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# 脑电双频指数监测下丙泊酚闭环靶控输注用于腹腔镜下胃癌根治术的效果评价

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[摘要] **目的**:探讨脑电双频指数(BIS)监测下丙泊酚闭环靶控输注用于腹腔镜下胃癌根治术的效果。**方法**:选取在本院接受腹腔镜下胃癌根治术治疗的原发性胃癌患者106例作为研究对象,根据麻醉方式不同分为对照组、观察组各53例。对照组接受BIS监测下手动调节丙泊酚靶控输注浓度,观察组接受BIS监测下丙泊酚闭环靶控输注。对比两组患者麻醉前(T0)、手术开始后30 min(T1)、手术结束前30 min(T2)的血流动力学指标水平、血清中炎症因子及应激激素含量的差异。**结果**:T0,两组血流动力学指标水平、血清中炎症因子及应激激素含量的差异无统计学意义。T1、T2,观察组血流动力学指标MAP、HR的水平低于对照组相应时间点;血清中炎症因子sICAM-1、IL-1β、IL-8、TNF-α的含量低于对照组相应时间点;血清中应激激素Cor、T4、glucagon的含量低于对照组相应时间点。**结论**:腹腔镜下胃癌根治术患者接受BIS监测下丙泊酚闭环靶控输注麻醉,可有效稳定患者术中血流动力学并抑制全身炎症应激反应。

[关键词] 腹腔镜下胃癌根治术;脑电双频指数;丙泊酚闭环靶控输注
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## Efficacy of bispectral index-monitored closed-loop targeted-controlled infusion of propofol for laparoscopic radical operation for gastric cancer

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**View from specialist: It is creative, and of certain scientific and educational value.**

[ABSTRACT] **Objective**: To discuss the efficacy of bispectral index (BIS)-monitored closed-loop targeted-controlled infusion of propofol for laparoscopic radical operation for gastric cancer. **Methods**: A total of 106 patients with primary gastric cancer who underwent laparoscopic radical operation for gastric cancer in our hospital between August 2015 and February 2018 were chosen as the research subjects and divided into the control group ($n=53$) and the observation group ($n=53$) according to the different anesthesia methods. Control group of patients received BIS-monitored manually adjusted targeted-controlled infusion concentration of propofol, and observation group of patients received BIS-monitored closed-loop targeted-controlled infusion of propofol. The differences in hemodynamic index levels as well as serum contents of inflammatory factors and stress hormones were compared between the two groups of patients before anesthesia (T0), 30 min after surgery started (T1) and 30 min before surgery ended (T2). **Results**: At T0, the differences in hemodynamic index levels as well as serum contents of inflammatory factors and stress hormones were not statistically significant between the two groups. At T1 and T2, hemodynamic indexes

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MAP and HR levels of observation group were lower than those of control group at the corresponding time points; serum inflammatory factors sICAM-1, IL-1β, IL-8 and TNF-α contents were lower than those of control group at the corresponding time points; serum stress hormones Cor, T4 and glucagon contents were lower than those of control group at the corresponding time points. Conclusion: BIS-monitored closed-loop targeted-controlled infusion of propofol can effectively stabilize the intraoperative hemodynamics and inhibit the systemic inflammatory stress response in patients with laparoscopic radical operation for gastric cancer.

[KEY WORDS] laparoscopic radical operation for gastric cancer; Bispectral index; Closed-loop targeted-controlled infusion of propofol

胃癌根治术是早期胃癌患者最可靠的治疗手段,腹腔镜下实施该手术具有微创优势,故已在临床普及[1,2]。维持一定的术中麻醉深度是手术顺利实施、术后平稳苏醒的基础,脑电双频指数(BIS)是将脑电图线性成分中代表不同镇静水平的各种脑电信号挑选出现并进行数字化处理、最终转化为简单量化指标的方式,其具体数值可准确反映患者的镇静情况[3,4]。BIS监测下麻醉用药可增加麻醉深度的可控性,本次研究将BIS监测下手动调节丙泊酚靶控输注、丙泊酚闭环靶控输注(CLTCI)这两种麻醉维持用药方式分别用于临床腹腔镜胃癌根治术患者中,对比两者带来的患者循环波动及机体损伤差异。

## 1 资料与方法

### 1.1 一般资料

选取2015年8月~2018年2月间在本院接受腹腔镜下胃癌根治术治疗的原发性胃癌患者106例作为研究对象,根据麻醉方式不同分为对照组、观察组各53例。对照组中男性26例,女性27例,年龄43~78岁;观察组中男性27例,女性26例,年龄45~76岁。组间基础资料分布差异不显著,且本院伦理委员会全员通过研究计划书。

### 1.2 入组标准

(1)原发性胃癌首次接受手术治疗;(2)入院前1年内无全麻病史;(3)麻醉过程中无明显药物过敏、数据收集完整;(4)本人或家属签署知情同意书。

### 1.3 排除标准

(1)合并全身炎症性疾病;(2)合并嗜铬细胞瘤等导致全身应激性疾病;(3)合并神经功能异常性疾病;(4)合并严重心肝肾功能不全。

### 1.4 麻醉方案

对照组患接受BIS监测下手动调节丙泊酚靶控输注浓度,具体如下:麻醉诱导采用舒芬太尼0.5 μg/kg、丙泊酚靶控浓度3.5 μg/mL,患者BIS值逐步下降至60以下后给予肌松药米库氯铵2 mg/kg,其后进行气管插管并行机械通气。手动调控丙泊酚靶控输注,维持患者术后BIS值40~60。

观察组患者接受BIS监测下丙泊酚闭环靶控输注,具体如下:麻醉诱导及插管方法同对照组。术中开启闭环控制,同样设置患者术中目标BIS值为40~60。当超出设定的BIS值范围时TCI泵将发出报警声,研究者根据具体情况重新进行设定。

### 1.5 观察指标

记录两组患者麻醉前(T0)、手术开始后30 min(T1)、手术结束前30 min(T2)的血流动力学指标水平,包括平均动脉压(MAP)、心率(HR)。相同时间点留取两组患者的外周血标本并分离、冻存上层血清,采用酶联免疫试剂盒检测其中炎症因子、应激激素的含量,炎症因子包括可溶性细胞间黏附分子-1(sICAM-1)、白介素-1β(IL-1β)、白介素-8(IL-8)、肿瘤坏死因子α(TNF-α);应激激素包括皮质醇(Cor)、甲状腺素(T4)、胰高血糖素(glucagon)。

### 1.6 统计学处理

所有数据采用SPSS25.0统计学软件进行分析处理,计量资料比较采用方差分析和$t$检验,$P<0.05$为差异有统计学意义。

## 2 结果

### 2.1 血流动力学指标

在T0时,两组MAP、HR水平的差异不显著($P>0.05$)。在T1、T2时,两组MAP、HR的水平均低于T0;且观察组MAP、HR的水平低于对照组相应时间点($P<0.05$)。见表1。

**表1 不同时间点血流动力学指标水平的比较($n=53$,$\bar{x}\pm s$)**

Table 1 Comparison of hemodynamic index levels at different time points($n=53$,$\bar{x}\pm s$)

| 组别 | 时间点 | MAP (mmHg) | HR (次/min) |
|---|---|---|---|
| 对照组 | T0 | 97.39±11.12 | 81.39±9.14 |
| | T1 | 84.30±9.94[a] | 72.18±8.05[a] |
| | T2 | 85.62±9.15[a] | 74.52±8.59[a] |
| 观察组 | T0 | 97.41±10.86 | 81.61±9.05 |
| | T1 | 75.88±8.23[ab] | 67.04±7.28[ab] |
| | T2 | 76.11±8.05[ac] | 66.21±8.54[ac] |

注:与组内T0比较,[a]$P<0.05$;与对照组T1比较,[b]$P<0.05$;与对照组T2比较,[c]$P<0.05$。

### 2.2 炎症因子

在T0时,两组血清中sICAM-1、IL-1β、IL-8、TNF-α含量的差异不显著($P>0.05$)。在T1、T2时,两组血清中sICAM-1、IL-1β、IL-8、TNF-α的含量均高于T0;而观察组血

清中 sICAM-1、IL-1β、IL-8、TNF-α 的含量低于对照组相应时间点($P<0.05$)。见表 2。

**表 2　不同时间点血清中炎症因子含量的比较($n=53$,pg/mL,$\bar{x}\pm s$)**

Table 2　Comparison of serum inflammatory factor contents at different time points ($n=53$,pg/mL,$\bar{x}\pm s$)

| 组别 | 时间点 | sICAM-1 | IL-1β | IL-8 | TNF-α |
|---|---|---|---|---|---|
| 对照组 | T0 | 10.28±1.74 | 7.43±0.81 | 13.29±1.58 | 5.11±0.58 |
| | T1 | 21.36±2.77[a] | 15.49±1.48[a] | 28.71±4.52[a] | 11.04±1.42[a] |
| | T2 | 25.85±3.09[a] | 22.71±2.85a | 34.56±4.17[a] | 18.39±2.17[a] |
| 观察组 | T0 | 10.45±1.61 | 7.52±0.86 | 13.42±1.76 | 5.06±0.64 |
| | T1 | 16.54±2.11ab | 11.27±1.53[a b] | 19.06±2.34[a b] | 8.47±0.91[a b] |
| | T2 | 19.06±2.87ac | 15.48±1.93[a c] | 25.72±3.41[a c] | 13.73±1.41[a c] |

注：与组内 T0 比较，[a]$P<0.05$；与对照组 T1 比较，[b]$P<0.05$；与对照组 T2 比较，[c]$P<0.05$。

### 2.3　应激激素

在 T0 时，两组血清中 Cor、T4、glucagon 含量的差异不显著($P>0.05$)。在 T1、T2 时，两组血清中 Cor、T4、glucagon 的含量均高于 T0；而观察组血清中 Cor、T4、glucagon 的含量低于对照组相应时间点($P<0.05$)。见表 3。

**表 3　不同时间点血清中应激激素含量的比较($n=53$,$\bar{x}\pm s$)**

Table 3　Comparison of serum stress hormone contents at different time points ($n=53$,$\bar{x}\pm s$)

| 组别 | 时间点 | Cor (nmol/L) | T4 (μg/dL) | Glucagon (mU/L) |
|---|---|---|---|---|
| 对照组 | T0 | 203.47±24.62 | 7.48±0.81 | 79.45±8.61 |
| | T1 | 340.28±42.19[a] | 12.67±1.95[a] | 143.28±16.67[a] |
| | T2 | 332.67±40.75[a] | 13.13±1.36[a] | 151.17±17.34[a] |
| 观察组 | T0 | 205.92±26.78 | 7.35±0.89 | 78.74±8.71 |
| | T1 | 284.16±30.95[a b] | 9.07±1.21[a b] | 106.32±13.44[a b] |
| | T2 | 273.09±30.21[a c] | 9.64±0.98[a c] | 118.03±15.23[a c] |

注：与组内 T0 比较，[a]$P<0.05$；与对照组 T1 比较，[b]$P<0.05$；与对照组 T2 比较，[c]$P<0.05$。

## 3　讨论

BIS 监测全身麻醉深度是公认的增加麻醉准确性的可靠方式，腹腔镜胃癌根治术作为早期原发性胃癌患者治疗的最可靠手段，在患者术中应用 BIS 监测麻醉有利于手术顺利实施以及术后平稳苏醒，目前普遍认为控制术中 BIS 值在 40～60 时可预防术中知晓。丙泊酚是全麻术中维持的主要药物，既往多采用手动调节丙泊酚靶控输注，而最新研究认为 CLTCI 可更为有效的反馈调节药物用量、避免过量用药以及由此带来的镇静深度短暂波动[5,6]。文中将 BIS 监测下手动调节丙泊酚靶控输注、CLTCI 均用于临床腹腔镜下胃癌根治术患者，从血流动力学稳定性、炎症反应、应激反应三方面探讨其应用价值差异。

镇静深度足够且稳定是确保全麻术中患者循环稳定的必要条件，若出现麻醉药物用量波动以及由此带来的镇静深度不足，可导致患者出现术中知晓以及血压升高、心率加快等镇静不足的循环血表现[7-9]。文中记录两组患者不同时间点平均动脉压、心率等血流动力学指标水平，发现：术中不同时间点两组患者的 MAP、HR 水平均较术前降低，这是全麻后患者进入镇静状态的直接表现；而术中不同时间点，观察组的 MAP、HR 水平较对照组低，说明 BIS 监测下 CLTCI 麻醉可更为有效的维持 BIS 值在预设范围内，减少术中因药物反馈不及时导致的镇静深度波动，在维持患者镇静深度并保持一定稳定性方面具有优势。

手术刺激是导致机体出现全身炎症反应的最主要刺激源，术中镇静深度及稳定性是影响机体术中炎症反应程度的最主要因素之一[10,11]。sICAM-1、IL-1β、IL-8、TNF-α 是来源于不同细胞的炎性介质，sICAM-1 可趋化中性粒细胞等炎症细胞间黏附并增加促炎介质合成分泌[12,13]；IL-1β、IL-8 是典型的促炎因子，可刺激其他炎症因子合成并扩大机体全身炎症反应[14,15]；TNF-α 由单核巨噬细胞分泌，可进一步诱导 CRP 等炎症因子合成，是参与机体炎症级联反应的重要因子[16,17]。文中两组患者术中上述炎症因子的含量均较术前增加，这与手术创伤直接相关；术中观察组患者血清中上述炎症因子的含量较对照组低，说明 BIS 监测下 CLTCI 麻醉有助于减轻腹腔镜胃癌根治术患者的全身炎症反应程度，间接证实该麻醉方式在维持患者镇静深度方面的作用。

与全身炎症反应机制类似的是机体的应激反应，手术创伤及炎症均可诱发机体应激反应发生，导致术中能量消耗增加、术后苏醒期躁动发生率大幅提升[18]。多种激素参与机体应激反应发生，包括 Cor、T4、glucagon 等。应激状态下下丘脑肾上腺皮质轴被激活，导致 Cor 合成增加[19,20]。应激状态下机体 TRH 合成增加并作用于下丘脑-甲状腺轴，导致 T4 合成增加，进一步促使能量代谢增强[21]。大量能量消耗可降低机体血糖水平，反应性导致 glucagon 合成增加以避免血糖值过低[22,23]。文中两组术中上述应激激素含量均较术前增加，这由手术刺激及机体炎症反应所致，也与既往研究结果吻合；观察组术中血清中上述应激激素的含量较对照组低，说明 BIS 监测下 CLTCI 麻醉可进一步缓解腹腔镜胃癌根治术患者的术中应激反应程度，进一步明确其在维持机体麻醉深度方面的优越性。

腹腔镜胃癌根治术患者接受 BIS 监测下 CLTCI 麻醉，较传统手动调节丙泊酚靶控输注浓度麻醉方式，在维持机体血流动力学稳定、减轻术中炎症应激

反应等方面均具有优势,是更为安全合理的麻醉维持方案,可作为日后此类手术患者全麻的优选方式。

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