在前瞻性研究中进一步验证。

3.3 其他围术期因素

术中使用氟比洛芬酯、液体总入量、胶体液入量及留置尿管等因素在单因素分析中表现出一定关联,但经多因素调整后均未显示稳定效应。既往

研究表明,氯胺酮以及对乙酰氨基酚等药物可降低术后寒战发生率^[1,18],5-羟色胺3受体拮抗剂格拉司琼也可能降低术后寒战发生率^[19],在断指再植手术中右美托咪定也可降低苏醒期寒战的发生率^[20]。但不同研究的药物种类、剂量、用药时机及患者人群存在差异,且围术期药物使用可能受手术类型、疼痛程度及麻醉医师用药习惯等因素影响,不同药物的相对效应及最佳剂量仍需进一步研究。既往一项全膝关节置换术研究显示,液体入量超过1 500 mL为术后寒战发生的独立危险因素^[21]。本研究中的液体入量及留置尿管等变量可能更多反映手术时间、手术复杂程度或围术期处理强度;同时,液体输入量可能与手术时间、出血量及手术规模密切相关^[21],因此在多因素模型中同时纳入相关变量后,效应估计可能减弱。与仅依据手术类型进行风险判断相比,关注手术时间和术中体温变化可能更具实际意义。

3.4 局限性与展望

本研究为单中心回顾性研究,尽管采用倾向性评分匹配和条件Logistic回归控制部分混杂因素,仍不能排除未测量混杂及残余混杂,如手术室温度、主动保温措施、输液温度、麻醉药物剂量及术后疼痛程度等。术后寒战依据临床记录进行二分类判定,未采用统一的分级量表,可能存在漏报或误分类。此外,术后寒战事件数及结局不一致匹配对数量有限,限制了多因素模型纳入变量的数量,并可能影响效应估计的稳定性。本研究的匹配分析仅纳入女性患者,将结论推广至男性患者、其他手术类型及不同层级医疗机构时应保持谨慎。

未来可开展多中心前瞻性研究,采用Crossley-Mahajan分级等标准化寒战评价方法,并结合恢复室连续观察^[22];连续记录围术期核心体温,系统收集主动保温、环境温度及麻醉镇痛方案等因素,以进一步明确手术类型、手术时间及体温变化与术后寒战的关系,并探索针对高风险患者的个体化预防策略。

3.5 结论

综上,倾向性评分匹配后,妇科手术女性患者术后寒战发生率高于普外科女性患者,但妇科手术与术后寒战的独立关联尚未得到充分证实。手术时间延长与术后寒战发生的比值升高相关,术中最低体温升高可能与术后寒战发生的比值降低有关。围术期手术时间评估和体温管理可能是术后寒战风险识别与预防中值得重点关注的环节。

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