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全膝关节置换术后皮温与血清指标变化的相关性研究*

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摘要 目的:研究膝骨性关节炎(knee osteoarthritis, KOA)患者行单侧全膝关节置换手术前后膝关节皮温、血清指标的变化规律以及膝关节功能恢复之间相关性。**方法:**将2016年9月-2017年3月在我院行单侧全膝关节置换术且术后未发生假体周围感染的患者作为研究对象,测量并记录基本信息、术前及术后膝关节皮温、血清指标及膝关节功能评分,并进行统计学分析。**结果:**本研究共收集病例65例,随访时间为6个月。双膝皮温、双膝皮温差于术后第5天达到峰值,PCT、CRP、ESR均于术后第3天达到峰值,IL-6、WBC于术后第1天达到峰值,HGB下降至最低水平为术后5-7天。患者非手术侧膝关节皮温于术后30天恢复至术前水平,而手术侧膝关节皮温及双膝皮温差直至术后6个月仍未恢复至术前水平;PCT、IL-6、CRP于术后60天恢复至术前水平,ESR于术后90天恢复至术前水平,WBC于术后15天恢复至术前水平。**结论:**KOA患者TKA术后双膝皮温差直至术后6月仍高于术前水平,而研究中的各项血清指标均于术后3月内恢复至术前水平。

关键词:全膝关节置换术;膝关节皮温;血清指标;膝关节功能

中图分类号:R684.3;R687.4 **文献标识码:**A **文章编号:**1673-6273(2018)05-889-05

The Relation between the Changes of Knee Skin Temperature and Serum Indices after Total Knee Arthroplasty*

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ABSTRACT Objective: To monitor the changes of knee skin temperature and serum indices for 180 days following total knee arthroplasty (TKA) of the patients with knee osteoarthritis (KOA) and find the relationship between the differential temperature and clinical outcome. **Methods:** Patients who attended for a unilateral TKA due to primary osteoarthritis between September 2016 and March 2017 were included in the study. The skin temperature of both knees was monitored preoperatively and postoperatively using an infrared thermometer. Serum indices and American knee society (KSS) knee scores were assessed. **Results:** Sixty-five patients were involved in the study and the follow-up time was 180 days. The skin temperature of both knees and were at their highest on Day 5; PCT, CRP, ESR were at their highest on Day 3; IL-6, WBC were at their highest on Day 1; HGB dropped to the lowest level on Day 5 to 7. The differential skin temperature and the skin temperature of operated knee didn't returned to preoperative values by Days 180, while the skin temperature of contralateral knees was approximately at preoperative values by Days 30. PCT, IL-6, CRP returned back to preoperative levels by Days 60, ESR returned back to preoperative level by Days 90, and WBC returned back to preoperative levels by Days 15. **Conclusions:** After TKA, the differential skin temperature of the patients with KOA increased quickly, then decreased gradually, it was still higher than the preoperative level until 6months post-TKA, while these serum indices in the study returned back to preoperative levels by 3 months.

Key words: Total knee arthroplasty; Temperature of knee skin; Serum indices; Knee joint function

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前言

膝骨性关节炎(knee osteoarthritis, KOA)是一种以膝关节软骨退行性改变及继发性骨质增生为特点的慢性关节疾病,多见于中老年人群,且女性发病率高于男性^[1]。而全膝关节置换术(total knee arthroplasty, TKA)则是治疗终末期膝骨性关节炎的一项成功技术。KOA患者在行TKA术后,由于生理性炎症反

应,膝关节局部皮温均会升高,但升高的幅度大小与持续的时间长短差异较大。假体周围感染是TKA术后一项严重的并发症,而患膝术后皮温异常升高往往是其典型临床表现之一。因此,临床上判断TKA术后患膝皮温升高是正常生理性炎症反应引起还是假体周围感染导致,显得尤为重要^[2-4]。很多国内外学者对该问题进行过相关研究,但未得到一致的结论。患者TKA术后患膝皮温升高是否是生理性的,皮温升高与血清学

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指标的变化之间是否存在相关性,还有待于进一步研究^[5-7]。

本研究拟收集在我院行全膝关节置换术的 KOA 患者的基本信息、手术前后膝关节局部皮温、血清指标、功能评分等数据,并对其进行统计学分析,进而明确 TKA 术后未发生感染的 KOA 患者膝关节局部皮温、血清指标的变化规律以及与膝关节功能恢复之间的相关性,从而为临床上判断 TKA 术后膝关节皮温升高是否为生理性所致以及通过测量膝关节皮温来预测膝关节功能恢复提供一定的参考。

1 材料与方法

1.1 研究对象及仪器设备

1.1.1 研究对象 将 2016 年 9 月-2017 年 3 月在我院接受初次单膝关节置换术的骨性关节炎患者作为研究对象,所有患者均签署知情同意书。

1.1.2 纳入与排除标准 纳入标准:(1)符合膝骨性关节炎诊断标准;(2)双膝关节既往无开放手术或者骨折的病史;(3)患侧股四头肌肌力 IV-V 级;(4)同组医师按同一标准手术流程进行手术;(5)术中未行髌骨置换;(6)术后切口及全身无感染现象,术后 21 天常规拆线;(7)同意参加研究。

排除标准:(1)类风湿性关节炎;(2)严重的基础疾病(如肾、心脏衰竭,中风后遗症,肿瘤,严重贫血,肝硬化,甲状腺功能亢进,自身免疫性疾病,糖尿病等);(3)随访资料不完整或随访不足 6 个月;(4)住院期间或随访中发生关节内感染、不明原因的关节僵硬、异位骨化、下肢深静脉血栓或其他影响功能恢复的并发症。

1.1.3 仪器设备 皮温测量使用便携式红外测温仪(Optris MS-B, Germany),检测范围:30.0℃-50.0℃;分辨率:0.10℃;重复精度:0.20℃。

1.2 手术方法及术后处置

术前常规备皮。麻醉方式选择腰硬联合麻醉。切开皮肤前 30 分钟至 2 小时内给予头孢唑林钠 2.0 g 静脉滴注以预防感染。切开皮肤前患肢上止血带,由术者依据患者 BMI 情况设置止血带压力,范围为 45-50 kPa,止血带时间不超过 1 小时。取膝关节前正中切口,髌内侧入路,常规截骨,高压脉冲冲洗伤口,安放股骨及胫骨假体,活动膝关节,见膝关节稳定,可伸直,屈曲可达 120 度。生理盐水冲洗伤口,高压脉冲反复冲洗,放置引流管一根,喷洒氨甲磺酸 1 g,于屈曲 90 度体位关闭切口,无菌敷贴覆盖。手术时间不超过 70 分钟。

术后常规使用 3 天头孢唑林钠 2.0 g 以预防感染,使用 2 周利伐沙班 10 mg 预防血栓形成;手术结束后即对手术侧膝关节行冷疗 24 小时;术后第一天拔除引流管后即指导患者使用 CPM 机进行功能锻炼,每天 2 次,并部分负重下短距离行走;术后第二天开始指导患者行患膝功能锻炼,每天 3 次;每次 CPM 机功能锻炼及人工锻炼结束后行冷疗 30 分钟;定期换药,术后 21 天常规拆线。

1.3 数据采集

1.3.1 基本信息的采集 登记患者的基本信息(年龄、性别、身高、体重等)以及术中止血带使用时间、手术时间、假体型号等信息,并分别对患者术前及术后 6 个月进行美国膝关节协会评分(American knee society knee score, KSS 评分)并记录。

1.3.2 皮温的采集 分别以经髌骨上、下缘的水平线及经髌骨内外缘的垂线为界限,将膝关节分为 9 个区域(见图 1)。

分别于患者术前 1 天和术后第 1、3、5、7、15、30、60、90、180 天的 8 时、12 时、16 时、20 时测量患者双膝关节 9 个区域的皮肤温度。测量之前,让患者双膝关节屈曲 90 度坐于室内温度在 25.0±1.0℃、湿度在 50.0%±10.0%的环境中,双下肢暴露 20-30 分钟后,使用红外测温仪距离皮肤 0.5 cm 处测量双膝关节 9 个区域皮温(见图 2),取监测日期的四个时间点 9 个区域皮温的均值作为一个独立数据,并记录^[2]。

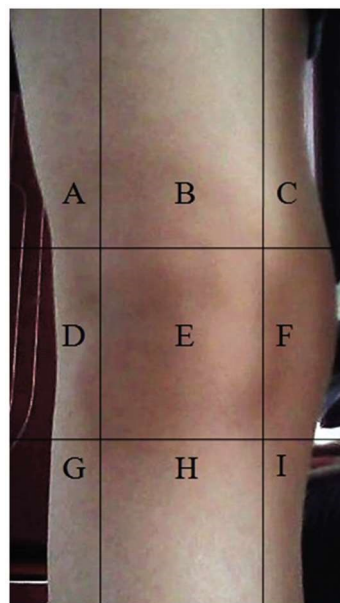


图 1 膝关节皮温测量区域示意图

Fig.1 The areas of knee skin temperature measurement

1.3.3 血清指标的采集 分别于每次监测日期(患者术前 1 天和术后第 1、3、5、7、15、30、60、90、180 天)的早晨 6 时抽取血液标本,统一送至西京医院检验科进行检验,检验项目包括:血常规、降钙素原组合、血沉、C 反应蛋白,记录患者检验单中的白细胞(White blood cell, WBC)、中性粒细胞单核细胞比(Neutrophil monocyte ratio, NLR)、血红蛋白(Hemoglobin, HGB)、降钙素原(Procalcitonin, PCT)、白介素-6(Interleukin-6, IL-6)、血沉(Erythrocyte sedimentation rate, ESR)、C 反应蛋白(C-reactive protein, CRP)等结果。

1.4 数据处理

使用统计软件 SPSS 19.0 对实验数据进行统计学分析,采用配对样本 t 检验对不同时间各项指标的数据进行分析,采用两独立样本单向 t 检验对两试验组指标进行统计分析,计量资料用均数±标准差($\bar{x} \pm s$)表示,P=0.05 作为检验水准。

2 结果

本研究共收集 65 例(其中男性病人 16 例,女性病人 49 例),在每次随访过程中,结合患者临床症状、体征、影像学资料及血清检查结果,无明显异常时,则排除假体周围感染。本研究中的 65 例患者在术后 6 月的随访过程中均排除假体周围感染。患者基本信息见表 1。

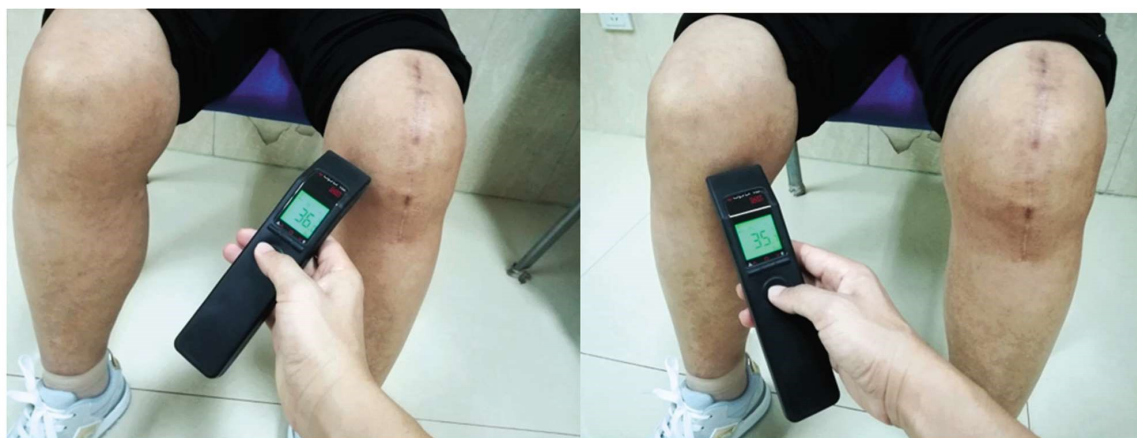


图2 膝关节皮温测量方法

Fig.2 The measurement of knee skin temperature

表1 患者基本信息(n=65)

Table 1 Basic information of patients

Independent variable	Age(years)	Height(cm)	Weight(kg)	BMI(kg/m ²)	Tourniquet time (minute)	Operation time (minute)
variation range	49-82	147-182	50-93	20.31-34.16	45-55	55-65
Mean± SD	67.2± 9.1	161± 6.6	67.08± 9.37	25.96± 2.89	51.2± 3.36	60.2± 2.94

对手术前后的相关指标进行配对 t 检验分析,结果发现:1. 患者膝关节髌骨内下区是膝皮温及双膝皮温差最高的区域,而膝关节中央区是皮肤温度最低的区域(数据未显示);2.患者双膝皮温、双膝皮温差于术后第 5 天达到峰值,非手术侧膝关节皮温于术后 30 天恢复至术前水平,而手术侧膝关节皮温及双膝皮温差直至本研究结束仍未恢复至术前水平,见表 2 及图

3-4;3.患者血 PCT、CRP、ESR 均于术后第 3 天达到峰值,IL-6、WBC 于术后第 1 天达到峰值,HGB 下降至最低水平为术后 5-7 天;PCT、IL-6、CRP 于术后 60 天恢复至术前水平,ESR 于术后 90 天恢复至术前水平,WBC 于术后 15 天恢复至术前水平,见表 2 及图 5。此外,研究发现 NLR 术后水平与术前相比,无显著性差异($P>0.05$)。

表2 患者 TKA 术前及术后的膝关节皮温、皮温差、血清指标

Table 2 Values of knee skin temperature and serum indices before and for 6 months following total knee arthroplasty(TKA) (n=65)

Independent variable	Preop	Postoperative time-points									
		1	3	5	7	15	30	60	90	180	
Operated knee (°C)	34.71± 0.33	36.72± 0.52	37.26± 0.44	37.55± 0.38	37.35± 0.38	36.96± 0.33	36.52± 0.30	36.14± 0.30	35.80± 0.36	35.43± 0.30	
Contralateral knee (°C)	34.67± 0.31	35.26± 0.30	35.45± 0.27	35.66± 0.29	35.47± 0.27	35.06± 0.27	34.73± 0.27	34.65± 0.26	34.58± 0.27	34.58± 0.25	
Differential (°C)	0.04± 0.18	1.47± 0.48	1.81± 0.40	1.89± 0.39	1.87± 0.44	1.82± 0.36	1.74± 0.37	1.49± 0.36	1.22± 0.38	0.86± 0.30	
PCT (ng/mL)	0.030± 0.096	0.086± 0.087	0.379± 0.150	0.291± 0.131	0.181± 0.100	0.126± 0.135	0.057± 0.080	0.031± 0.013	0.032± 0.011	0.028± 0.012	
IL-6 (pg/mL)	3.98± 1.38	86.71± 37.35	74.85± 33.43	61.70± 25.96	52.20± 22.43	36.65± 16.49	16.16± 8.45	6.30± 5.40	4.46± 2.37	4.05± 1.61	
CRP (mg/mL)	1.15± 1.10	17.30± 8.62	77.66± 39.95	63.25± 32.70	41.51± 24.44	20.92± 12.95	5.68± 4.99	1.11± 0.56	1.15± 0.61	1.27± 0.51	
ESR (mm/hr)	12.21± 6.39	23.68± 9.52	66.14± 12.89	61.82± 11.70	55.17± 11.56	43.28± 10.34	27.47± 8.29	19.31± 6.27	13.31± 6.24	13.78± 6.47	
WBC (10 ⁹ /L)	6.14± 1.86	10.78± 2.67	8.92± 2.18	7.85± 1.71	7.13± 2.14	6.33± 1.72	6.50± 1.74	6.39± 1.71	6.35± 1.79	6.38± 1.50	
HGB (g/L)	135.6± 9.1	118.0± 11.1	102.4± 13.5	92.7± 13.2	92.6± 13.7	100.6± 13.5	111.4± 11.8	121.5± 9.8	132.0± 9.7	136.1± 7.8	
NLR	10.55± 3.53	10.80± 2.74	10.56± 3.42	10.42± 3.77	10.20± 3.62	10.91± 3.71	10.51± 3.32	10.24± 3.65	10.98± 3.43	10.73± 3.78	

根据双膝皮温差异幅度大小将患者分为 a 组(皮温差 < 2.0 °C)、b 组(皮温差 ≥ 2.0 °C)。对两组患者年龄、BMI、止血带使用时间、手术时间、术后血清指标以及膝关节评分改善值分别进行两独立样本 t 检验,发现两组间患者年龄、PCT、IL-6、

CRP、ESR、WBC 以及膝关节评分改善值有显著性差异 ($P < 0.05$),而两组间 BMI、止血带使用时间、手术时间、血红蛋白值无显著性差异($P > 0.05$),见表 3。

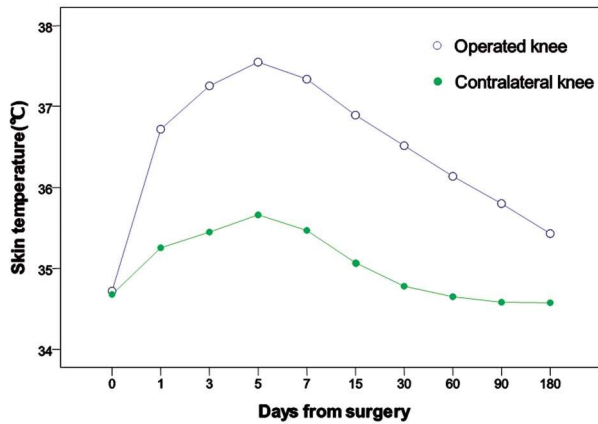


图 3 双膝关节皮温变化趋势

Fig.3 Skin temperature changes of the operated and contralateral knees

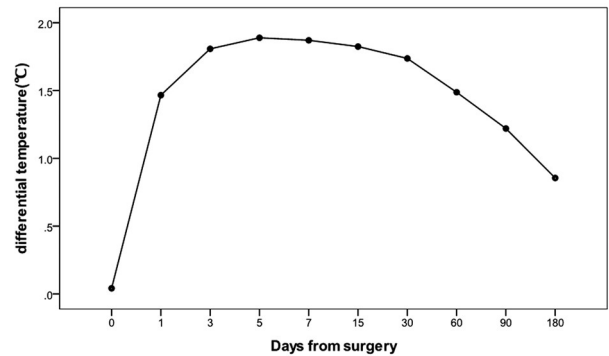


图 4 双膝关节皮温差变化趋势

Fig.4 The differential temperature change of the operated and contralateral knee

3 讨论

全膝关节置换术被认为是 21 世纪最重要的医学突破之一,但存在一些可能会影响临床预后的手术并发症,比如假体周围感染、下肢深静脉血栓形成、假体周围骨折等^[6-9]。据报道,在我国,初次人工全膝关节置换术后的感染率约为 1%~2%,

但感染一旦发生,则可能成为灾难性的并发症^[10-13]。而临床上发现无论感染发生与否,手术侧膝关节皮温均会增高,且持续时间较长。有学者认为,患者在行全膝关节置换术后,由于手术创伤和假体的刺激,导致机体白细胞释放内源性递质、炎细胞浸润,引起膝关节局部毛细血管扩张、血流增快,从而导致膝关节皮温升高^[13-16]。

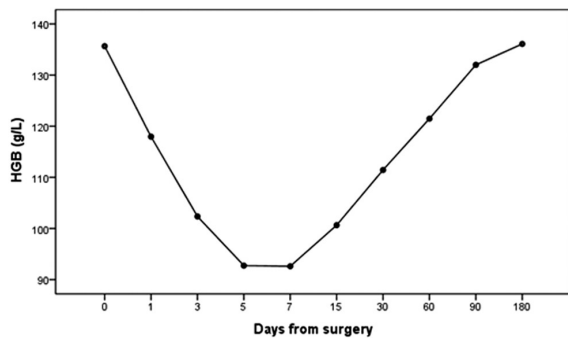
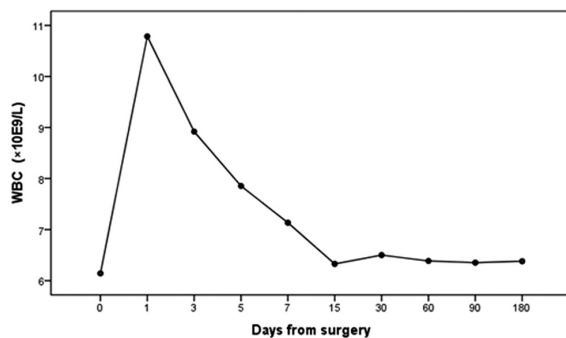


图 5 患者各项血清指标变化趋势

Fig.5 Serum indices changes

Yirong Zeng、Wenjun Feng 等报道的双膝皮温差高峰时间为术后 7 天,高峰值分别约为 2.4 °C,叶奕、庞清江等报道的双膝皮温差高峰时间出现在术后 3 天,高峰值为 2.9 °C。而本研究发现最高值出现在术后 5 天,高峰值平均约为 1.9 °C。本研究中患者在行 TKA 术后的双膝皮温差较以往研究结果偏低,分析认为,随着全膝关节置换技术的改进、手术器械的精进、手术医师经验的累积、围手术期处置的完善,从而减少了手术创伤以及炎性介质的释放,双膝皮温差亦较以往减低。比如,在本研究中,为了减少患膝渗出、减轻患肢肿胀、促进早期康复,我院于患者术后 24 小时内及每次膝关节功能锻炼后,给予患膝冰敷 30 分钟常规冷疗处置;本研究中患者平均手术时间较以往大大缩短;本研究中患者膝关节功能锻炼方法采用 CPM 机辅助锻炼联合人工辅助锻炼,而锻炼强度循序渐进,进而患者锻炼时疼痛程度较以往降低,效果较以往显著提高^[5-7]。与既往

报道相比较,本研究中患者双膝皮温稍高,考虑可能与地区性差异、季节性差异及红外测温仪型号不同有一定的关系。

国外研究发现患者行 TKA 术后 1 年时,手术侧膝关节皮温仍高于对侧或术前水平,分析认为可能是正常炎症反应导致的^[16-18]。本研究发现,双膝皮温差于术后前 5 天内迅速上升,之后缓慢下降,直至 TKA 术后 6 月,患者手术侧膝关节皮温仍高于对侧及术前水平;而患者 PCT、IL-6、CRP、ESR、WBC 水平于术后 1-3 天内迅速升高至最高水平,之后缓慢下降,这与既往研究结果基本一致,考虑可能与手术创伤以及植入物刺激引起的急性炎症反应有关。作者认为,双膝皮温差 TKA 术后 5 天后和(或)上述血清指标术后 3 天后仍呈上升趋势的患者应当引起临床医师的重视,应结合临床症状、影像学检查以及血清指标等资料,排除假体周围感染的可能。此外,本研究组后续拟收集更大样本量的患者进行更长随访时间的观察来探索 6 月后,

甚至 1 年后患者的膝关节皮温变化情况。

表 3 两组病人间的基本信息、血清指标、KSS 评分改善值(n=65)

Table 3 Two groups of patients'values of basic information, serum indices and KSS Score difference between visits(n=65)

Factors	Elevation in differential temperature				P
	Mild (n=37)		Severe (n=28)		
	Mean	SD	Mean	SD	
Differential skin temperature (°C)	1.6	0.24	2.3	0.20	<0.01
Age (years)	63.2	7.91	72.4	7.79	<0.01
BMI (kg/m²)	25.5	2.93	26.6	2.77	0.11
Tourniquet time (minute)	51.4	3.34	50.9	3.43	0.60
Operation time (minute)	60.4	2.76	60.0	3.19	0.59
PCT (ng/mL)	0.321	0.119	0.455	0.154	<0.01
IL-6 (pg/mL)	71.86	33.39	106.33	33.44	<0.01
CRP (mg/mL)	62.70	32.61	97.43	40.66	<0.01
ESR (mm/hr)	61.54	11.65	72.21	12.06	<0.01
WBC (10 ⁹ /L)	10.21	2.64	11.55	2.56	0.04
HGB (g/L)	94.05	13.98	90.71	13.22	0.33
KSS Score difference between visits	74.81	10.05	58.71	14.23	<0.01

通过对依据双膝皮温差异大小分成的 a、b 两组间各项指标进行两独立样本单侧 t 检验发现:皮温差较高的 b 组患者的年龄、PCT、IL-6、CRP、ESR、WBC 也较高, b 组患者 KSS 评分改善值较 a 组偏低;而两组间 BMI、止血带使用时间、手术时间、血红蛋白值无明显差异^[9,19-21]。作者推测,TKA 术后双膝皮温差值较高者,可能预示着患者 PCT、IL-6、CRP、ESR、WBC 水平也较高,而膝关节功能恢复则可能较双膝皮温差值低者差一些。因为本研究仅仅是一项初步的探索性研究,因此,需要后续更加深入、更加严密的实验来论证或者推翻上述推测。

KOA 患者在行全膝人工关节置换术后,膝关节皮温及血清指标均处于动态变化的过程,本研究通过监测各项指标并对数据进行分析,旨在建立正常情况下 TKA 术后患者的膝关节皮温、血清指标的变化趋势模型。根据变化趋势模型,我们可以对 TKA 术后患膝皮温升高是否为生理性炎症反应所致做出初步判断,并为初步鉴别假体周围感染提供一定的参考价值。此外,结合患者的临床症状、影像学资料,同时再动态监测患者的膝关节皮温及血清指标,或将更加有助于假体周围感染的诊断或者排除^[5-7,20]。

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