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氢化泼尼松联合泵注甲氧明预防老年患者髋关节置换术骨水泥反应的临床效果观察*

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摘要 目的:观察氢化泼尼松联合泵注甲氧明预防老年患者髋关节置换术骨水泥反应的临床效果。**方法:**将腰硬联合麻醉下行髋关节置换术的 60 例老年患者随机分为观察组(A 组)与对照组(B 组),观察组在骨水泥植入前静脉给予氢化泼尼松 0.5 mg/kg,并以 $3 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ 持续泵注甲氧明,对照组在相同时点给予地塞米松 0.1 mg/kg。记录和比较两组患者骨水泥植入前(T_0)、植入时(T_1)、植入后 3 分钟(T_2)、植入后 5 分钟(T_3)、植入后 10 分钟(T_4)及植入后 30 分钟(T_5)时的动脉收缩压(SBP)、平均动脉压(MAP)、心率(HR)、血氧饱和度(SPO_2)及中心静脉压(CVP)、动脉血 pH 值、动脉氧分压(PO_2)、动脉二氧化碳分压(PCO_2)及血乳酸(Lac)水平的变化。**结果:**与 T_0 时比较,对照组 T_2 、 T_3 时 SBP、MAP 及 PO_2 明显下降,HR 显著上升,而同时点观察组 SBP、MAP 及 PO_2 较对照组明显升高,HR 较对照组显著降低($P<0.05$),观察组各时点 SBP、MAP 及 HR 比较差异无统计学意义($P>0.05$)。与 T_0 时比较,对照组 T_3 、 T_4 时血清 Lac 水平显著升高($P<0.05$),同时点观察组与之比较明显降低($P<0.05$)。观察组各时点 pH、 PO_2 、Lac 及 PCO_2 均无明显变化($P>0.05$)。**结论:**老年患者行髋关节置换术在骨水泥植入前预防性给予氢化泼尼松及泵注甲氧明能使患者血流动力学平稳,改善机体微循环及组织氧供。

关键词:氢化泼尼松;甲氧明;老年人;髋关节置换术;骨水泥植入综合征

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Observation on the Clinical Efficacy of Hydroprednisone Combined with Pump Injection of Methoxamine in the Prevention of Bone Cement Implantation Syndrome in Elderly Patients Undergoing Hip Replacement*

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ABSTRACT Objective: To observe the clinical effects of hydroprednisone combined with pump injection of methoxamine on the prevention of bone cement implantation syndrome in elderly patients with hip replacement. **Methods:** Sixty elderly patients undergoing hip arthroplasty with combined spinal-epidural anesthesia were randomly divided into observation group and control group. Patients in the observation group were given 0.5 mg/kg hydroprednisone intravenously and pump injection of methoxamine $3 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ continuously before bone cement implantation. Patients in the control group were given dexamethasone 0.1 mg/kg at the same time. The arterial systolic pressure (SBP), mean arterial pressure (MAP), heart rate (HR), blood oxygen saturation (SPO_2) and central venous pressure (CVP) were recorded and compared in the two groups before bone cement implantation (T_0), at implantation (T_1), 3 minutes after implantation (T_2), 5 minutes after implantation (T_3), 10 minutes after implantation (T_4) and 30 minutes after implantation (T_5). The changes of arterial blood pH, arterial oxygen partial pressure (PO_2), arterial carbon dioxide partial pressure (PCO_2) and blood lactic acid (Lac) were observed at T_0 to T_5 in the two groups. **Results:** The SBP, MAP and PO_2 were decreased while the HR increased significantly at T_2 , T_3 compared with T_0 in the control group ($P<0.05$), the SBP, MAP and PO_2 in the observation group were significantly higher while HR were significantly lower than those in the controlled group at the same time ($P<0.05$). The serum lac level in the control group increased significantly at T_3 , T_4 compared with T_0 ($P<0.05$), and it was significantly lower in the observation group than that in the control at the same time ($P<0.05$). There was no significant change in the SBP, MAP, HR, pH, PO_2 , PCO_2 and Lac at different time points in the observation group ($P>0.05$). **Conclusion:** Prophylaxis of hydroprednisone and pump injection of methoxamine can make hemodynamics stable and improve microcirculation and tissue oxygen supply in the treatment of elderly patients with hip replacement before bone cement implantation.

Key words: Hydroprednisone; Methoxamine; Elderly; Hip replacement; Bone cement implantation syndrome

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前言

老年人由于骨质疏松且常伴有其他基础疾病导致身体协调能力差,易发生股骨颈骨折,手术治疗能使老年患者快速康复,减少长期卧床的并发症,提高生活质量^[1-3]。随着生活水平及医疗水平的提高,选择人工髋关节置换术的老年患者逐渐增多,术中为加强关节的稳定性常需使用骨水泥将假体固定到骨髓腔内,植入的骨水泥单体及附加物被吸收入血后可诱发低血压、低血氧、肺栓塞、心率失常甚至心跳骤停等一系列症状,称为骨水泥植入综合征 (bone cement implantation syndrome, BCIS),是导致围术期老年患者突发死亡的重要原因^[4]。

BCIS 的发生机制复杂,骨水泥单体毒性、髓腔内高压、组胺释放和高敏反应三种学说得到学术界认可^[4-6]。预防 BCIS 的发生需骨科医生积极改进骨水泥技术,麻醉医生也应密切监测病人的各项生命体征,植入前充分补充容量,并应用肾上腺皮质激素及血管活性药物^[7-9]。传统激素常使用小剂量地塞米松,起效慢,副作用较多。氢化泼尼松为中短效类皮质激素类药物,副作用小。传统升压药物麻黄素兼具 α 与 β 受体兴奋作用,在升压的同时可使心率加快,增加心肌氧耗。甲氧明是近年来使用的选择性最高 α_1 的受体激动剂,血压升高时不增加心率,可改善心肌血流和氧供。本研究通过探讨氢化泼尼松联合泵注甲氧明预防老年患者髋关节置换术骨水泥植入时血流动力学及动脉血气的变化,旨在为临床麻醉的安全性提供参考。

1 资料和方法

1.1 一般资料

选择我院拟行单侧髋关节置换术的老年患者 60 例,年龄 65~84 岁,体重 45~74 kg,男 25 例,女 35 例,ASA 分级 II-III 级。患者均行严格的术前检查及准备,血压、血糖、血红蛋白均调整至可行手术范围,无肺部感染,肝肾功能无明显异常,无腰硬联合麻醉禁忌症。本研究经本院伦理委员会批准,患者签署知情同意书。采用数字随机法将患者随机分为观察组(A 组)及对照组(B 组)。

1.2 麻醉及用药方法

患者入室后常规行心电图、无创血压及氧饱和度监测,常规面罩吸氧,氧流量为 2 L/min。在局麻下行颈内静脉穿刺及桡动脉穿刺监测中心静脉压和直接动脉压。术中输液用乳酸林格氏液及万汶,根据中心静脉压调整输血量及速度。患者均行腰硬联合麻醉,麻醉穿刺点选择 L₂₋₃,穿刺成功后蛛网膜下腔给予

0.75%罗哌卡因 1.2~1.8 mL,硬膜外导管置入 3 cm,调节麻醉平面至 T₁₀ 以下。坏死关节取出后,用髓腔挫扩髓,并用脉冲清创器充分清洗髓腔再植入骨水泥。观察组 A 组在骨水泥植入前 10 min 静脉给予氢化泼尼松 0.5 mg/kg,并以 3 $\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ 持续泵注甲氧明,对照组 B 组在相同时点给予地塞米松 0.1 mg/kg。在骨水泥植入期间,患者若出现平均动脉压低于基础值的 20%或收缩压低于 90 mmHg,立即静脉推注甲氧明 1~2 mg 或麻黄碱 6~10 mg。

1.3 观察指标

观察并记录骨水泥植入前(T₀)、植入时(T₁)、植入后 3 分钟(T₂)、植入后 5 分钟(T₃)、植入后 10 分钟(T₄)及植入后 30 分钟(T₅)时两组患者的动脉收缩压(SBP)、平均动脉压(MAP)、心率(HR)、血氧饱和度(SPO₂)及中心静脉压(CVP)。抽取 T₀~T₅ 各时点动脉血 2 mL 进行血气分析,观察 pH 值、动脉氧分压(PO₂)、动脉二氧化碳分压(PCO₂)及血乳酸(Lac)水平的变化。

1.4 统计学方法

应用 SPSS16.0 统计软件处理。计量资料以均数 $\pm$ 标准差($\bar{x}\pm s$)表示,组间比较采用 t 检验,组内比较采用单因素方差分析,计数资料组间比较采用卡方检验,以 $P<0.05$ 为差异有统计学意义。

2 结果

2.1 两组一般临床资料的比较

两组患者的性别构成比、年龄、体重、ASA 分级、手术时间、出血量等一般临床资料比较差异无统计学意义($P>0.05$),见表 1。

2.2 两组不同时点血流动力学参数的比较

与 T₀ 时比较,B 组 T₂、T₃ 时 SBP 及 MAP 明显下降,HR 显著上升($P<0.05$);与同时点 A 组比较,B 组 SBP 及 MAP 显著降低,HR 明显增加($P<0.05$),以上指标在 T₄、T₅ 逐渐恢复。A 组各时点 SBP、MAP 及 HR 比较差异均无统计学意义 ($P>0.05$)。B 组中,8 例在骨水泥植入后因血压下降剧烈需用升压药紧急处理,A 组无一例需紧急处理。两组患者 CVP 及 SPO₂ 均无明显变化($P>0.05$),见表 2。

2.3 两组动脉血气分析结果的比较

与 T₀ 时比较,B 组 T₂、T₃ 时 PO₂ 显著下降($P<0.05$),且明显低于同时点 A 组 ($P<0.05$)。与 T₀ 时比较,B 组在 T₃、T₄ 时 Lac 显著升高($P<0.05$),且明显高于同时点 A 组($P<0.05$)。A 组各时点 PH、PO₂、Lac 及 PCO₂ 均无明显变化($P>0.05$),见表 3。

表 1 两组患者基本情况的比较($\bar{x}\pm s$, n=30)

Table 1 Comparison of the general information between two groups($\bar{x}\pm s$, n=30)

	Sex (M/F)	Age (years)	Weight (kg)	ASA classification (II/III)	Operation time (min)	Bleeding volume (mL)
Group A	12/18	75.4 $\pm$ 7.4	63.5 $\pm$ 8.2	14/16	115.6 $\pm$ 13.8	360.3 $\pm$ 56.6
Group B	13/17	76.6 $\pm$ 7.7	62.3 $\pm$ 7.4	12/18	114.7 $\pm$ 12.4	358.7 $\pm$ 53.2

3 讨论

老年人髋部骨折早期采用手术治疗不仅能使患者早日离

床活动,缩短康复时间,而且能提高患者生活质量,减少长期卧床引起的肺部感染、褥疮、血管栓塞等并发症^[10,11],改善患者预后。采用非手术治疗 30 天患者住院死亡率是采用手术治疗的

2 倍^[12]。老年患者由于骨质疏松、骨组织生长能力差,使用骨水泥型假体才能取得满意的手术效果,但骨水泥植入期间,患者常有不同程度的低血压、心律失常、凝血功能障碍、肺动脉高

压、肺栓塞、低氧血症等并发症,使约 0.6-1%的患者出现心跳骤停^[13-16]。因此,减少骨水泥植入综合征造成的不利影响对老年患者的安全显得尤为重要。

表 2 两组各时点血流动力学、CVP 及 SPO₂ 的变化($\bar{x} \pm s$, n=30)Table 2 Changes of SBP, MAP, HR, CVP and SPO₂ at different time points between two groups($\bar{x} \pm s$, n=30)

Index	Groups	T ₀	T ₁	T ₂	T ₃	T ₄	T ₅
SBP(mmHg)	Group A	137.8± 12.9	131.2± 10.7	129.5± 10.2	132.6± 10.6	133.4± 11.5	135.4± 10.5
	Group B	139.7± 12.5	133.4± 9.8	109.1± 8.3 ^{ab}	111.8± 9.2 ^{ab}	130.5± 10.3	134.3± 11.2
MAP(mmHg)	Group A	105.3± 8.5	101.3± 8.7	96.3± 7.1	100.3± 7.5	102.3± 8.0	103.3± 8.4
	Group B	103.3± 7.3	99.9± 6.3	84.7± 6.8 ^{ab}	88.2± 6.1 ^{ab}	101.3± 7.4	102.3± 7.3
HR(次/min)	Group A	86.3± 11.2	87.3± 12.1	90.4± 11.8	88.9± 10.5	87.9± 11.3	85.6± 10.7
	Group B	85.1± 10.8	86.3± 10.7	110.1± 14.4 ^{ab}	107.1± 12.9 ^{ab}	95.1± 13.0	89.1± 11.1
SPO ₂ (%)	Group A	98.2± 1.8	98.1± 1.7	97.3± 2.1	97.7± 1.9	98.0± 1.8	98.3± 1.6
	Group B	98.3± 1.7	97.2± 2.1	96.8± 2.1	96.7± 1.7	97.5± 2.2	98.0± 1.9
CVP(cmH ₂ O)	Group A	6.9± 1.4	6.5± 1.7	7.0± 1.7	6.8± 1.2	6.3± 1.5	6.6± 1.3
	Group B	6.8± 1.3	6.7± 1.4	6.1± 1.3	6.4± 1.5	6.8± 1.6	6.9± 1.9

Note: compared with the basic values of this group, ^aP<0.05; comparison with group A at the same time, ^bP<0.05.

表 3 两组各时点动脉血气指标的比较($\bar{x} \pm s$, n=30)Table 3 Comparison of the results of arterial blood gas at different time points between two groups ($\bar{x} \pm s$, n=30)

Index	Groups	T ₀	T ₁	T ₂	T ₃	T ₄	T ₅
PH	Group A	7.41± 0.04	7.37± 0.05	7.36± 0.04	7.40± 0.06	7.32± 0.05	7.39± 0.03
	Group B	7.41± 0.06	7.39± 0.07	7.36± 0.06	7.35± 0.04	7.38± 0.06	7.40± 0.07
PO ₂	Group A	106.2± 10.1	102.3± 11.5	98.5± 10.3	99.8± 11.5	105.4± 10.6	107.6± 11.3
	Group B	105.3± 10.8	100.2± 12.1	81.4± 9.6 ^{ab}	82.1± 11.1 ^{ab}	99.8± 10.6	102.5± 11.5
PCO ₂	Group A	35.6± 2.2	37.6± 2.4	37.2± 2.6	36.7± 2.2	37.6± 2.5	36.6± 1.9
	Group B	37.1± 2.6	37.7± 2.8	38.2± 2.4	37.5± 2.3	38.3± 2.4	37.3± 2.1
Lac	Group A	0.98± 0.19	1.13± 0.22	1.14± 0.27	1.15± 0.24	1.13± 0.29	1.03± 0.25
	Group B	1.01± 0.20	1.13± 0.22	1.26± 0.21	1.38± 0.31 ^{ab}	1.39± 0.34 ^{ab}	1.13± 0.25

Note: compared with the basic values of this group, ^aP<0.05; comparison with group A at the same time, ^bP<0.05.

骨水泥是由液态单体经聚合酶粉催化而成的高分子聚合物,液态单体的主要成分为甲基丙烯酸甲酯(LMMA),是一种有强烈刺激性和毒性的物质,其被吸收入血后可破坏粒细胞及内皮细胞,释放蛋白水解酶,引发细胞溶解,同时补体系统被激活,凝血因子释放而形成的微小栓子可使肺循环阻力增加诱发低氧血症^[17]。LMMA 还可作用于血管平滑肌的钙通道,引起外周血管扩张、回心血量减少而导致低血压。骨水泥对人体属异物,植入后诱发机体发生过敏反应,释放的组胺等血管活性物质可使血压进一步下降^[18]。皮质激素可抑制巨噬细胞功能,稳定溶酶体膜,抑制炎症介质前列腺素、白三烯及组胺等的产生,阻止补体参与炎症反应,具有明显的抗炎及抗变态反应的作用。

地塞米松临床应用多年,属长效糖皮质激素,对下丘脑-垂体-肾上腺轴(HPA)的抑制强度是氢化泼尼松的 12.5 倍,抑制时间是氢化泼尼松的 2 倍,对电解质及免疫功能的影响也较明显。氢化泼尼松的半衰期短,起效迅速,对 HPA 轴抑制小,短期使用对肾上腺皮质功能无影响,其非特异性抗炎及抗变态反应强度高,且它不需要经肝脏代谢,可用于肝功能不全的老年

患者^[19]。髋关节置换术时,手术创伤引起的失血以及椎管内麻醉后交感神经阻滞引起的血管扩张易使患者因血容量不足导致低血压。因此,容量充足对保障老年患者围术期安全尤为重要。

本研究中,两组患者在骨水泥植入前均在中心静脉压的参考下输注了足够的晶胶体,但对照组在骨水泥植入后仍出现明显的血流动力学变化,说明容量充足并不能防止骨水泥综合征的发生。老年患者由于血管硬化,重要脏器的灌注对血压依赖性增强,为了维持术中血压稳定,使老年患者血管张力保持在接近生理状态,预防性使用 α_1 受体激动剂,可避免因术中过度补液而在患者苏醒后因血管张力恢复引起回心血量剧增,增加老年患者心肺并发症的风险^[20]。甲氧明是一种人工合成的高度选择性 α_1 受体激动剂,主要作用于分布在外周血管的 α_1A 和 α_1B 受体,对分布于冠状动脉的 α_1D 受体几乎无作用。甲氧明可使外周血管阻力增加,升高血压,反射性的降低心率,对心肌无兴奋作用,还可增加冠状动脉和心内膜下血流量,增加心肌灌注压,减少心肌氧耗^[21]。甲氧明起效迅速,作用时间短,若待血压下降再单次给药,而老年患者血管调节能力差,可能会引

起异常血压升高和严重心动过缓。本研究采用在骨水泥植入前预防性持续泵注的给药方式,可使血药浓度相对恒定,血流动力学平稳,控制心率,降低心肌氧耗^[22,23]。此外,对照组在骨水泥植入后出现动脉血氧分压显著下降和血乳酸显著上升,说明有机体组织缺氧和微循环障碍过程^[24-27],随着血压上升,组织器官灌流量增加,至骨水泥植入后 30 分钟,氧分压及血乳酸逐渐恢复到正常值,而观察组动脉血氧分压及血乳酸在骨水泥植入期间无明显变化。

综上所述,老年患者行髋关节置换术在骨水泥植入前预防性给予氯化琥珀酰胆碱及泵注甲氧明能使患者血流动力学平稳,改善机体微循环及组织氧供。

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