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经皮穴位电刺激对老年髋关节置换术患者脑氧代谢 以及术后认知功能、镇痛效果的影响*

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摘要 目的:探讨经皮穴位电刺激(TEAS)对老年髋关节置换术患者脑氧代谢以及术后认知功能、镇痛效果的影响。**方法:**选取2016年1月~2018年7月期间我院收治的行髋关节置换术患者91例为研究对象,将研究对象根据随机数字表法分为对照组(n=45)和研究组(n=46),对照组给予常规麻醉处理,研究组在对照组基础上给予TEAS,比较两组脑氧代谢、术后认知功能以及镇痛效果,记录两组术后的不良反应发生情况。**结果:**在降压开始后20 min(T_1)、降压开始后40 min(T_2)、停止降压后20 min(T_3)时间点时,两组静脉血氧含量(C_{jvO_2})较降压前即刻(T_0)时间点升高,且研究组高于对照组($P<0.05$),两组脑动-静脉血氧含量差($Da-jvO_2$)、脑氧摄取率($CERO_2$)较 T_0 时间点降低,且研究组低于对照组($P<0.05$)。两组患者术后72h简易智能量表(MMSE)评分均较术前24h降低,但研究组高于对照组($P<0.05$),研究组术后认知功能障碍(POCD)发生率低于对照组($P<0.05$)。与术前比较,两组患者术后8h、术后24h、术后48h视觉疼痛模拟量表(VAS)评分均升高($P<0.05$),但研究组术后8h、术后24h、术后48h等时间点VAS评分均低于对照组($P<0.05$)。两组患者不良反应总发生率比较无差异($P>0.05$)。**结论:**TEAS对老年髋关节置换术后患者的镇痛效果确切,可有效改善脑氧代谢情况,提高术后认知功能,临床应用价值较高。

关键词:经皮穴位电刺激;老年;髋关节置换术;脑氧代谢;认知;镇痛

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Effect of Transcutaneous Electrical Acupoint Stimulation on Cerebral Oxygen Metabolism, Postoperative Cognitive Function and Analgesic Effect in Elderly Patients Undergoing Hip Replacement*

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ABSTRACT Objective: To investigate the effect of transcutaneous electrical acupoint stimulation (TEAS) on cerebral oxygen metabolism, postoperative cognitive function and analgesic effect in elderly patients undergoing hip replacement. **Methods:** 91 patients who underwent hip replacement in our hospital from January 2016 to July 2018 were selected as the research subjects. The subjects were randomly divided into control group (n=45) and research group (n=46) according to the digital table method. The control group was given routine anesthesia and the research group was given TEAS on the basis of the control group. The cerebral oxygen metabolism, postoperative cognitive function and analgesic effect were compared between the two groups, and the occurrence of adverse reactions in the two groups was recorded. **Results:** The venous blood oxygen content (C_{jvO_2}) increased at 20 minutes after the onset of hypotension (T_1), 40 minutes after the onset of hypotension (T_2) and 20 minutes after the cessation of hypotension (T_3), and the research group was higher than the control group ($P<0.05$). The cerebral arterial venous oxygen content difference ($Da-C_{jvO_2}$) and cerebral extraction rate of oxygen ($CERO_2$) of the two groups was lower than that at T_0 time points, and that of the research group was lower than that of the control group ($P<0.05$). The Mini-Mental state examine (MMSE) scores at 72 hours after operation in both groups were lower than those at 24 hours before operation, but those in the research group were higher than those in the control group ($P<0.05$). Postoperative cognitive dysfunction (POCD) in the research group was lower than that in the control group ($P<0.05$). Compared with those before operation, the visual analogue scale (VAS) scores of the two groups increased at 8 hours, 24 hours and 48 hours after operation ($P<0.05$). However, the VAS scores of the research group at 8 hours, 24 hours and 48 hours after operation were lower than those of the control group ($P<0.05$). There was no significant difference in the total incidence of adverse reactions between the two groups ($P>0.05$). **Conclusions:** TEAS has a definite analgesic effect on elderly patients undergoing hip replacement. It can effectively improve cerebral oxygen metabolism and cognitive function, and it has a high clinical application value.

Key words: Transcutaneous electrical acupoint stimulation; Elderly; Hip replacement; Cerebral oxygen metabolism; Cognitive

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前言

髋关节置换术是人工关节置换术中的一种,历经多年的实践,该手术已在临床上广泛运用,并已发展成为可靠的治疗手段^[1,2]。髋关节置换术作为有创手术,术后早期疼痛可能会引发较为严重的并发症,此外,老年髋关节置换术患者常与多种基础疾病合并,其机体代偿能力较弱,在经历手术及麻醉等多种因素影响下,易出现脏器缺氧、缺血等损害作用,尤以中枢神经对缺氧、缺血的反应最为敏感,所以在经髋关节置换术后进行有效的镇痛、积极的脑保护具有重要的临床意义^[3-5]。经皮穴位电刺激(Transcutaneous electrical acupoint stimulation, TEAS)是一种新型治疗方法,是将经皮神经电刺激与针灸穴位疗法相结合,可发挥与电针类似的镇痛作用,在缓解患者疼痛、改善临床症状及生活质量等方面效果显著^[6,7]。本研究通过对我院收治的行髋关节置换术的老年患者给予 TEAS,并分析其对患者脑氧代谢、术后认知功能、镇痛效果的影响,以期为临床治疗提供参考。

1 资料与方法

1.1 一般资料

选取 2016 年 1 月~2018 年 7 月期间我院收治的行髋关节置换术患者 91 例为研究对象。纳入标准:(1)均符合手术指征;(2)年龄 ≥ 65 岁;(3)无酗酒史者;(4)均由同一组医师进行手术操作;(5)无长期阿片类药物滥用史者;(6)自愿参与本次研究并签署知情同意书。排除标准:(1)肝、肾以及神经系统功能存在异常者;(2)经穴局部存在皮肤感染者;(3)伴有自身免疫缺陷疾病者;(4)既往有针灸治疗史者;(5)患有精神疾患无法配合本次研究者。将研究对象根据随机数字表法分为对照组($n=45$)和研究组($n=46$),其中对照组男 24 例,女 21 例,年龄 65~82 岁,平均(71.29 ± 2.31)岁;美国麻醉医师协会(American Society of Anesthesiologists, ASA) 分级:I 级 25 例,II 级 20 例;体质量指数 $20.2 \sim 23.8 \text{ kg/m}^2$,平均(21.95 ± 0.38) kg/m^2 。研究组男 22 例,女 24 例,年龄 66~80 岁,平均(72.07 ± 2.53)岁;ASA 分级:I 级 23 例,II 级 23 例;体质量指数 $20.5 \sim 24.1 \text{ kg/m}^2$,平均(21.88 ± 0.42) kg/m^2 。两组患者一般资料比较无差异($P>0.05$)。

1.2 方法

两组患者均行髋关节置换术且采用相同的麻醉方法,术前常规禁饮禁食,入室后采用 Da-tes-Ohmeda 多功能监护仪(芬兰)监测患者心电图、心率、血氧饱和度、血压等,开放静脉通道。麻醉诱导方式如下:静脉注射咪达唑仑(江苏恩华药业股份有限公司,国药准字 H20031037,规格:2 mL : 2 mg) 0.04 mg/kg,舒芬太尼(宜昌人福药业有限责任公司,国药准字:H20054256,规格:5 mL : 250 μg)3~4 $\mu\text{g/kg}$,丙泊酚(Fresenius Kabi Austria GmbH,国药准字:J20130024,规格:50 mL : 0.5 g) 1.0 mg/kg,顺式阿曲库铵(江苏恒瑞医药股份有限公司,国药准字:H20171002,规格:5 mg)0.2 mg/kg,气管插管,行机械通气,

呼吸参数设置如下:潮气量 8~10 mL/kg,呼吸频率 14~16 次/min,呼气末二氧化碳 30~35 mmHg,吸气与呼气比值:1:1.5。麻醉维持:舒芬太尼 5~10 $\mu\text{g/kg} \cdot \text{h}$,吸入 1.5%~2%的七氟烷(河北一品制药股份有限公司,国药准字 H20173156,规格:250 mL)维持麻醉。两组患者均在手术开始 10 min 后控制平均动脉压,快速降低至基础值的 70%。研究组在此基础上联合 TEAS 治疗,具体如下:采用上海华谊医用仪器有限公司生产的穴位神经刺激仪,于麻醉诱导前在百会、双侧的内关以及风池等穴位各粘贴一电极,疏密波设置为 2/100 Hz,刺激强度以患者耐受为宜,峰电流为 8~12 mA,诱导 30 min,刺激持续至手术结束。

1.3 观察指标

分别于降压前即刻(T_0)、降压开始后 20 min(T_1)、降压开始后 40 min(T_2)、停止降压后 20 min(T_3)等时间点采集动脉和颈内静脉球部血样,采用丹麦雷度公司生产的 ABL800 血气分析仪检测动脉血氧饱和度(Saturation of arterial blood oxygen, SaO_2)、颈内静脉球部血氧分压(Saturation of jugular venous oxygen, SjvO_2)、血红蛋白(Hemoglobin, Hb)、动脉血氧分压(Partial pressure of oxygen in artery, PaO_2),根据 Fick 公式计算脑氧代谢指标:动脉血氧含量(Arterial blood oxygen content, CaO_2)、静脉血氧含量(Venous blood oxygen content, CjvO_2)、脑动-静脉血氧含量差(Cerebral arterial venous oxygen content difference, Da-jvO_2)、脑氧摄取率(Cerebral extraction rate of oxygen, CERO_2)。其中 $\text{CjvO}_2 = \text{Hb} \times \text{SjvO}_2 \times 1.38 + \text{PaO}_2 \times 0.003$; $\text{CaO}_2 = \text{Hb} \times \text{SaO}_2 \times 1.38 + \text{PaO}_2 \times 0.003$; $\text{Da-jvO}_2 = \text{CaO}_2 - \text{CjvO}_2$; $\text{CERO}_2 = \text{Da-jvO}_2 / \text{CaO}_2 \times 100\%$ 。于术前 24h、术后 72h 采用简易智能量表(Mini-Mental state examine, MMSE)^[8]对患者认知功能进行评价,若降低 1 个标准差及其以上者则认定为认知功能下降,比较术后认知功能障碍(Postoperative cognitive dysfunction, POCD)发生率。于术前、术后 8h、术后 24h、术后 48h 采用视觉疼痛模拟量表(Visual analogue scale, VAS)评分^[9]对患者镇痛效果进行评价,其中 VAS 评分范围为 0~10 分,0 分为无痛,10 分为难以忍受的疼痛。分数越高,其镇痛效果越差。记录两组患者术后的不良反应。

1.4 统计学方法

采用 SPSS 25.0 统计学软件分析数据,计数资料以%表示,行卡方检验,计量资料以均值 $\pm$ 标准差表示,行 t 检验,检验标准设置为 $\alpha=0.05$ 。

2 结果

2.1 两组患者不同时间点脑氧代谢指标比较

两组患者 T_0 时间点 CaO_2 、 CjvO_2 、 Da-jvO_2 、 CERO_2 比较差异无统计学意义($P>0.05$),两组 T_1 、 T_2 、 T_3 时间点 CaO_2 与 T_0 时间点比较差异无统计学意义($P>0.05$),在 T_1 、 T_2 、 T_3 时间点时,两组 CjvO_2 较 T_0 时间点升高,且研究组高于对照组($P<0.05$),两组 Da-jvO_2 、 CERO_2 较 T_0 时间点降低,且研究组较对照组低

($P<0.05$),见表 1。

表 1 两组患者不同时间点脑氧代谢指标比较($\bar{x}\pm s$)

Table 1 Comparison of cerebral oxygen metabolism indices between two groups at different time points($\bar{x}\pm s$)

Groups	Time points	CaO ₂ (ml/L)	CjvO ₂ (ml/L)	Da-jvO ₂ (ml/L)	CERO ₂ (%)
Control group(n=45)	T ₀	153.25± 16.19	109.73± 12.65	21.76± 1.77	14.20± 0.11
	T ₁	153.92± 17.41	115.54± 13.53*	19.19± 1.55*	9.60± 0.76*
	T ₂	154.37± 18.83	124.27± 17.27*	15.05± 0.78*	7.56± 0.39*
	T ₃	155.13± 16.14	117.73± 15.25*	18.70± 0.45*	9.35± 0.23*
Research group(n=46)	T ₀	154.20± 18.57	109.97± 11.31	22.61± 3.71	14.30± 1.85
	T ₁	154.69± 15.63	123.25± 14.31**	16.06± 0.67**	8.03± 0.34**
	T ₂	155.08± 15.34	132.37± 18.26**	11.61± 1.49**	5.81± 0.75**
	T ₃	155.27± 17.20	129.74± 11.54**	13.05± 2.89**	6.53± 1.45**

Note: compared with T₀,* $P<0.05$; compared with control group, ** $P<0.05$.

2.2 两组患者认知功能比较

术前 24h 两组患者 MMSE 评分比较无差异 ($P>0.05$),术后 72h 两组患者 MMSE 评分均较术前 24h 降低,但研究组高

于对照组 ($P<0.05$),研究组 POCD 发生率低于对照组 ($P<0.05$),详见表 2。

表 2 两组患者认知功能比较

Table 2 Comparison of cognitive function between two groups

Groups	MMSE score (scores)		POCD[n(%)]	
	24 hours before operation	72 hours after operation	Occurrence	Un-occurrence
Control group(n=45)	27.89± 2.21	21.45± 2.23*	21(46.67)	24(53.33)
Research group(n=46)	28.10± 1.96	24.47± 1.46*	12(26.09)	34(73.91)
χ^2/t	0.480	7.659	4.168	
P	0.633	0.000	0.041	

Note: Compared with 24 hours before operation,* $P<0.05$.

2.3 两组患者镇痛效果比较

术前两组患者 VAS 评分比较无差异 ($P>0.05$),与术前比较,两组患者术后 8h、术后 24h、术后 48hVAS 评分均升高($P<$

0.05),但研究组术后 8h、术后 24h、术后 48h 等时间点 VAS 评分均低于对照组 ($P<0.05$),详见表 3。

表 3 两组患者 VAS 评分比较($\bar{x}\pm s$,分)

Table 3 Comparison of VAS scores between two groups($\bar{x}\pm s$, scores)

Groups	Before operation	8 hours after operation	24 hours after operation	48 hours after operation
Control group(n=45)	2.24± 0.61	3.95± 1.01 ^a	5.58± 1.31a	4.64± 0.97a
Research group(n=46)	2.25± 0.54	3.34± 0.85a	4.32± 1.09a	3.97± 0.91a
t	0.083	3.120	4.992	3.399
P	0.934	0.002	0.000	0.001

Note: compared with before operation, ^a $P<0.05$.

2.4 两组患者不良反应比较

对照组患者术后出现 2 例呕吐、1 例躁动、1 例寒战,不良反应总发生率为 8.89%(4/45),研究组术后出现 1 例呕吐、1 例躁动,不良反应总发生率为 4.35%(2/46),两组患者不良反应总发生率比较无差异($\chi^2=0.762$, $P=0.383$)。

髋关节置换术是临床上出血较多的术式,也是手术中疼痛反应较为强烈的一类术式^[10,11]。老年患者行髋关节置换术日益增多,其自身调节能力差,剧烈的疼痛感、应激反应以及紧张焦虑感易引起其他组织器官连续性病变^[12]。其中药物可能会抑制脑血流自身调节能力,引起脑组织缺血、缺氧,影响手术安全^[13]。与此同时,老年人中枢神经系统储备功能下降,手术创伤、应激等情况均可导致神经递质功能损害以及神经系统代谢

3 讨论

性障碍^[14,15]。随着年龄的增加,POCD 发生率不断升高,持续时间亦越长,远期预后较差^[16,17]。因此,术中控制脑氧代谢,减少术后疼痛以及 POCD 发生率已成为临床的研究热点。TEAS 是通过皮肤将脉冲电流输入人体以治疗疼痛的电疗方法,经络学说认为,督脉起于胞中,上行入脑达巅,故而历代医家皆认为“病变在脑,首取督脉”,百会为督脉之要穴,具有推动督脉运行、改善脑部缺血之功效,内关、风池具有安神醒脑、壮阳益气之功效^[18-20]。

本次研究结果显示,两组 T₁、T₂、T₃ 时间点 CjvO₂ 较 T₀ 时间点升高,且研究组高于对照组,Da-jvO₂、CERO₂ 较 T₀ 时间点降低,且研究组低于对照组,提示老年髋关节置换术患者应用 TEAS,可有效改善患者脑氧代谢情况,脑组织回流血液首先汇入颈静脉球部,随后进入腔静脉进行循环交换,CjvO₂ 与 CaO₂ 的差值可对脑氧耗与脑血流之间的关系准确反映,若 CERO₂、Da-jvO₂ 降低表明脑组织氧耗减少,机体供氧充足^[21-23]。路楷等人^[24]临床研究亦证实,针刺百会、内关穴等穴位可改善脑代谢与低灌注功能,增强脑部血流量,促进脑神经细胞机能再恢复,而 TEAS 可发挥与针刺类似的效果,有效改善脑部供血供氧情况。同时本次研究中研究组术后 MMSE 评分高于对照组,POCD 发生率低于对照组,提示经 TEAS 治疗后,患者认知功能有所改善,可能由于术中脑组织氧耗减少,机体供氧充足,对机体脑损伤较小,脑神经细胞机能可正常运行进而增强学习记忆功能^[25-27]。同时,两组患者术后不同时间点 VAS 评分呈现先升高后降低趋势,但研究组均低于对照组,表明老年髋关节置换术后均会产生不同程度的疼痛,应用 TEAS 可有效缓解患者术后早期疼痛,现临床有关 TEAS 的镇痛机制尚不十分明确,可能是通过调节感觉神经纤维以抑制疼痛的传导,同时在实施电刺激治疗时,适当的刺激频率可引起脑脊液中强啡肽和脑啡肽的释放,发挥与外源性阿片类镇痛药物类似的作用^[28-30]。同时两组患者不良反应总发生率比较差异无统计学意义,提示 TEAS 安全性较好。

综上所述,TEAS 可有效减轻老年髋关节置换术后患者的疼痛,改善脑氧代谢、术后认知功能情况,具有脑保护作用,且安全性较好。

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有望成为今后肝癌治疗的新靶点。

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