



doi:10.7659/j.issn.1005-6947.250053

<http://dx.doi.org/10.7659/j.issn.1005-6947.250053>

China Journal of General Surgery, 2025, 34(10):2191-2197.

· 临床研究 ·

## 术中低体温对老年腹股沟疝修补术后并发症的影响分析

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### 摘要

**背景与目的：**老年腹股沟疝患者因生理机能衰退和体温调节能力减弱，术中易发生低体温，增加术后感染、认知功能障碍及血清肿等并发症发生风险。本研究旨在探讨术中体温水平与老年腹股沟疝术后并发症的关系，并评估其预测价值。

**方法：**回顾性分析2018年4月—2024年10月在西南医科大学附属医院接受腹股沟疝修补术的358例老年患者的临床资料。低体温被定义为中心温度 $<36.0\text{ }^{\circ}\text{C}$ ，根据术中体温水平将患者分为低体温组（20例）和正常体温组（338例）。比较两组患者的围手术期指标及术后并发症发生情况，采用多因素Logistic回归分析术后并发症发生的独立危险因素，并通过受试者工作特征（ROC）曲线评估术中体温的预测效能。

**结果：**与正常体温组比较，低体温组患者的手术时间延长，术后白细胞（WBC）及中性粒细胞/淋巴细胞比值（NLR）明显升高，术后并发症发生率显著增加（25.0% vs. 3.8%， $P<0.001$ ）。多因素分析显示，年龄、营养风险评分、术中出血量、术后WBC、术后NLR及术中低体温均为术后并发症发生的独立危险因素。ROC曲线结果表明，术中体温预测术后并发症的曲线下面积为0.717，截断值为 $36.42\text{ }^{\circ}\text{C}$ ，敏感度70.0%，特异度89.5%。

**结论：**老年腹股沟疝患者术中低体温可显著增加术后并发症发生风险，且体温水平具有较好的预后预测价值。维持术中体温不低于 $36.4\text{ }^{\circ}\text{C}$ 有助于降低并发症发生率、改善围术期结局。

### 关键词

疝，腹股沟；疝修补术；老年人；低体温；术后并发症

中图分类号：R656.2

## Analysis of the impact of intraoperative hypothermia on postoperative complications after inguinal hernia repair in elderly patients

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### Abstract

**Background and Aims:** Elderly patients with inguinal hernia are prone to intraoperative hypothermia due to diminished thermoregulatory capacity, which may increase the risk of postoperative complications such as infection, seroma, and cognitive dysfunction. This study aimed to investigate the relationship between intraoperative body temperature and postoperative complications in elderly patients undergoing

收稿日期：2025-02-06；修订日期：2025-04-10。

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inguinal hernia repair and to evaluate its predictive value.

**Methods:** Clinical data of 358 elderly patients who underwent tension-free inguinal hernia repair at the Affiliated Hospital of Southwest Medical University from April 2018 to October 2024 were retrospectively analyzed. Patients were divided into a hypothermia group ( $<36.0\text{ }^{\circ}\text{C}$ ) and a normothermia group ( $\geq 36.0\text{ }^{\circ}\text{C}$ ) according to intraoperative temperature levels. Perioperative parameters and postoperative complications were compared between the two groups. Independent risk factors for complications were identified using multivariate logistic regression, and the predictive performance of intraoperative temperature was evaluated by receiver operating characteristic (ROC) curve analysis.

**Results:** Compared with the normothermia group, patients with intraoperative hypothermia had significantly longer operative time, higher postoperative white blood cell (WBC) count and neutrophil-to-lymphocyte ratio (NLR), and an increased incidence of complications (25.0% vs. 3.8%,  $P<0.001$ ). Multivariate analysis identified age, NRS 2002 score, intraoperative blood loss, postoperative WBC, postoperative NLR, and intraoperative hypothermia as independent risk factors for postoperative complications. ROC analysis showed that intraoperative temperature had a good predictive value for complications (AUC=0.717, optimal cutoff=36.42  $^{\circ}\text{C}$ , sensitivity=70.0%, specificity=89.5%).

**Conclusion:** Intraoperative hypothermia significantly increases postoperative complication risk in elderly patients undergoing inguinal hernia repair. Maintaining intraoperative temperature above 36.4  $^{\circ}\text{C}$  may reduce the incidence of complications and improve perioperative outcomes.

#### Key words

Hernia, Ingual; Herniorrhaphy; Aged; Hypothermia; Postoperative Complications

CLC number: R656.2

腹股沟疝是普外科常见病，占腹外疝的90%以上<sup>[1]</sup>。老年患者因腹壁肌肉萎缩和慢性腹压增高（如便秘、前列腺增生）导致发病率显著升高（>30%）<sup>[2-4]</sup>。随着年龄增长，体温调节能力减弱，术中低体温发生率升高<sup>[5-7]</sup>，可能通过抑制免疫功能、促进促炎因子释放，增加切口感染等并发症发生风险<sup>[8]</sup>。外周血白细胞（white blood cells, WBC）和中性粒细胞与淋巴细胞比值（neutrophil-lymphocyte ratio, NLR）可动态监测此类炎症反应过程<sup>[9-10]</sup>。然而，术中体温阈值对并发症发生的预测价值仍需进一步验证。本研究旨在探究老年腹股沟疝患者术中体温水平对术后并发症的影响，为优化术中体温管理提供依据。

## 1 资料与方法

### 1.1 一般资料

回顾性分析2018年4月—2024年10月于西南医科大学附属医院行腹股沟疝无张力修补手术治疗的358例老年腹股沟疝患者的临床资料，其中

男275例，女83例，平均年龄（ $74.23 \pm 6.94$ ）岁。术中低体温是麻醉和手术中常见的并发症之一，低体温被定义为中心温度 $<36.0\text{ }^{\circ}\text{C}$ <sup>[11]</sup>。根据术中体温监测情况将研究对象分为低体温组20例和正常体温组338例。本研究获得西南医科大学附属医院医学伦理委员会批准（批号：KY2023243），并豁免患者知情同意。

纳入标准：(1)腹股沟疝诊断明确；(2)老年患者，年龄 $>60$ 岁<sup>[12-13]</sup>；(3)入院记录、手术记录、血常规等病历资料完整可查，能够随访术后的恢复情况；(4)手术指征明确，选择手术治疗且术后恢复顺利，未出现因并发症导致患者30 d死亡的病例发生；(5)术前体温正常，术中体温监测记录完整；(6)采用营养风险筛查工具简表（NRS 2002）评估均不存在营养风险。排除标准：(1)存在其他急慢性感染疾病导致炎症指标异常；(2)合并甲状腺功能亢进症、甲状腺功能减退症等影响代谢的疾病或长期应用解热镇痛、镇静剂等影响体温的药物；(3)正在接受免疫抑制药物或血液系统药物治疗的患者。

## 1.2 方法

**1.2.1 手术方法与术中体温监测** 所有老年腹股沟疝患者均采用腹股沟疝无张力修补术, 具体手术方式为李金斯坦手术, 手术方法参照李仁杰等<sup>[13]</sup>的研究。为做到两组同质性以及控制时间、季节和医疗水平进步等混杂因素对手术预后的影响, 术者均为具有丰富疝修补手术操作经验的主任医师。将室内温度设置为22~24℃, 室内湿度设置为40%~50%, 术中棉被覆盖双侧膝关节至足部以保温。通过鼓膜测温仪(美国TY-CO公司生产, GENIUS Model 3000A型)分别在手术开始时(T1)、手术过程中(T2)和手术结束(T3)时测量体温, 计算3次测得体温的平均值作为术中体温水平(T)。

**1.2.2 观察指标和评估手术预后** 收集纳入研究患者的年龄、性别、体质质量指数(body mass index, BMI)、营养状况、合并症、美国麻醉医师协会(American Society of Anesthesiologists Score, ASA)分级、心理状态、术前WBC、术前NLR、手术时间、出血量、术中体温水平以及术后WBC、术后NLR、手术预后等临床资料。其中NRS 2002评分≥3则存在营养风险<sup>[14]</sup>; 心理状态采用焦虑自评量表(self-rating anxiety scale, SAS)和抑郁自评量表(self-rating depression scale, SDS)进行评价, 得分越高越严重<sup>[15]</sup>; WBC和NLR根据血细胞分析结果获得, 本院检验科采用希森美康XN-2000全自动血液分析仪进行血细胞分类和计数。根据中性粒细胞(neutrophils, N)比率和淋巴细胞(lymphocyte, L)比率计算NLR, NLR的计算公式为NLR=N/L。根据术后30 d内并发症的发生情况评估手术预后, 术后并发症包括切口感染、静脉血栓栓塞(venous thromboembolism, VTE)、术后认知功能障碍(postoperative cognitive dysfunction, POCD)、血清肿、神经感觉异常、阴囊水肿和尿潴留等。

## 1.3 统计学处理

采用SPSS 22.0软件进行统计分析。计量资料以均数±标准差( $\bar{x} \pm s$ )表示, 比较采用t检验; 计数资料采用例数(百分比)[n (%)]表示, 间比较采用 $\chi^2$ 检验。应用Logistic回归法进行多因素

分析手术预后的影响因素。运用受试者工作曲线(ROC)分析术中体温水平对患者预后的预测价值。 $P<0.05$ 为差异有统计学意义。

## 2 结 果

### 2.1 患者基线资料

两组患者的基线资料, 包括年龄、性别、BMI、NRS 2002评分、合并症、ASA分级以及心理状态SAS和SDS评分差异均无统计学意义(均 $P>0.05$ ), 具有可比性(表1)。

表1 两组患者基线资料比较

Table 1 Comparison of the baseline data between the two groups of patients

资料	低体温组 (n=20)	正常体温组 (n=338)	t/ $\chi^2$	P
年龄(岁, $\bar{x} \pm s$ )	72.50±5.46	74.53±7.05	-1.262	0.208
性别[n(%)]				
男	12(60.0)	263(77.8)	3.363	0.067
女	8(40.0)	75(22.2)		
BMI(kg/m <sup>2</sup> , $\bar{x} \pm s$ )	23.88±3.34	25.20±3.49	-1.648	0.100
NRS 2002评分[n(%)]				
0	3(15.0)	42(12.4)		
1	13(65.0)	269(79.6)	3.756	0.153
2	4(20.0)	27(8.0)		
合并症[n(%)]				
是	9(45.0)	90(26.6)	3.186	0.074
否	11(55.0)	248(73.4)		
ASA分级[n(%)]				
I/II级	14(70.0)	289(85.5)	3.490	0.062
III/IV级	6(30.0)	49(14.5)		
心理状态( $\bar{x} \pm s$ )				
SAS	42.65±9.25	42.46±8.91	0.093	0.926
SDS	43.25±6.79	45.28±6.82	-1.296	0.196

### 2.2 患者围手术期指标

与正常体温组比较, 低体温组的手术时间延长、术后WBC与术后NLR更高(均 $P<0.05$ ); 低体温组的总并发症发生率明显高于正常体温组(25.0% vs. 3.8%,  $P<0.001$ ), 其中主要切口感染、POCD、血清肿和神经感觉异常的发生率升高(表2)。

表2 两组患者围手术期指标比较

Table 2 Comparison of the perioperative variables between the two groups of patients

指标	低体温组(n=20)	正常体温组(n=338)	t/χ <sup>2</sup>	P
术前WBC(×10 <sup>9</sup> /L, $\bar{x} \pm s$ )	7.39±1.69	7.93±1.42	-1.626	0.105
术前NLR( $\bar{x} \pm s$ )	1.73±0.30	1.62±0.24	1.904	0.058
手术时间(min, $\bar{x} \pm s$ )	98.45±12.31	90.87±13.61	2.431	0.016
出血量(mL, $\bar{x} \pm s$ )	82.00±14.03	75.98±13.79	1.895	0.059
术中体温水平(℃, $\bar{x} \pm s$ )	35.46±0.26	36.52±0.23	-19.975	<0.001
术后WBC(×10 <sup>9</sup> /L, $\bar{x} \pm s$ )	12.67±1.33	11.94±1.40	2.301	0.022
术后NLR( $\bar{x} \pm s$ )	4.29±0.95	3.69±0.88	2.932	0.004
并发症 <sup>1)[n(%)]</sup>	5(25.0)	13(3.8)	17.695	<0.001
切口感染	4(20.0)	9(2.7)	16.219	<0.001
VTE	1(5.0)	4(1.2)	1.997	0.158
POCD	2(10.0)	2(0.6)	7.811	0.005
血清肿	2(10.0)	3(0.9)	5.730	0.017
神经感觉异常	2(10.0)	2(0.6)	7.811	0.005
阴囊水肿	1(5.0)	4(1.2)	1.997	0.158
尿潴留	1(5.0)	2(0.6)	0.704	0.401

注:1)患者可能合并发生一种以上并发症

Note: 1) A patient may have more than one type of complication

### 2.3 老年腹股沟疝修补术预后的危险因素分析

将上述研究因素[年龄、性别(男=1,女=0)、BMI、并发症(是=1,否=0)、ASA分级(I/II级=1,III/IV级=0)、术前WBC、术前NLR、手术时间、出血量、术后WBC、术后NLR、分组(低体温组=1,正常体温组=0)]作为自变量,并发症作为因变量(并发症=1,未发生并发症=0)纳入多因素Logistic回归分析,结果显示,年龄( $OR=1.085$ , 95% CI=1.027~1.147),术前WBC( $OR=1.529$ , 95% CI=1.136~2.059),术前NLR( $OR=3.516$ , 95% CI=1.998~6.165),术中低体温( $OR=7.842$ , 95% CI=1.475~41.789),术后WBC( $OR=1.133$ , 95% CI=0.924~1.391),术后NLR( $OR=1.206$ , 95% CI=0.897~1.623),手术时间( $OR=1.008$ , 95% CI=0.994~1.022),出血量( $OR=1.070$ , 95% CI=1.026~1.116)均是老年腹股沟疝修补术后发生并发症的危险因素(表3)。

1.027~1.147,  $P=0.048$ )、NRS 2002评分( $OR=3.931$ , 95% CI=1.336~11.587,  $P=0.013$ )、出血量( $OR=1.070$ , 95% CI=1.026~1.116,  $P=0.002$ )、术后WBC( $OR=1.529$ , 95% CI=1.136~2.059,  $P=0.005$ )、术后NLR( $OR=3.516$ , 95% CI=1.998~6.165,  $P<0.001$ )、术中低体温( $OR=7.842$ , 95% CI=1.475~41.789,  $P=0.017$ )均是老年腹股沟疝修补术后发生并发症的危险因素(表3)。

表3 老年腹股沟疝修补术预后危险因素的多因素Logistic回归分析

Table 3 Multivariate logistic regression analysis of risk factors affecting prognosis after inguinal hernia repair in elderly patients

因素	$\beta$	S.E.	Wald/χ <sup>2</sup>	P	OR(95% CI)
年龄	0.082	0.028	8.524	0.003	1.085(1.027~1.147)
性别	-0.235	0.256	0.842	0.359	0.791(0.478~1.308)
BMI	0.073	0.068	1.146	0.284	1.076(0.941~1.228)
NRS 2002评分	1.368	0.552	6.147	0.013	3.931(1.336~11.587)
并发症	0.456	0.387	1.385	0.239	1.578(0.735~3.387)
ASA分级	0.321	0.276	1.334	0.248	1.378(0.798~2.379)
SAS评分	0.041	0.035	1.380	0.240	1.042(0.973~1.116)
SDS评分	0.033	0.032	1.062	0.303	1.034(0.971~1.099)
术前WBC	0.125	0.103	1.458	0.227	1.133(0.924~1.391)
术前NLR	0.187	0.145	1.689	0.194	1.206(0.897~1.623)
手术时间	0.008	0.007	1.310	0.253	1.008(0.994~1.022)
出血量	0.068	0.022	9.420	0.002	1.070(1.026~1.116)
术后WBC	0.425	0.152	7.837	0.005	1.529(1.136~2.059)
术后NLR	1.256	0.287	19.072	<0.001	3.516(1.998~6.165)
分组	2.058	0.856	5.704	0.017	7.842(1.475~41.789)

## 2.4 ROC 曲线分析术中体温水平和炎症指标对预后的预测价值

绘制 ROC 曲线分析术中体温水平和术后 WBC、NLR 等炎症指标对患者预后的预测价值,结果显示,三者的曲线下面积 (AUC) 均>0.7,其中术中体温水平的 AUC 为 0.717 (95% CI=0.592~0.842,  $P=0.003$ ),根据 Youden 指数计算出理想截断值为 36.42 ℃,敏感度为 70.0%,特异度为 89.5% (图 1) (表 4)。

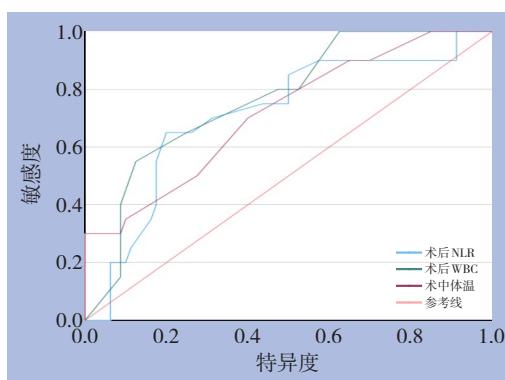


图 1 术中体温水平、术后 WBC 及 NLR 预测手术预后的 ROC 曲线

Figure 1 ROC curves of intraoperative body temperature, postoperative WBC level, and NLR for predicting surgical prognosis

表 4 术中体温水平、术后 WBC 及 NLR 对手术预后的预测效能

Table 4 Predictive value of intraoperative body temperature, postoperative WBC level, and NLR for surgical prognosis

因素	AUC(95% CI)	S.E.	P	截断值	敏感度 (%)	特异度 (%)
术后 WBC	0.768(0.661~0.874)	0.054	<0.001	12.03	65.0	75.0
术后 NLR	0.714(0.586~0.841)	0.065	0.003	3.52	85.0	72.5
术中体温水平	0.717(0.592~0.842)	0.064	0.003	36.42	70.0	89.5

## 3 讨 论

### 3.1 老年腹股沟疝患者术后并发症的危险因素

老年腹股沟疝患者占比高 (60.8%),且术后并发症发生风险显著增加,这主要是由于老年患者身体机能衰退和生理储备能力下降<sup>[16]</sup>。本研究结果显示,术后总并发症发生率为 5.0%,与既往研究相符 (4.5%),显著高于中青年患者 (2.7%)<sup>[17]</sup>。主要并发症包括切口感染、血清肿、VTE、POCD 等。年龄作为术后并发症发生的危险因素<sup>[18]</sup>,在

本研究中也得到了验证。因此,对于老年患者,术前应进行全面风险评估,以预防并发症的发生。此外,术中出血量也被发现是并发症发生的重要危险因素,可能与血清肿风险增加有关<sup>[19~20]</sup>。术中应该谨慎操作,减少出血,以降低血清肿等并发症发生的风险。

### 3.2 术中体温水平对术后并发症的影响

术中低体温是老年腹股沟疝患者术后发生并发症的另一重要危险因素。适宜体温对机体新陈代谢和生命活动至关重要<sup>[21]</sup>。本研究中发现,低体温组患者手术时间更长,可能因为手术暴露时间长导致热量散失增加。术中低体温可引发肌肉寒战,增加氧耗和应激反应,促使免疫细胞释放白介素、肿瘤坏死因子等炎症因子,导致异常的免疫炎症反应<sup>[22~23]</sup>。这种反应可能损伤神经元细胞,破坏特异性烯醇化酶及 S100-β 蛋白,增加 POCD 的风险<sup>[24~25]</sup>,并延长切口愈合时间,增加感染风险<sup>[26~27]</sup>。在本研究中也得到了验证,低体温组的切口感染和 POCD 发生率均增加。

### 3.3 术中体温水平与炎症因子对并发症发生的预测价值

WBC 和 NLR 作为全身炎症指标,可间接反映手术创伤程度及感染风险<sup>[28~29]</sup>。本研究显示,低体温组患者术后 WBC、NLR 及并发症发生率均显著高于正常体温组。多因素 Logistic 回归分析进一步证实了术中低体温、术后 WBC 和 NLR 是并发症发生的危险因素。ROC 曲线分析表明,术中体温水平对并发症发生具有较高的预测价值 (AUC>0.7),理想截断值为 36.42 ℃。这与现有研究结果一致,提示术中体温管理对改善患者预后具有重要意义<sup>[30~31]</sup>。尽管《中国加速康复外科临床实践指南 (2021 版)》<sup>[32]</sup>建议术中维持核心体温不低于 36 ℃,但具体控制范围尚需进一步研究。本研究显示,将术中体温控制在 36.4 ℃以上可能有助于降低并发症发生风险,但仍需前瞻性研究验证。

综上所述,老年腹股沟疝患者术中低体温可显著增加并发症发生风险,且术中体温水平对预后具有预测价值。术中应严格控制体温,以改善患者预后。然而,本研究为单中心回顾性研究,样本量有限,可能存在信息和选择偏倚导致结论可靠性降低,未来需开展多中心前瞻性研究进一步验证结论。

作者贡献声明：李安平参与采集整理数据，技术及材料支持，调研整理文献，起草及修订论文；汪洋参与提出研究选题，修订及终审文献及工作支持。

利益冲突：所有作者均声明不存在利益冲突。

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(本文编辑 姜晖)

**本文引用格式:**李安平,汪洋.术中低体温对老年腹股沟疝修补术后并发症的影响分析[J].中国普通外科杂志,2025,34(10):2191–2197. doi:10.7659/j.issn.1005-6947.250053

**Cite this article as:** Li AP, Wang Y. Analysis of the impact of intraoperative hypothermia on postoperative complications after inguinal hernia repair in elderly patients[J]. Chin J Gen Surg, 2025, 34 (10):2191–2197. doi:10.7659/j.issn.1005-6947.250053