

超声 PENG 阻滞在老年患者 TKA 中的应用价值及对术后舒适度的影响

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[摘要] **目的** 探讨超声引导下髌关节囊周围神经(ultrasound-guided pericapsular nerve block, PENG)阻滞在老年全膝关节置换术(total knee arthroplasty, TKA)中的应用效果。**方法** 选取在江苏省南通市中医院和南通大学附属医院治疗的 TKA 患者 120 例, 采用信封法将患者分为观察组($n=60$)和对照组($n=60$), 观察组给予超声引导下 PENG 阻滞复合全身麻醉, 对照组给予全身麻醉, 观察 2 组麻醉效果等。**结果** 观察组和对照组手术时间、术中出血量和麻醉时间比较差异无统计学意义($P>0.05$); 2 组平均动脉压(mean arterial pressure, MAP)、收缩压(systolic pressure, SBP)、舒张压(diastolic pressure, DBP)、心率(heart rate, HR)在时点间与组间·时点间交互作用方面比较差异有统计学意义($P<0.05$), 在组间比较差异无统计学意义($P>0.05$)。2 组血氧饱和度(blood oxygen saturation, SpO₂)_{在组间、时点间、组间·时点间方面差异均无统计学意义($P>0.05$)。2 组疼痛 VAS 评分、舒适度视觉模拟(visual analogue scores, VAS)评分在组间、时点间、组间·时点间交互作用方面比较差异有统计学意义($P<0.05$)。观察组心动过缓和低血压发生率为 0.00% 和 1.67%, 明显低于对照组($P<0.05$)。**结论** 超声引导下 PENG 阻滞在老年 TKA 中有较好的应用效果, 具有术后疼痛轻、舒适度好等优点。}

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The application value of ultrasound-guided PENG block in elderly patients with TKA and its impact on postoperative comfort

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[Abstract] **Objective** To investigate the application effect of ultrasound-guided pericapsular nerve group (PENG) block in elderly patients undergoing total knee arthroplasty (TKA). **Methods** A total of 120 patients with TKA who were treated in our hospital and the Affiliated Hospital of Nantong University were selected and divided into the observation group ($n=60$) and the control group ($n=60$) by envelope method. The observation group was given ultrasound-guided PENG block and general anesthesia, and the control group was given general anesthesia, to observe the anesthesia effects of the two groups. **Results** There was no significant difference between the observation group and the control group with respect to duration of operation, intraoperative bleeding and anesthesia time ($P>0.05$). There was a significant difference in the interaction between time points and time points between groups in terms of mean

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arterial pressure (MAP), systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) between the two groups ($P < 0.05$), while there was no significant difference between groups ($P > 0.05$). There was no significant difference in interaction between groups, time points and time points between groups with respect to blood oxygen saturation (SpO_2) ($P > 0.05$). There was a significant difference in interaction between groups, time points and time points between groups in terms of visual analogue scale (VAS) score for pain and comfort. **Conclusion** Ultrasound-guided PENG block has a good application effect in elderly TKA, with the advantages of less postoperative pain, and good comfort.

[Key words] arthroplasty, replacement, knee; ultrasound guidance; elderly

全膝关节置换术 (total knee arthroplasty, TKA) 是临床治疗膝关节疾病晚期的常用术式^[1]。目前老年 TKA 常用的麻醉方法为全身麻醉, 但仍有部分患者术中麻醉深度不足, 而盲目增加全身麻醉药物使用量又会增加呼吸抑制、寒颤、认知障碍等麻醉并发症风险^[2]。外周神经阻滞是全身麻醉的重要补充, 可减轻机体应激反应。髋关节囊周围神经阻滞 (hip joint capsule peripheral nerve block, PENG) 可有效阻断手术切口位置的痛觉传导, 抑制中枢敏化^[3]。有研究认为超声引导下实施 PENG 可减少全身麻醉药物使用剂量, 具有良好的辅助镇痛作用^[4]。本研究探讨超声引导下 PENG 阻滞在老年 TKA 中的应用效果。

在江苏省南通市中医院和南通大学附属医院治疗的 TKA 患者 120 例, 纳入标准: ①因膝关节骨性关节炎在我院行 TKA 治疗; ②单侧病变; ③无外周神经阻滞禁忌证; ④符合美国麻醉师协会 (American Society of Anesthesiologists, ASA) 分级 II ~ III 级^[5]; ⑤患者及家属知情同意。排除标准: ①有精神疾病及认知功能障碍; ②有药物等滥用史; ③合并有恶性肿瘤、凝血功能障碍、免疫系统疾病等其他严重疾病。采用信封法将患者分为观察组 ($n = 60$) 和对照组 ($n = 60$), 2 组临床一般资料比较差异无统计学意义 ($P > 0.01$), 见表 1。

本研究获得医院伦理委员会批准 (20179283)。

1 资料与方法

1.1 一般资料 选取 2018 年 1 月—2022 年 12 月

表 1 2 组临床一般资料比较

Table 1 Comparison of clinical general information between the two groups

($n = 60$)

组别	性别(例数, %)		年龄($\bar{x} \pm s$, 岁)	体重指数 ($\bar{x} \pm s$)	ASA 分级(例数, %)	
	男性	女性			II	III
观察组	38(63.33)	22(36.67)	66.69 ± 8.82	22.15 ± 2.03	37(61.67)	23(38.33)
对照组	40(66.67)	20(33.33)	65.18 ± 9.10	22.06 ± 1.98	35(58.33)	25(41.67)
χ^2/t 值	0.147		0.923	0.246	0.139	
P 值	0.702		0.358	0.806	0.709	

1.2 手术及麻醉方法 对照组给予全身麻醉, 术前禁食禁饮, 入室后连接心电监护。麻醉诱导: 依次静脉注射咪唑啉 0.02 mg/kg, 芬太尼 2.5 μ g/kg, 依托咪酯 0.1~0.2 mg/kg, 顺式阿曲库铵 0.2 mg/kg。行气管插管机械通气。术中麻醉维持: 吸入 1%~2% 七氟醚, 静脉输注瑞芬太尼 0.05~0.2 μ g · kg⁻¹ · min⁻¹ 维持麻醉深度, 维持脑电双频指数 (bispectral index, BIS) 45~55。间断注射顺式阿曲库铵 3~4 mg 维持肌松弛。术毕于髌骨外侧窝内放置引流管, 缝合切口后加压包扎。

观察组给予超声引导下 PENG 阻滞复合全身

麻醉, 首先行 PENG 阻滞, 患者取仰卧位, 常规消毒、铺巾, 将低频超声探头 (2~5 MHz) 放置于髌前下棘部位, 与腹股沟韧带平行。将针头与皮肤呈 45° 刺入, 针尖至腰大肌下方和耻骨之间时, 注入无菌生理盐水 1 mL, 超声确认生理盐水在耻骨表面扩散后, 回抽无血注入 0.4% 盐酸罗哌卡因 20 mL。将高频超声探头 (6~13 MHz) 横向放置于髌前上棘下方, 在缝匠肌表面外侧注入 0.4% 盐酸罗哌卡因 5 mL。如局部感觉及运动功能减弱, 提示阻滞成功, 退出针芯。30 min 之后再行全身麻醉, 全身麻醉方法同对照组。

1.3 观察指标及判定方法 ①比较2组手术时间、术中出血量和麻醉时间;②比较2组不同时间点血流动力学参数,2组入室后均连接心电监护,仪器为深圳迈瑞医疗电子股份有限公司PM-9000心电监护仪,于麻醉前(T₀)、麻醉后5 min(T₁)、麻醉后30 min(T₂)和术毕(T₃)时记录患者收缩压(systolic pressure, SBP)、舒张压(diastolic pressure, DBP)、心率(heart rate, HR)和血氧饱和度(Blood oxygen saturation, SpO₂),平均动脉压(mean arterial pressure, MAP) = DBP + 1/3(SBP - DBP);③采用视觉模拟评分法(visual analogue scale, VAS)^[6]评估患者疼痛及舒适度情况,分数0~10,疼痛VAS评分分数越高,则表明患者疼痛越严重,舒适度VAS评分分数越高,则表明患者舒适度越好;④对比2组不良反应发生情况,包括心动过缓、低血压、恶心呕吐、头痛和寒颤的发生率。

1.4 统计学方法 应用SPSS 22.0统计软件分析数据。计量资料比较采用 t 检验或重复测量方差分析;计数资料比较采用 χ^2 检验。 $P < 0.05$ 为差异有统计学意义。

表3 2组不同时间点血流动力学参数比较

Table 3 Comparison of hemodynamic parameters at different time points between the two groups

(n=60, $\bar{x} \pm s$)

组别	MAP(mmHg)				SBP(mmHg)			
	T ₀	T ₁	T ₂	T ₃	T ₀	T ₁	T ₂	T ₃
观察组	98.87±11.03	84.69±12.11	93.31±10.06	97.15±11.17	135.41±8.82	126.65±9.10	131.55±9.03	134.40±9.00
对照组	98.12±10.84	83.36±11.41	93.10±9.81	96.68±12.11	135.18±8.90	127.13±9.06	132.20±9.41	133.39±8.15
组间		F 值=1.622	P 值=0.554			F 值=1.781	P 值=0.495	
时点间		F 值=5.544	P 值<0.001			F 值=6.689	P 值<0.001	
组间·时点间		F 值=7.715	P 值<0.001			F 值=8.103	P 值<0.001	
组别	DBP(mmHg)				HR(次/min)			
	T ₀	T ₁	T ₂	T ₃	T ₀	T ₁	T ₂	T ₃
观察组	91.15±6.69	83.31±7.10	87.71±7.06	90.06±6.80	76.65±11.15	70.65±10.85	63.36±9.95	75.45±12.03
对照组	92.00±6.73	84.00±7.06	87.12±6.95	89.98±7.11	76.18±10.08	71.14±9.96	64.10±9.81	74.43±11.83
组间		F 值=1.882	P 值=0.443			F 值=1.322	P 值=0.618	
时点间		F 值=6.901	P 值<0.001			F 值=7.111	P 值<0.001	
组间时点间		F 值=7.954	P 值<0.001			F 值=8.654	P 值<0.001	
组别	SpO ₂ (%)							
	T ₀	T ₁	T ₂	T ₃				
观察组	98.89±2.03	98.12±1.97	98.35±2.00	98.10±1.91				
对照组	98.95±1.99	98.03±2.01	98.18±1.95	98.22±2.00				
组间		F 值=0.662	P 值=0.884					
时点间		F 值=0.811	P 值=0.726					
组间·时点间		F 值=1.703	P 值=0.512					

1 mmHg=0.133 kPa

2.3 2组术后疼痛及舒适度情况比较 2组疼痛VAS评分、舒适度VAS评分在组间、时点间、组间·时点间交互作用方面比较差异有统计学意义($P < 0.05$)。见表4。

2 结果

2.1 2组手术时间等指标比较 观察组和对照组手术时间、术中出血量和麻醉时间比较差异无统计学意义($P > 0.05$)。见表2。

表2 2组手术时间等指标比较

Table 2 Comparison of duration of operation and other indicators between the two groups

(n=60, $\bar{x} \pm s$)

组别	手术时间(min)	术中出血量(mL)	麻醉时间(min)
观察组	112.54±22.62	450.54±98.89	94.43±16.61
对照组	118.81±20.51	446.61±92.20	97.70±15.53
t 值	1.591	0.225	1.114
P 值	0.114	0.822	0.268

2.2 2组不同时间点血流动力学参数比较 2组MAP、SBP、DBP、HR在时点间与组间·时点间交互作用方面比较差异有统计学意义($P < 0.05$),在组间比较差异无统计学意义($P > 0.05$)。2组SpO₂在组间、时点间、组间·时点间交互作用方面差异均无统计学意义($P > 0.05$)。见表3。

2.4 2组不良反应比较 观察组心动过缓和低血压发生率明显低于对照组($P < 0.05$);观察组和对照组恶心呕吐、头痛及寒颤发生率比较差异无统计学意义($P > 0.05$)。见表5。

表4 2组术后疼痛及舒适度VAS评分情况比较

Table 4 Comparison of VAS scores for postoperative pain and comfort between the two groups

(n=60, $\bar{x} \pm s$, 分)

组别	疼痛 VAS 评分			舒适度 VAS 评分		
	术后 6 h	术后 12 h	术后 24 h	术后 6 h	术后 12 h	术后 24 h
观察组	3.84±0.94	2.89±0.81	2.23±0.90	4.45±0.86	5.41±0.95	7.22±1.00
对照组	4.51±0.83	3.70±0.85	2.50±0.82	3.89±0.81	4.53±0.88	6.96±0.98
组间	F 值=6.554 P 值<0.001			F 值=5.382 P 值<0.001		
时点间	F 值=6.021 P 值<0.001			F 值=6.011 P 值<0.001		
组间·时点间	F 值=14.921 P 值<0.001			F 值=11.321 P 值<0.001		

表5 2组不良反应比较

Table 5 Comparison of adverse reactions between the two groups

(n=60, 例数, %)

组别	恶心呕吐	头痛	心动过缓	低血压	寒颤
观察组	1(1.67)	1(1.67)	0(0.00)	1(1.67)	2(3.33)
对照组	3(5.00)	5(8.33)	6(10.00)	8(13.33)	0(0.00)
χ^2 值	0.259	1.579	4.386	4.324	0.508
P 值	0.611	0.209	0.036	0.038	0.476

3 讨 论

TKA 是临床治疗膝关节骨性关节炎、类风湿性关节炎、创伤性关节炎等疾病晚期的首选方法,近年来其临床应用越来越广泛,技术也日益成熟^[7-8]。由于上述膝关节疾病好发于老年人,而老年患者机体各器官、各系统功能发生生理性退变、合并疾病多,对 TKA 手术的耐受性较差,因此在对老年患者实施 TKA 治疗时一般首选全身麻醉^[9-10]。但在实际工作中发现,部分患者术中易发生体动、术中知晓,不利于手术的顺利实施,术后还易出现神经衰弱、反复噩梦、惊恐障碍。如果通过追加全身麻醉药物的剂量进行处理,患者易出现呼吸抑制、寒颤、术后认知障碍等多种麻醉并发症,增加围术期安全风险^[11-12]。神经阻滞是通过阻滞该神经支配区域内感觉神经与运动神经兴奋性传导而产生镇痛作用,以确保围术期安全^[13-14]。PENG 阻滞是一种下肢局部镇痛新技术,可阻断支配下肢感觉神经的分支而产生局部镇痛作用。该方法已在下肢骨折、髋关节置换术等手术治疗领域有所应用^[15-16]。

术中疼痛是由手术操作损伤膝关节周围软组织、神经所致。良好的麻醉应能获得良好的镇痛镇静效果,以维持术中血流动力学指标稳定。本研究发现,采用超声引导下 PENG 阻滞复合全身麻醉者麻醉起效时间明显快于采用单纯全身麻醉者;2 组手术时间、术中出血量、麻醉时间以及麻醉效果比较差异无统计学意义。2 组 T0、T1、T2 和 T3 时 MAP、SBP、DBP、HR 和 SpO₂ 比较差异无统计学意义。这一结果提示,超声引导下 PENG 阻滞复合全身麻醉和单纯全身麻醉在老年 TKA 中均具有良

好的应用效果,可维持围术期血流动力学指标稳定,其中超声引导下 PENG 阻滞麻醉起效更快。这是由于 2 组在术中均采用 BIS 值来判断麻醉深度,可通过追加全身麻醉药物维持理想的麻醉深度,因此两种麻醉方案均具有良好的麻醉效果。其中超声引导下 PENG 阻滞复合全身麻醉方案在术前进行局部神经阻滞,可阻滞相关区域内交感神经,促进血管扩张,可促进全身麻醉药物发挥疗效。全身麻醉的中枢镇痛机制是阻止痛觉信号的传导。PENG 技术主要阻滞髋关节的感觉神经,主要由股神经、闭孔神经、副闭孔神经支配,主要分布于髋关节囊的前方、外侧和内侧。PENG 阻滞时将针头刺入至腰大肌下方和耻骨之间时,注入局麻药物可减弱或消除局部感觉及运动功能。

TKA 手术创伤较大,术后疼痛剧烈,不仅给患者造成巨大的痛苦,还会影响睡眠、进食和术后康复训练,继而影响患者术后膝关节功能恢复^[17-18]。本研究发现,采用超声引导下 PENG 阻滞复合全身麻醉者术后 6 h 和 12 h 时疼痛 VAS 评分明显低于采用单纯全身麻醉者;术后 6 h 和 12 h 时舒适度 VAS 评分明显高于采用单纯全身麻醉者,这一结果提示,在老年 TKA 中应用超声引导下 PENG 阻滞可更好地缓解术后疼痛、提高舒适度。这是由于超声引导下 PENG 阻滞可阻断股外侧皮神经支配的下肢痛觉信号传导,在超声引导下操作可更加清晰地观察和精准操作,确保局麻药物扩散,而产生良好的局部镇痛效果,从而降低患者疼痛程度、提高患者舒适度。

老年患者常存在心肺功能储备差、动脉粥样硬化等基础病变,血管舒缩调节功能相对较弱^[19-20]。大量的全身麻醉药物静注后会引引起血管扩张,易导致术中低血压、心动过缓等麻醉不良反应,甚至引起心脑血管不良事件^[21-25]。本研究发现,采用超声引导下 PENG 阻滞复合全身麻醉者心动过缓和低血压发生率明显低于采用单纯全身麻醉者。这一结果提示,在老年 TKA 中应用超声引导下 PENG 阻滞具有更好的安全性。这是由于超声引导下 PENG 阻滞辅助全身麻醉可取得更好的镇痛效果,从而减少全身麻醉药物的使用量,因此可降低因全身麻醉

药物引起的麻醉并发症。

综上所述,超声引导下 PENG 阻滞在老年 TKA 中有较好的应用效果,具有麻醉起效快、术后疼痛轻、舒适度好等优点。

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