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## 【临床研究】

# 右美托咪定联合小剂量奥氮平对骨科全身麻醉老年患者术后谵妄的影响

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**摘要:** 目的 探讨右美托咪定联合小剂量奥氮平对骨科全身麻醉老年患者术后谵妄的影响。方法 选择2019年9月至2020年2月于南通市第一人民医院接受全身麻醉下骨科手术的80例老年患者为研究对象,采用随机数字表法将患者分为观察组与对照组,每组40例。2组患者入手术室后均给予右美托咪定 $1 \mu\text{g} \cdot \text{kg}^{-1}$ ,静脉滴注,滴注速度为 $1 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$ ,10 min后滴注速度调整为 $0.2 \sim 0.4 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$ ,持续静脉滴注,直至Richmond躁动-镇静评分为0分时停用。在此基础上,观察组患者清醒后给予奥氮平片2.5 mg,每日1次,持续应用1周。观察2组患者术后谵妄发生率及持续时间,采用简易智力状态检查量表(MMSE)评估患者术前24 h及术后24、48、72 h认知功能,采用酶联免疫吸附试验测定患者术前及术后24 h血清中5-羟色胺(5-HT)、多巴胺(DA)水平。结果 观察组和对照组患者术后谵妄发生率分别为5.00%(2/40)、27.50%(11/40),谵妄持续时间分别为( $4.12 \pm 0.65$ )、( $4.51 \pm 0.72$ ) d;观察组患者术后谵妄发生率显著低于对照组( $P < 0.05$ ),但2组患者谵妄持续时间比较差异无统计学意义( $P > 0.05$ )。术前2组患者MMSE评分比较差异无统计学意义( $P > 0.05$ );对照组患者术后24、48、72 h时MMSE评分显著低于术前( $P < 0.05$ );观察组患者术后24 h时MMSE评分显著低于术前( $P < 0.05$ ),术后48、72 h时MMSE评分与术前比较差异无统计学意义( $P > 0.05$ );术后24、48、72 h,观察组患者MMSE评分显著高于对照组( $P < 0.05$ )。术前2组患者血清5-HT、DA水平比较差异无统计学意义( $P > 0.05$ ),2组患者术后24 h时血清5-HT、DA水平显著低于术前( $P < 0.05$ );术后24 h,观察组患者血清5-HT、DA水平显著低于对照组( $P < 0.05$ )。结论 右美托咪定联合小剂量奥氮平可以显著降低骨科全身麻醉老年患者术后谵妄发生率,改善患者术后认知功能。

**关键词:** 右美托咪定;奥氮平;骨科手术;全身麻醉;谵妄

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## Effect of dexmedetomidine combined with low-dose olanzapine on postoperative delirium in elderly patients undergoing orthopaedic operation under general anesthesia

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**Abstract:** **Objective** To investigate the effect of dexmedetomidine combined with low-dose olanzapine on postoperative delirium in elderly patients undergoing orthopaedic operation under general anesthesia. **Methods** A total of 80 elderly patients who underwent orthopaedic operation under general anesthesia in the First People's Hospital of Nantong City from September 2019 to February 2020 were selected as the research subjects, and the patients were divided into observation group and control group by using random number table, with 40 cases in each group. After entering the operating room, the patients in both groups were given dexmedetomidine  $1 \mu\text{g} \cdot \text{kg}^{-1}$  intravenously at a rate of  $1 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$ , after 10 minutes, the infusion rate was adjusted to  $0.2 \sim 0.4 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$  until the Richmond agitation and sedation scale score was 0. On this basis, the patients in the observation group were given olanzapine tablets 2.5 mg once a day for 1 week after waking up. The incidence and duration of postoperative delirium of patients in the two groups were observed. The cognitive function of patients were evaluated by mini-mental state examination (MMSE) at 24 hours before operation and 24, 48 and 72 hours after operation. The levels of serum 5-hydroxytryptamine (5-HT) and dopamine (DA) were measured by enzyme-linked immunosorbent assay before operation and 24 hours after operation. **Results** The incidence of postoperative delirium in the observation group and the control group was 5.00% (2/40) and 27.50% (11/40), and the delirium duration was ( $4.12 \pm 0.65$ ) and ( $4.51 \pm 0.72$ ) days, respectively. The incidence of postoperative delirium in the observation group was significantly lower than that in the control group ( $P < 0.05$ ), but there was no significant difference in delirium duration between the two groups ( $P > 0.05$ ). There

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was no significant difference in the MMSE score between the two groups before operation ( $P > 0.05$ ). The MMSE scores of patients in the control group at 24, 48 and 72 hours after operation were significantly lower than those before operation ( $P < 0.05$ ). The MMSE score of patients in the observation group at 24 hours after operation was significantly lower than that before operation ( $P < 0.05$ ), but there was no significant difference in the MMSE score between 48, 72 hours after operation and before operation ( $P > 0.05$ ). The MMSE score in the observation group was significantly higher than that in the control group at 24, 48 and 72 hours after operation ( $P < 0.05$ ). There was no significant difference in the levels of serum 5-HT and DA between the two groups before operation ( $P > 0.05$ ). The levels of serum 5-HT and DA at 24 hours after operation were significantly lower than those before operation in the two groups ( $P < 0.05$ ). The levels of serum 5-HT and DA in the observation group were significantly lower than those in the control group at 24 hours after operation ( $P < 0.05$ ). **Conclusion** Dexmedetomidine combined with low-dose olanzapine can significantly reduce the incidence of postoperative delirium and improve postoperative cognitive function in elderly patients undergoing orthopaedic operation under general anesthesia.

**Key words:** dexmedetomidine; olanzapine; orthopaedic operation; general anaesthesia; delirium

老年人是骨科疾病的高发人群,且通常需要手术治疗,但老年人机体机能减退,基础疾病较多,手术耐受性降低,对手术安全与麻醉效果要求较高。研究显示,全身麻醉骨科手术老年患者术后谵妄发生率为15.3%~51.0%<sup>[1-2]</sup>。术后谵妄会延长患者住院时间,增加治疗费用,并影响患者远期认知功能,降低患者生活质量<sup>[3]</sup>。右美托咪定具有抑制炎症反应、镇痛和镇静作用,手术中应用右美托咪定可降低患者术后谵妄发生率,且具有较高的安全性<sup>[4]</sup>。奥氮平是治疗谵妄的常用药物,但单独使用剂量较大,患者易出现嗜睡、食欲增加等不良反应<sup>[5]</sup>。本研究旨在探讨右美托咪定联合小剂量奥氮平对骨科全身麻醉老年患者术后谵妄的影响。

## 1 资料与方法

**1.1 一般资料** 选择2019年9月至2020年2月于南通市第一人民医院接受全身麻醉下骨科手术的老年患者为研究对象。病例纳入标准:(1)年龄≥60岁,行择期骨科手术;(2)美国麻醉学会分级I~Ⅲ级;(3)简易智力状态检查量表(mini-mental state examination, MMSE)评分≥23分;(4)患者及家属自愿参与本研究并签署知情同意书。排除标准:(1)近3个月接受过抗抑郁、镇静治疗;(2)合并精神性疾病、中枢神经系统疾病及意识障碍;(3)有严重的肝肾功能障碍、内分泌系统疾病、神经肌肉疾病;(4)术中预计失血量超过300 mL。本研究共纳入全身麻醉下行骨科手术患者80例,采用随机数字表法将患者分为观察组与对照组,每组40例。对照组:男25例,女15例;年龄62~93(73.51±7.20)岁,手术时间50~78(66.31±4.51)min;手术类型:下肢骨折手术14例,膝关节置换术12例,腰椎椎间融合术9例,髋部骨折手术5例。观察组:男23例,女17例;年龄60~94(72.95±7.13)岁,手术时间51~85(68.25±4.93)min;手术类型:下肢骨折手术15例,膝关节置换术13例,腰椎椎间融合术8例,髋部骨折手术4例。2组患者的性别、年龄、手术时

间及手术类型比较差异无统计学意义( $P > 0.05$ ),具有可比性。本研究经医院伦理委员审批后实施。

**1.2 麻醉方法与药物应用** 所有患者入手术室后予以吸氧、开放静脉通路,术中行心率、血压等生命体征监测,采用维库溴铵(浙江仙琚制药股份有限公司,国药准字H19991172)0.1 mg·kg<sup>-1</sup>、芬太尼(宜昌人福药业有限责任公司,国药准字H42022076)4 μg·kg<sup>-1</sup>、丙泊酚(西安力邦制药有限公司,国药准字H20010368)1.5 mg·kg<sup>-1</sup>全身麻醉方案。2组患者入手术室后均给予右美托咪定(辰欣药业股份有限公司,国药准字H20163388)1 μg·kg<sup>-1</sup>(用生理盐水稀释为4 mg·L<sup>-1</sup>),静脉滴注,滴注速度为1 μg·kg<sup>-1</sup>·h<sup>-1</sup>,10 min后滴注速度调整为0.2~0.4 μg·kg<sup>-1</sup>·h<sup>-1</sup>,持续静脉滴注,直至Richmond躁动-镇静评分为0分时停用。在此基础上,观察组患者清醒后给予奥氮平片(齐鲁制药有限公司,国药准字H20183500)2.5 mg,每日1次,持续应用1周。

**1.3 观察指标** (1)谵妄发生情况:观察2组患者术后谵妄发生率及持续时间。(2)认知功能:采用MMSE评估患者术前24 h及术后24、48、72 h认知功能,MMSE总分0~30分,患者评分越高,认知功能越好。(3)血清神经递质水平:采集患者术前及术后24 h空腹肘静脉血液3 mL,1 500 r·min<sup>-1</sup>离心10 min,取上层血清,采用酶联免疫吸附试验测定血清中5-羟色胺(5-hydroxytryptamine, 5-HT)、多巴胺(dopamine, DA)水平,试剂盒购自美国Elab-science公司,严格按照试剂盒说明书操作。

**1.4 统计学处理** 应用SPSS 22.0软件进行统计学分析。计量资料以均数±标准差( $\bar{x} \pm s$ )表示,两组间比较采用t检验;计数资料以例数和百分率表示,组间比较采用 $\chi^2$ 检验; $P < 0.05$ 为差异有统计学意义。

## 2 结果

**2.1 2组患者术后谵妄发生率及持续时间比较** 观察组和对照组患者术后谵妄发生率分别为

5.00% (2/40)、27.50% (11/40), 谵妄持续时间分别为 $(4.12 \pm 0.65)$ 、 $(4.51 \pm 0.72)$  d; 观察组患者术后谵妄发生率显著低于对照组, 差异有统计学意义 ( $\chi^2 = 7.440, P < 0.05$ ); 2组患者谵妄持续时间比较差异无统计学意义 ( $t = 0.953, P > 0.05$ )。

**2.2 2组患者认知功能比较** 结果见表1。术前2组患者MMSE评分比较差异无统计学意义 ( $P > 0.05$ ); 对照组患者术后24、48、72 h时MMSE评分显著低于术前, 差异有统计学意义 ( $P < 0.05$ ); 观察组患者术后24 h时MMSE评分显著低于术前, 差异有统计学意义 ( $P < 0.05$ ); 观察组患者术后48、72 h时MMSE评分与术前比较差异无统计学意义 ( $P > 0.05$ ); 术后24、48、72 h, 观察组患者MMSE评分显著高于对照组, 差异有统计学意义 ( $P < 0.05$ )。

表1 2组患者不同时间点MMSE评分比较

Tab. 1 Comparison of the MMSE score of patients between the two groups at different time points ( $\bar{x} \pm s$ )

组别	n	MMSE评分			
		术前	术后24 h	术后48 h	术后72 h
对照组	40	$28.46 \pm 4.05$	$24.25 \pm 3.76^a$	$25.13 \pm 5.72^a$	$25.61 \pm 5.23^a$
观察组	40	$28.35 \pm 4.12$	$26.53 \pm 3.10^a$	$27.04 \pm 4.37$	$27.51 \pm 4.71$
t		0.943	4.103	5.024	5.317
P		0.512	0.046	0.034	0.021

注:与术前比较<sup>a</sup> $P < 0.05$ 。

**2.3 2组患者血清5-HT和DA水平比较** 结果见表2。术前2组患者血清5-HT、DA水平比较差异无统计学意义 ( $P > 0.05$ ); 2组患者术后24 h时血清5-HT、DA水平显著低于术前, 差异有统计学意义 ( $P < 0.05$ ); 术后24 h, 观察组患者血清5-HT、DA水平显著低于对照组, 差异有统计学意义 ( $P < 0.05$ )。

表2 2组患者血清5-HT和DA水平比较

Tab. 2 Comparison of the levels of serum 5-HT and DA of patients between the two groups ( $\bar{x} \pm s$ )

组别	n	5-HT/( $\mu\text{g} \cdot \text{L}^{-1}$ )	DA/( $\mu\text{g} \cdot \text{L}^{-1}$ )
对照组	40		
		术前	$243.19 \pm 18.24$
观察组	40	术后24 h	$186.34 \pm 14.20^a$
		术前	$250.04 \pm 20.08$
		术后24 h	$152.71 \pm 13.71^{ab}$
			$72.54 \pm 9.16$
			$41.63 \pm 5.92^{ab}$

注:与术前比较<sup>a</sup> $P < 0.05$ ; 与对照组比较<sup>b</sup> $P < 0.05$ 。

### 3 讨论

谵妄是急性暂时性脑功能异常, 通常于术后数小时和数日内发生, 多见于老年人, 患者常表现为注意力障碍、认知功能降低等。手术、麻醉等多种因素可诱发谵妄。研究显示, 术后谵妄发生率与患者的年龄呈显著正相关, 并可能增加患者术后并发症发生率<sup>[6]</sup>。谵妄的发生是导致手术患者短期病死率升高的高风险因素, 谵妄每持续48 h可使病死率增

加约11%<sup>[7]</sup>。因此, 积极防治术后患者谵妄的发生对改善患者预后具有重要意义。

目前, 药物干预是预防手术患者术后谵妄的重要措施, 右美托咪定是预防术后谵妄的常用药物。右美托咪定为 $\alpha_2$ -肾上腺素能受体激动剂, 可通过抑制 $\gamma$ -氨基丁酸受体活化、增强胆碱能受体活性而维持中枢神经系统稳定, 并对神经细胞有保护作用, 从而降低术后谵妄发生率<sup>[8-9]</sup>。丙泊酚用量是患者术后谵妄的高风险因素, 右美托咪定可通过减少丙泊酚的用量而降低术后谵妄发生率<sup>[10]</sup>。有研究显示, 麻醉诱导前静脉注射右美托咪定 $0.5 \mu\text{g} \cdot \text{kg}^{-1}$ , 并以 $0.4 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$ 维持静脉滴注至术前30 min可显著降低老年髋部骨折手术患者的术后谵妄发生率<sup>[11]</sup>。但是, 单一的药物干预预防谵妄的效果仍不理想, 因此, 探寻综合治疗措施来预防术后谵妄的发生成为临床关注的重点。奥氮平为新型抗精神病药物, 可通过拮抗5-HT受体、胆碱能受体和多巴胺受体等多种途径控制谵妄症状。有研究显示, 奥氮平预防性应用能改善患者术后认知功能, 降低术后谵妄的发生风险<sup>[12-13]</sup>, 但通常其使用剂量较大, 患者易产生嗜睡、意识不清、昏迷等不良反应。本研究结果显示, 观察组患者术后谵妄发生率显著低于对照组, 提示右美托咪定联合小剂量奥氮平可以显著降低骨科老年患者术后谵妄发生率; 但2组患者谵妄持续时间比较差异无统计学意义, 提示右美托咪定联合小剂量奥氮平可能对术后谵妄有较好的预防效果, 但仍无法逆转谵妄症状, 其具体原因仍需进一步研究。谵妄的发病机制复杂, 较多学者倾向于神经递质变化学说, 认为多巴胺能神经递质功能增强与胆碱能神经递质功能减退是谵妄发病的重要机制。5-HT、DA为参与精神情绪活动的关键中枢神经递质, 研究发现, 谵妄患者常表现出多巴胺转运体基因多态性和5-HT1A受体基因多态性<sup>[14]</sup>。本研究结果显示, 术后24、48、72 h, 观察组患者MMSE评分显著高于对照组; 术后24 h, 观察组患者血清5-HT、DA水平显著低于对照组; 提示右美托咪定联合小剂量奥氮平可以显著改善骨科老年患者术后的认知功能, 其机制可能与降低神经递质5-HT、DA水平有关。

综上所述, 右美托咪定联合小剂量奥氮平可以显著降低骨科全身麻醉老年患者术后谵妄发生率, 改善患者术后认知功能, 其机制可能与抑制神经递质5-HT、DA分泌有关。但本研究样本量较小, 且为单中心研究, 右美托咪定联合小剂量奥氮平对手术患者术后谵妄的预防效果及其具体机制尚有待进一步研究。

**参考文献:**

- [1] KUWAHARA M, YURUGI S, MASHIBA K, et al. Postoperative delirium in plastic or dermatologic surgery [J]. *Eur J Plast Surg*, 2008, 31(4): 171-174.
- [2] MARTINS S, FERNANDES L. Delirium in elderly people: a review [J]. *Front Neurol*, 2012, 3:101.
- [3] 李呈凯,白树财,宋秀钢,等.老年髋部骨折患者术后谵妄相关危险因素的回顾性研究[J].中华骨科杂志,2018,38(4):250-256.
- LI C K, BAI S C, SONG X G, et al. A retrospective study on risk factors associated with postoperative delirium in elderly patients with hip fracture [J]. *Chin J Orthop*, 2018, 38(4): 250-256.
- [4] 杨俊华,黄俊杰,王建成,等.不同时机输注右美托咪定对老年患者股骨颈骨折手术后谵妄及对C反应蛋白和皮质醇的影响[J].广东医学,2020,41(16):1669-1673.
- YANG J H, HUANG J J, WANG J C, et al. Effects of dexmedetomidine on perioperative delirium and C-reactive protein and cortisol levels in elderly patients undergoing femoral neck fracture surgery [J]. *Guangdong Med J*, 2020, 41(16): 1669-1673.
- [5] DEVLIN J W, SKROBIK Y, GÉLINAS C, et al. Clinical practice guidelines for the prevention and management of pain, agitation/sedation, delirium, immobility, and sleep disruption in adult patients in the ICU [J]. *Crit Care Med*, 2018, 46(9): e825-e873.
- [6] BHATTACHARYA B, MAUNG A, BARRE K, et al. Postoperative delirium is associated with increased intensive care unit and hospital length of stays after liver transplantation [J]. *J Surg Res*, 2017, 207:223-228.
- [7] GONZÁLEZ M, MARTÍNEZ G, CALDERÓN J, et al. Impact of delirium on short-term mortality in elderly inpatients: a prospective cohort study [J]. *Psychosomatics*, 2009, 50(3): 234-238.
- [8] 谭沁,李颖川.术后谵妄预防措施的研究进展[J].医学综述, 2020, 26(6): 1166-1170.
- TAN Q, LI Y C, Advances in preventive measures for postoperative delirium [J]. *Med Recapit*, 2020, 26(6): 1166-1170.
- [9] HUANG R, CHEN Y, YU A C, et al. Dexmedetomidine-induced stimulation of glutamine oxidation in astrocytes: a possible mechanism for its neuroprotective activity [J]. *J Cereb Blood Flow Metab*, 2000, 20(6): 895-898.
- [10] NEUFELD K J, YUE J R, ROBINSON T N, et al. Antipsychotic medication for prevention and treatment of delirium in hospitalized adults: a systematic review and meta-analysis [J]. *J Am Geriatr Soc*, 2016, 64(4): 705-714.
- [11] 杨艳,陈鹏.小剂量右美托咪定联合舒芬太尼静脉自控镇痛对老年髋部骨折患者术后谵妄的影响[J].现代中西医结合杂志,2020,29(5):108-110.
- YANG Y, CHEN P. Effect of low-dose dexmedetomidine combined with sufentanil patient-controlled intravenous analgesia on postoperative delirium in elderly patients with hip fracture [J]. *Mod J Integr Tradit Chin Western Med*, 2020, 29(5): 108-110.
- [12] GILMORE M L, WOLFE D J. Antipsychotic prophylaxis in surgical patients modestly decreases delirium incidence, but not duration in high-incidence samples: a meta-analysis [J]. *Gen Hosp Psychiatry*, 2013, 35(4): 370-375.
- [13] LIU S B, ZHAO R, YANG R L, et al. Are dexmedetomidine and olanzapine suitable to control delirium in critically ill elderly patients? A retrospective cohort study [J]. *Biomed Pharmacother*, 2021, 139:111617.
- [14] RAMIREZ-BERMUDEZ J, RUIZ-CHOW A, PEREZ-NERI I, et al. Cerebrospinal fluid homovanillic acid is correlated to psychotic features in neurological patients with delirium [J]. *Gen Hosp Psychiatry*, 2008, 30(4): 337-343.

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**(上接第 172 页)****参考文献:**

- [1] BONNEY S, LENCZNER E, HARVEY E J. Sternal fractures: anterior plating rationale [J]. *J Trauma*, 2004, 57(6): 1344-1346.
- [2] PLASS A, GRÜNENFELDER J, REUTHEBEUCH O, et al. New transverse plate fixation system for complicated sternal wound infection after median sternotomy [J]. *Ann Thorac Surg*, 2018, 83(3): 1210-1212.
- [3] 陈林,刘胜中,魏大闯,等.胸骨结扎带固定胸骨在成人前正中切口心脏手术中的应用研究[J].实用医院临床杂志,2020,17(1):177-179.
- CHEN L, LIU S Z, WEI D C, et al. Application of sternal ligature fixation in adult anterior median incision cardiac surgery [J]. *Pract J Clin Med*, 2020, 17(1): 177-179.
- [4] DHIR U, KUMAR A, SAKLANI R, et al. Post-surgical outcomes after sternal closure using zipfix band and steel wires [J]. *Int J Cardiovasc Thorac Surg*, 2020, 6(6): 85-89.
- [5] 张京京,杜少鸣,刘建,等.镍钛合金抓握式接骨板治疗多发性肋骨骨折 39 例报道[J].安徽医药,2016,20(3):531-532.
- ZHANG J J, DU S M, LIU J, et al. A report of 39 cases of multiple rib fractures treated by Nitinol grasping plate [J]. *Anhui Med Pharm J*, 2016, 20(3): 531-532.
- [6] NEZAFATI P, SHOMALI A, KAHROM M, et al. Zipfix versus conventional sternal closure: one-year follow-up [J]. *Heart Lung Circ*, 2019, 28(3): 443-449.
- [7] KAUL P. Sternal reconstruction after post-sternotomy mediastinitis [J]. *J Cardiothorac Surg*, 2017, 12(1): 94.
- [8] 赵东,朱仕杰,张致琦,等. Sternal lock 胸骨固定系统在老年心脏手术患者中的应用[J].上海医学,2017,40(4):238-239.
- ZHAO D, ZHU S J, ZHANG Z Q, et al. The application of sternal-lock sternal fixation system in elderly patients undergoing cardiac surgery [J]. *Shanghai Med J*, 2017, 40(4): 238-239.
- [9] VOS R J, VAN PUTTE B P, KLOPPENBURG G T L. Prevention of deep sternal wound infection in cardiac surgery: a literature review [J]. *J Hosp Infect*, 2018, 100(4): 411-420.
- [10] MARASCO S F, FULLER L, ZIMMET A, et al. Prospective, randomized, controlled trial of polymer cable ties versus standard wire closure of midline sternotomy [J]. *J Thorac Cardiovasc Surg*, 2018, 156(4): 1589-1595.e1.

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